Future Naval Ship Procurement:
A Case Study of the Navy's Next-Generation Destroyer

by

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Submitted to the Engineering Systems Division in Partial Fulfillment of the Requirements for the Degree of Master of Science in Technology and Policy

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Abstract

Cost growth and inefficiencies are a serious problem in almost all major U.S. defense procurement programs, and have existed for many years despite repeated efforts to control them. These problems are particularly virulent in the design and acquisition of new naval warships. If the Navy cannot bring its costs under control, it will not be able to afford the capabilities it needs to execute the nation's national security.

Several factors influence the cost growth of weapons procurement programs. Intentionally low estimates can help convince Congress to commit to programs that are actually very expensive. Bureaucratic politics can cause the Navy to spend money on superfluous features unjustified by strategic requirements. Private industry can push new, expensive technology on the Navy. Members of Congress can include pork-barrel provisions to bring more money to their constituents, often without national interest justifications.

This thesis evaluates the development of the DDG 1000, the Navy's next-generation destroyer, and the dramatic change that occurred to the design of that ship during its development. Based on that analysis, it makes recommendations for the future of the DDG 1000 and for naval ship procurement more generally. The thesis finds that though a new ship was justified in the post-Cold War world, the actual design of that ship was determined by bureaucratic politics and the ship's procurement plan was determined by pork-barrel politics, neither of which properly served the nation's strategic interests.

The thesis recommends that the DDG 1000 be used solely as a technology demonstration platform, reducing procurement spending while salvaging its technological advances; that the DDG 1000 be procured from a single shipyard; that the Navy design a smaller and cheaper warship to serve the needs of the future fleet; and that the nation implement specific measures to reduce the influence of bureaucratic politics and pork barrel politics on resource allocation and procurement.

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A Note on Terminology

Over the course of its development, the DDG 1000 Next Generation Destroyer has been known by several different names. The program started in 1994 under the larger SC-21 program with the designation of DD-21 for "Destroyer for the 21st Century." The Next-Generation Destroyer continued under that name until 2001, when the Bush Administration came into office. On November 1, 2001, the DD-21 program was cancelled and the DD(X) program was initiated. For all intents and purposes, however, DD(X) was simply DD-21 renamed with a few modifications. Nevertheless, DD(X) was still merely a developmental name – as evidenced by the "X."

On April 7, 2006, the Navy announced that the first DD(X) would be designated the DDG 1000 and that it would be named the Zumwalt. Subsequent ships of this class will proceed in sequential order: DDG 1001, DDG 1002... As is customary with Navy ships, all ships of this type can be referred to by the name and/or designation of the first ship of the class. Thus, any ship of this class could be known as "DDG 1000 class," "Zumwalt class," or even simply "DDG 1000s" or "Zumwalts."

In this thesis, the three designations are used essentially interchangeably. However, in general this paper refers to the ship under study by the designation it had at the time of the context of the discussion. For example, when the thesis explains an aspect of the program that existed sometime between 1994 and November 1, 2001, it uses "DD-21." For events or changes that took place between November 1, 2001 and April 7, 2006, it uses "DD(X)." For descriptions of the ship in the present, that span multiple stages or when there is no associated time context, the thesis uses "DDG 1000" or "Zumwalt." Of course, there are exceptions to this rule, but this is the basic framework used to aid the reader in understanding the progression of events.

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Chapter 1: Introduction

Much has been made in the media in recent years about the huge cost growth in military procurement programs. In mid-2005, the Defense Department was already $300 billion over budget on the more than 80 major new weapons systems it was developing.[1]

Despite repeated efforts to reduce it, weapons system cost growth is a hardy perennial. New or old, however, cost growth in defense procurement has huge implications for the nation. When costs are initially underestimated, the nation bites off more weapons than it can ultimately chew. Congress commits to weapons programs based on the low estimates, and is usually reluctant to cancel them after the full costs are known, because it has already invested itself and because of pork barrel politics. This, in turn, results either in increased defense spending or in the lengthening of the weapons program timeline, slowing procurement. In the extreme, cost growth can even lead to cancelled weapons programs, wasting taxpayers' dollars with little benefit to the nation.

Another problem in weapons procurement is gold plating: the incorporation of expensive advanced technology that goes beyond what is actually needed. In addition, inefficient procurement strategies and pork barrel politics play a role in raising the costs of weapon systems. Depending on how one looks at it, paying too much for defense either weakens national security, as more efficient weapons procurement programs could free up more money for additional defense, hurts domestic programs where additional

[1] Tim Weiner, "Arms Fiascoes Lead to Alarm Inside Pentagon," *The New York Times*, June 8, 2005.

funds could be allocated, or burdens taxpayers with larger bills than they would otherwise pay.

Cost growth and inefficiencies in weapons programs are problems throughout the Defense Department, and especially in the Navy. The Navy spends about 16% of its budget for research and development, and another 22% for procurement of surface ships, submarines, aircraft carriers, aircraft, and the weapons and sensor systems on board those platforms.[2]

Without its ships, the Navy clearly could not function, and because ships, like all mechanical systems, gradually age and wear out, the Navy must constantly procure new ships in order to maintain a fleet. Not surprisingly, naval warships are extremely expensive. They are complex systems of systems including the hull itself, propulsion, plumbing, electricity, ventilation, and weapons. Furthermore, they must be of high quality and meet rigorous performance standards in order to engage in combat if necessary. As with other weapons platforms, new generations of warships are almost always more expensive than previous generations, despite efforts to build them more efficiently, and they frequently experience large cost growth from initial estimates to final costs.

The Navy's next-generation destroyer, the DDG 1000, is a prime example of a ship that has experienced enormous cost growth. In 1996, the DDG 1000 (at that time known as the DD-21) was intended to be a land-attack destroyer smaller than today's Arleigh Burke destroyer class, with increased survivability (the ability to endure combat and still be able to fight), and capabilities primarily designed to support joint ground

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[2] Department of the Navy, *Highlights of the Department of the Navy FY 2006/FY 2007 Budget*, February 2005 (accessed May 4, 2006); available from http://164.224.25.30/FY06.nsf/HIGHLIGHTS?openfRAMESET.

forces operating ashore. At the time, the plans for the ship called for a target cost of $750 million (FY 1996 dollars) and construction was planned to start in FY 2004. In FY 2007 dollars, that amounts to approximately $1.06 billion. Since then, the ship has grown dramatically in size, complexity, and cost. Today, plans call for a DDG 1000 that is approximately 50% larger than the Arleigh Burke class, has significant anti-air warfare capabilities, and, by some estimates, is expected to cost as much as $4.7 billion for the first ship and $3.4 billion for the fifth ship.[3] The Zumwalt's land attack capabilities, though improved over those of existing ship classes, are reduced by comparison to its original goals, and construction is expected to begin on the first two ships of the class in FY 2007. Thus the DDG 1000 has seen significant changes for the worse in all three broad categories of weapons procurement: cost, schedule, and capability. The cost growth, specifically, has been so dramatic that the number of DDG 1000s to be procured has dropped from 24 ships planned as of 2001 to around 5-8 today. Such a small flight of ships will be unable to fulfill many of the ship class's objectives and represents a serious failure of the procurement system.

This thesis analyzes the DDG 1000 program in detail and examines the strategic, bureaucratic, and political forces that caused these changes and subsequent failure. It finds that while a strategic need for a new ship class did exist in the post-Cold War environment, the specific design of the ship was shaped not by strategic requirements, but by the outcome of bureaucratic politics among the Navy, the Marine Corps, and the Office of the Secretary of Defense. Furthermore, the procurement strategy – how actually to go about purchasing the ship – was influenced more by pork barrel politics in Congress

[3] J. Michael Gilmore, "The Navy's DD(X) Destroyer Program," testimony before the Subcommittee on Projection Forces, Committee on Armed Services, U.S. House of Representatives (Washington, D.C., July 19, 2005), 4.

than any consideration for efficiency, and was a large factor in the ship's observed cost growth.

The history of the DDG 1000 begins with the fall of the Soviet Union and the end of the Cold War. With the Soviet Navy gone, the U.S. Navy found itself peerless: no other nation could challenge it on the open ocean. This change in the strategic environment threatened the Navy's existence: with no superpower navy to oppose, the Navy would find it difficult to justify continued spending at anything like its Cold War levels. Therefore, the Navy had to redefine itself to hold its own as an institution in the post-Cold War environment. The story of the DDG 1000 is one chapter in the story of the Navy's attempts to reconcile its bureaucratic tendencies with its new environment.

As explained in more detail in the ensuing chapters, the Navy allied with the Marine Corps to establish (and fulfill) a strategic requirement for land attack – that is, the ability to fire ordnance from the sea to support ground operations ashore. Fulfilling this requirement also entailed the ability to fight in the littoral, or coastal, regions of the world in order to get close enough to the shore for ship-based weapons to be in range of their targets ashore. Later, more general Department of Defense (DoD) requirements for access to regions of the world where enemies would attempt to deny U.S. access enhanced the need for this naval capability. However, littoral warfare was not something the large, blue-water Navy did very well. With its smaller size, reduced visibility to radar, and enhanced survivability that would allow it to operate better in the littorals, the DD-21 was supposed to be one of the first steps in transforming the Navy from its blue-water past to a brown-water (littoral) future.

Unfortunately, during the past 12 years of the DD-21/DD(X)/DDG 1000 program, the Navy has not done a very good job of establishing its role in the post-Cold War world, or of making the case for the new destroyer in that role. The Navy's troubles began with the very start of the SC-21 program. Fulfilling a land attack role was a way for the Navy to continue receiving its traditional share of the defense budget, but it did not meet the desires of the surface Navy for large, multi-mission cruiser platforms with advanced air-warfare suites. As a result, the small, inexpensive land attack destroyer was first established as a part of a larger family of ships known collectively as SC-21, or surface combatants for the 21st Century. That family was to include the CG-21 cruiser, a "full capability" surface combatant to replace the current CG 47 Ticonderoga-class cruisers starting in 2020. The CG-21 would incorporate many of the same technologies as the DD-21, but would also have a new, highly advanced radar and air warfare system for the future of fleet air defense. For the surface warfare community within the Navy, the DD-21 offered a stepping stone on the way to this larger and more desirable cruiser. Developing and testing much of the technology for the CG-21 on the DD-21 would reduce the apparent research and development costs of the CG-21, and would also make the CG-21 seem like the natural next step after production of the DD-21. Of the two ships, the CG-21 has always been the more important project in the minds of the Navy's surface warriors and it still exists today under the designation CG(X). While the CG-21/CG(X) may end up being a very impressive and capable craft, its relevance to a transformed, brown-water Navy is questionable.

The difficulty the Navy has had in redefining itself is also manifest in the lack of a coherent long-term shipbuilding plan. Procuring naval ships is a huge undertaking. The

research and development phase alone to produce a new ship's design can take years, as evidenced by the DD-21/DD(X)'s 12 year old program. Actual construction of each ship is also a multi-year program, sometimes taking as many as six years to complete. And the long-term implications of a ship are not trivial. Once commissioned, it may be 35-40 years before a ship is decommissioned and retired from the fleet. Therefore, it is extremely important for the Navy to have a clear vision of the composition of its fleet in the long-term to effectively plan and build that fleet. To avoid bloc obsolescence (the sudden retiring of a large number of ships around the same time) of its fleet, the Navy should also continually build ships at a steady rate. Steady procurement levels can also help to protect the militarily important shipbuilding industrial base (by providing a constant level of work for contractors and workers), within the capacity of the industrial base and the limits of defense budget. Confusion and delays in the present can result in a lack of capability in the future as old ships must be retired before new ships are ready to take their place.

Unfortunately, the Navy has not done a very good job recently in defining an explicit long-term shipbuilding plan. From June of 2000, when it published the *Report on Naval Vessel Force Structure Requirements*, to February of 2006, when it published the *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2007*, the Navy had no published long-term plan for its shipbuilding/fleet needs. Furthermore, during those six years, the Navy's implied long-term plans, based on successive Future Years Defense Programs (the five to six year prospective budget plan promulgated by the DoD each year), public statements, and official documents, varied significantly from year to year, demonstrating that the Navy did not have a single,

coherent vision for its future throughout this time. The 2000 plan called for a force of 310 ships, including 116 surface combatants.[4] Surface combatants are those naval ships (like the DDG 1000) which float on the surface of the oceans (unlike submarines), and use their guns, missiles, and torpedoes to attack enemy submarines, aircraft, surface ships, and targets ashore. They are distinct from aircraft carriers which, though they reside on the surface, have virtually no organic weapons systems and are instead dependent on their aircraft for offensive firepower, and on their aircraft and other ships for defensive firepower. The 2006 plan calls for a force of 313 ships, including 143 surface combatants (55 of which are the smaller littoral combat ships).[5] While these plans may seem similar, in between, the Navy's leadership used numbers that implied plans ranging from a 375-ship plan in 2002 and 2003, to a 260-ship plan in 2005. Adding to the confusion were the fact that the Secretary of Defense refused to endorse the Navy's 375-ship plan as a Department goal, and that the 260-ship plan that was described in 2005 was actually presented along with a 325-ship plan as two options with no real commitment. These various plans represent huge differences in capability, cost, and fleet architecture, suggesting a lack of clarity about true needs.

The failure to shift its focus from large, multi-mission platforms such as the existing surface fleet and future CG(X), and the confusion surrounding the Navy's long-term shipbuilding plans are indicators that the Navy is still unsure of its role in the coming decades. However, the Navy will ultimately define itself not by what it says, but by what it does – what kind of ships it procures, how many ships it procures, and how it

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[4] Eric J. Labs, *Transforming the Navy's Surface Combatant Force* (Washington, D.C.: Congressional Budget Office, March 2003), xiii-xiv.
[5] U.S. Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2007* (Washington, D.C., February 7, 2006).

organizes those ships and the people that man them. The Navy has had notable successes in these areas. It has planned and begun production of the LCS – a small, modular ship designed for littoral warfare, representing a new and different type of ship from existing naval vessels. It started to shift away from the Cold War-era system of large carrier battlegroups and six-month deployment schedules with the introduction of new fleet formations and Sea Swap (a system that keeps ships on station longer without fatiguing sailors by switching crews at sea). In many ways, the Navy has adapted to meet the new environment. However, the serious problems faced by the DDG 1000 (described above) and the fact that it is a premier Navy program suggest that the Navy is still having troubles defining itself in this new age.

This issue is not at all trivial. As described above, the construction of a single ship, let alone an entirely new class, is a huge undertaking with implications for the next 30-40 years of the Navy's existence. Billions of dollars are spent to construct each ship, and billions more are spent manning, fueling, maintaining, and upgrading it over the course of its lifetime. Those tax dollars are a valuable resource that could be spent for the betterment of the nation in several other ways both in and out of the defense department. The DDG 1000 program currently finds itself in a very difficult position. Cost increases and changes to the FY 2005 budget have forced the Navy to reduce the number of DDG 1000s to be procured to just 5-7 ships. With such a small order, the Zumwalt can hardly be expected to fulfill many of its goals such as transforming the fleet, providing the kind of fire support the Marine Corps needs, or beginning to replenish the gradually aging fleet. Worse, Congress has passed a law forcing the Navy to construct these ships at two shipyards, further increasing the cost and wasting the taxpayers' dollars with little

appreciable benefit. Clearly something must be changed to ameliorate this situation. This thesis attempts to analyze the factors that led to the DDG 1000's problems in order to craft effective solutions.

The next chapter provides a more detailed background and context for the origin of the DDG 1000, and begins to describe some of the factors that have affected its subsequent development. Chapter 3 outlines several theories that may have played a role in the development of the DDG 1000. Briefly, these are the "Rational Actor" model, the bureaucratic politics model, industry forces, and pork barrel politics. Chapter Four uses the theories described in the third chapter and applies them to each major step in the development of the DDG 1000: the need for a new ship, the design of the ship, and the procurement of the ship. The study finds that the need for a new ship was motivated mostly by strategic requirements, the design of the ship was motivated primarily by bureaucratic politics, and the procurement strategy resulted predominantly from Congressional pork barrel politics.

Chapter 5 concludes the thesis with five recommendations for both the DDG 1000 program specifically and the future of weapons procurement more generally. In brief, those recommendations are:

1. **Cancel serial production of the DDG 1000 and use it solely as a technology demonstration platform.**
2. **Execute a winner-take-all strategy for procurement of the DDG 1000.**
3. **Design and procure a smaller, cheaper frigate-class surface combatant to serve in the fleet of the 21st Century.**

4. **Set up real competitions between branches of the armed forces and offices within those branches for the purpose of allocating resources.**
5. **Reduce the influence of pork barrel politics by reducing the excess shipbuilding capacity through the establishment of an independent commission for that purpose.**

Chapter 2: Background

Section 1: Introduction

While most people picture ships when they think of a Navy, a single ship is rarely the decisive factor in a battle at sea. Instead, the larger formation of those ships – the Fleet – and how it is employed are the major factors that affect the outcome of a battle. Over the course of the 230 years that the U.S. Navy has existed, it has seen many different fleet architectures. Changes in strategy and ship technology have forced complementary changes in fleet structure. Currently, the Navy finds itself at an important crossroads. First, the current generation of surface combatants is getting older – both in terms of age of technology and the age of individual ships – and will need to be replaced with new ships in order to have a Navy in the future. Second, new technology and a new global strategic environment are developing that could have significant effects on the fleet. Finally, Defense Secretary Rumsfeld's drive for "military transformation" complicates the picture by calling for a smaller, lighter, and faster Navy, which the Navy tries to deliver, in part, through the DDG 1000. The nature of the DDG 1000, thus, has a greatly enhanced significance: it will start to define the basic structure of the next battle fleet, in turn affecting the future resource needs of the Navy and armed forces.

Section 2: A Brief History of the Navy

2.1: 1775-1945

The first U.S. Navy had a relatively restricted role: it was supposed to protect U.S. trade and defend the U.S. coast. As a result, the fleet consisted of dispersed and independent warships that seldom concentrated their forces. During peace, the nation's ships were based at overseas stations to protect U.S. trade abroad; at war, the ships would scatter to attack enemy sea lines of communication. [6]

In 1889, the Navy fundamentally transformed itself according to the ideas advocated by Alfred Thayer Mahan. Rather than using independent warships to attack an enemy's lines of communication, the Navy would organize, train, and equip its fleet "to destroy any opposing enemy battle fleet, and to thereby establish 'control of the seas.'"[7] This transformation effort had significant effects on the makeup of the fleet. The old fleet, split between coastal monitors and long-range cruisers, was replaced by a battle line of battleships, cruisers, gunboats, and destroyers of widely varying size.[8] During this period, the Navy trained to fight as a single entity in huge battles on the open ocean. Every surface combatant under this model was designed to bring offensive firepower to the enemy.

Early in World War II, as large battleships were decimated by the aircraft launched from carriers, the aircraft carrier became the most powerful source of firepower and the center of the U.S. Navy's fleet. Unlike the fully concentrated battle fleet of the battleship era, the fleet of the carrier era was more dispersed. The increased firepower

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[6] Robert O. Work, *Naval Transformation and the Littoral Combat Ship* (Washington, D.C.: Center for Strategic and Budgetary Assessments, February, 2004), 11.
[7] Ibid.
[8] Ibid.

that the carriers could wield allowed the fleet to operate in carrier battle groups consisting of several carriers, which would project offensive firepower over long distances via aircraft, and their escort ships, which would defend the carriers from threats from surface ships, submarines, and small boats. Over the course of the Cold War, the increasing size of aircraft carriers and the weapons load of their aircraft allowed each battle group to wield the same level of firepower with fewer carriers, further dispersing the fleet's offensive potential. This permitted more carrier groups, each with fewer carriers, which could be more widely dispersed.

2.2: Cold War Fleet Structure

By the end of the Cold War, the Navy had settled on a fleet consisting of 12 carrier battle groups (CVBG) and 11 amphibious groups (which were prepared to launch amphibious assaults, sending Marines ashore) as an affordable compromise that met most of its needs for forward presence and power projection. The fleet structure of 12 CVBGs operated at the end of the Cold War had both positive and negative effects on the capabilities of the Navy. On the one hand, it gave the Navy more flexibility: it could employ the CVBGs separately in many different theaters, or combine them in different ways as needed. Not surprisingly, the peacetime posture also experienced a change during the carrier era. In order to deter potential adversaries and reassure U.S. allies, the Navy kept carrier battle groups forward deployed in two to three different theaters. However, ships cannot stay deployed indefinitely. Like all mechanical systems, they require maintenance and upkeep, and even more importantly, their crews need time at home. As a result, the Navy developed a system in which ships would deploy for six

months out of every two years, and spend the remaining 18 months doing maintenance and training. That basic deployment schedule still exists today for most ships. However, it is not clear that this system is the most efficient way to employ the Navy's resources, and in fact the Navy is beginning to explore new ways to manage those resources.

First, while it is true that ships require time in port for maintenance and upgrades, it is not clear that they need to be in port for 75% of their time to ensure they are still functioning properly at the end of their 35-40 year service lives. In fact, recently, Navy ships have been decommissioned well before the end of their nominal service lives.[9] Second, the system of deploying as a battle group, though more flexible than older plans which envisioned the entire fleet fighting as a whole, still limits the flexibility of the Navy to some extent. The current ships in the Navy's fleet are highly capable platforms which can execute many different missions with a large amount of firepower, even when operating individually. However, because nine ships (including 6 surface combatants)[10] must deploy and operate with each aircraft carrier, they become tied up and unable to operate on their own, reducing the Navy's operational flexibility. At the same time, logistics for battle groups can become extremely difficult as large numbers of ships need to be supplied with fuel and provisions in the same region at the same time. The disadvantages of this system are so significant, in fact, that the Navy has already begun to change its system. The Navy has refined its deployment structure, changing carrier battle groups to slightly smaller "carrier strike groups" and adding "expeditionary strike

[9] "CG-47 Ticonderoga-class," from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/systems/ship/cg-47-list.htm. "FFG-7 Oliver Hazard Perry-class," from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/systems/ship/ffg-7-unit.htm. "DD-963 Spruance-class," from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/systems/ship/dd-963-unit.htm.

[10] "Battle Group Composition," from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/agency/navy/batgru-composition.htm.

groups" that consist of both surface combatants and the amphibious assault ships that carry Marines and their equipment. Additionally, in order to make more efficient use of its ships by keeping them on station longer, it has begun to test out a procedure known as "Sea Swap." Under this system, the crew on a deployed ship is replaced overseas by flying a new crew out to the ship so that the ship can stay on deployment for another six months without keeping the crew deployed for a full year. Sea Swap, if applied to enough ships in the fleet, would allow the Navy to maintain the same forward presence with fewer ships in its arsenal, which has clear implications for any estimation of the proper ship strength the Navy should have. It should be noted, however, that Sea Swap has some disadvantages of its own. For one thing, it prevents crews from spending as much time training on the actual ship they will ultimately take on deployment. Sea Swap also does not address the most expensive cost in a ship's total lifecycle cost: personnel. Finally, it reduces crew identity with their ship, since instead of spending years on the same hull, they may train on one and deploy on another for only a relatively short time.

2.3: Cold War Ship Classes

Immediately following the end of WWII, the Navy found itself peerless: no other nation had a navy that could challenge the U.S. on the open ocean. Furthermore, the "technological advancements of nuclear weapons, jets, guided missiles, and fast attack submarines demanded a thorough reappraisal of battle fleet tactics and weapons."[11] The Navy also had such a large, new, and powerful fleet built during the war, that it could gradually retire the oldest ships and continue to use the same fleet for years to come. These three strategic factors combined to lead the Navy to modernize its existing

[11] Work, 32.

combatants to maintain their effectiveness in the immediate post-War years rather than construct an entirely new generation right away.

Surface naval tactics changed dramatically in the shift to the carrier era. During the age of the battleship, surface ships performed offensive roles: attacking other ships at sea or offering fire support for operations on land from coastal waters. In the carrier era, on the other hand, surface combatants performed a more defensive role: protecting the carriers from attack from aircraft, submarines, and other surface ships. As a result, the characteristics of surface combatants saw several major shifts. First of all, because the primary source of firepower in a fleet was its carriers, and because the aircraft borne by those carriers could engage before the fleets were even in sight of each other, naval guns were deemphasized. The range of carrier-borne aircraft also meant that the threat from the guns of enemy surface ships was limited. The greatest fears during the Cold War were that an enemy could launch a salvo of missiles at a carrier that could penetrate a battlegroup's defenses, or that a nuclear weapon could be detonated near a battlegroup, obliterating its ships. Therefore, naval armor was also reduced. The combination of these two changes resulted in a shrinking of the largest ships in the fleet. By the end of the Cold War, the largest guns on naval ships had five-inch diameters, armor was mainly used to protect critical ship compartments, and was often Kevlar rather than thick steel, and ship displacements were consolidated into a relatively narrow, intermediate band of between 4,000-9,000 tons.

The Navy's fleet is composed of essentially the same types of ships now as it was at the end of the Cold War. Two of these ship classes have remarkable similarities, and the other class is not very different, just a little smaller. The Navy currently operates

Oliver Hazard Perry (FFG 7) class frigates, Ticonderoga (CG 47) class cruisers, and Arleigh Burke (DDG 51) class destroyers. Perry class frigates displace around 4,000 tons, Ticonderoga class cruisers displace 9,600 tons, and Arleigh Burke destroyers displace about 9,200 tons. Arleigh Burkes and Ticonderogas both carry VLS cells for launching missiles and the Aegis combat system (see discussions in next paragraphs), while frigates have an older type of missile launcher for some anti-air capability. All three types have similar sonar systems, five-inch guns, and a top speed of about 30 knots. All three are "multi-mission" platforms, meaning that they are capable of executing a variety of different types of missions – anti-air, anti-submarine, and anti-surface warfare. Finally, the Ticonderogas and the latest Arleigh Burkes can embark SH-60 helicopters. The main point is that the Navy's current fleet of surface ships is composed of ships that are all very similar in size, armament, and capability, and that each is capable enough to perform a variety of different missions, even operating on its own. The ships of this generation were constructed in "baselines" or "Flights," meaning that later ship designs of the same class were modified to incorporate the latest technologies and features. For example, Flight I and II Arleigh-Burkes could not embark helicopters, while Flight IIA could embark two SH-60s. This continual upgrading and modernization allowed these types of ships to remain the best and most powerful in the world even as their original designs grew older.[12]

[12] "CG-47 Ticonderoga-class," from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/systems/ship/cg-47-specs.htm. "FFG-7 Oliver Hazard Perry-class," from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/systems/ship/ffg-7-specs.htm. "DDG-51 Arleigh Burke-class," from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/systems/ship/ddg-51-specs.htm.

One of the most important developments during the Cold War was the creation of the vertical launch system (VLS). VLS is a missile launch system that consists of a block of cells below the deck of a ship that open to release and launch a variety of different missiles, including the Tomahawk cruise missile. This system allowed surface ships to carry more missiles and launch them faster. The ability to carry 90-127 missiles of various types gave cruisers and destroyers a level of long-range, offensive firepower comparable to that of the carriers.

VLS was developed to complement the Aegis air defense system. The Aegis system was a new anti-air warfare system, including a new, phased-array radar system, introduced in the 1980s to counter the "threat of saturation missile raids conducted by long-range Soviet aviation and submarine forces."[13] This combat system was designed to allow surface ships to dominate the air and had significant implications not only for air defense, but also for offensive capabilities and airspace management of friendly aircraft.

Section 3: Changes to the Strategic Environment, 1990-Present

3.1: A Changing Mission

During the Cold War, the Navy had a very clear, very important mission: deterring and countering the massive Soviet Navy on the high seas. Ballistic missile submarines hid themselves, ready to strike in the event of a Soviet attack. Attack submarines tracked Soviet missile subs to destroy them if they attempted a launch. Naval aviators honed their skills to combat Soviet pilots in the air. And the surface navy defended the carriers from the Soviet surface fleet and readied itself to launch strike operations in the event of a crisis. This mission took on different meanings for the

[13] Work, 15

different communities within the Navy, but the basic premise was always there, and it was always accepted as being of the utmost importance. This primary mission led the United States to build a 600-ship Navy by the late 1980s[14] under Secretary of the Navy John Lehman, who argued that the 600-ship Navy was geographically necessary to prevail against the Soviet Union should the two nations ever go to war.[15]

However, the end of the Cold War brought a great deal of uncertainty to the strategic environment. Very suddenly there was no foreign navy that could match the U.S. on the open ocean, and the future threats to the U.S. were very unclear. Without the Soviet Union to threaten the United States, there were calls throughout government and the nation for a reduced military and reduced defense spending. Along with the calls for a reduction in the defense budget, came calls to change the shape of the armed forces, including the Navy.[16] "Fundamental questions about the Navy's role in the post-Cold War world"[17] were raised on Capitol Hill as early as 1991. Since the Navy no longer had a superpower adversary, the need for its continued support at levels resembling those of the Cold War was brought into serious question.

At the same time, the surface community in the Navy wanted to continue to maintain a large fleet of powerful, multi-mission combatants, especially cruisers, as it had done during the Cold War. This was the form of the Navy in which most of the leaders of the surface community had lived for many years, and it was what they perceived as necessary for the nation's defense. On another level, these powerful ships were the type

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[14] Kenneth J. Hagan, *This People's Navy: The Making of American Sea Power* (New York, NY: The Free Press, 1991), 383.
[15] John B. Hattendorf, Peter M. Swartz, and Yuri Zhukov, *The Evolution of the U.S. Navy's Maritime Strategy, 1977-1986* (Newport, RI: Naval War College Press, 2004), 50-51.
[16] Andy Pasztor, "The Pentagon's Turf Wars," *The Wall Street Journal*, September 17, 1992.
[17] Andy Pasztor, "Mismanagement, Budget Cuts, Doubts Over Role Have Navy Sailing Against the Wind in Congress," *The Wall Street Journal*, June 4, 1991.

of ships naval officers were used to commanding, and were the type they wanted to continue to command. The Navy was, at the end of the Cold War, a large, entrenched bureaucracy that wanted to preserve its own existence. However, without a new mission to justify it, the surface navy would be unable to obtain the funding necessary to continue to exist as it wanted.

3.2: A Changing Strategy

Even before the end of the Cold War, there were discussions within and outside the Navy about the best strategic course it could take. In the last years of the Soviet empire, Admiral Elmo R. Zumwalt (the same admiral for whom the first DDG 1000 will be named) argued against building huge fleets centered on supercarriers and designed to defeat major powers. Instead, he argued for designing new ships to fight limited wars and to intervene regionally to assist with diplomacy. These discussions were not merely theoretical, as events in the late 1980s began to suggest a serious deficiency in the Navy's capabilities for such missions. On July 3, 1988, the *Vincennes*, an Aegis-capable cruiser "'fired in error' on an Iran Air jetliner, killing 290 passengers."[18] The Aegis combat system was supposed to be the most sophisticated electronics and air warfare system in the Navy, optimized to "command the air" to defend the fleet in open ocean engagements. Because the *Vincennes* was operating in restricted, littoral waters in the Persian Gulf, however, with increased air traffic and land clutter, sailors had difficulty distinguishing between a commercial jetliner in a commercial air lane and a fighter plane on an attack trajectory. The incident had serious implications for the ability of the blue-water Navy to operate in limited engagements and patrols in restricted waters. In

[18] Hagan, 386.

addition, the military buildup in the Middle East in the summer of 1990 illustrated further weaknesses. As the carrier battlegroups proceeded to the Persian Gulf, the carriers had to remain outside because they were deep-draft, blue-water ships that could not enter the shallow, restricted waters. Limited by their range, the carriers' aircraft could not provide cover for the frigates and other small ships that could enter the Gulf in this configuration. As a result, those ships "were more dangerously exposed than if the entire fleet had been structured for modern limited conflicts at sea."[19]

At the same time, the Marine Corps was changing and developing its own new doctrines. Instead of using boats to land on the beach and gradually move inland, the Marines were developing a new system of amphibious assault that used aircraft, especially the planned V-22, to bypass initial defenses and strike more important targets deeper inland directly. In order to accomplish this type of ship-to-objective maneuver (STOM) tactic, the Marine Corps needed artillery support from ships at sea to suppress enemy firepower at least until they were on the ground and could effectively defend themselves. In other words, the Marine Corps developed a need for increased land attack.

By allying with the Marines, the surface Navy found its new mission: land attack from littoral waters.[20] This mission was made explicit in two guiding naval strategic documents: *...From the Sea* in 1992, followed by *Forward...From the Sea* in 1994. Both of these papers defined an operational concept that was characterized by enhanced coordination between the Navy and Marine Corps, increased naval support of operations ashore, and littoral capability. They also emphasized the continued forward presence of

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[19] Ibid, 386-387.

[20] I am very grateful to Owen R. Coté, Jr. of MIT's Security Studies Program for this insight regarding the apparent alliance (that is mentioned several times throughout this paper) between the Navy and the Marine Corps in the formation of naval strategy and the development of the DD-21 immediately following the end of the Cold War.

the Navy for the purposes of deterrence and quick response, and the shift from a focus on a global threat to a focus on regional conflicts.

3.3: A Changing Fleet

As the Navy began to implement its new strategy, several different concepts emerged. One of the earliest and most radical was the "Arsenal Ship" advocated by Admiral Boorda, the Chief of Naval Operations (CNO) from 1994 to 1996. The Arsenal Ship was to be a remote missile magazine – a ship with a minimal crew that carried as many as 500 VLS cells which could be called upon by joint forces on the ground, Air Force command and control aircraft in the air, or other surface ships at sea to fire huge salvos of cruise missiles at distant targets on land. However, because the ship could find no support among any of the major bureaucratic actors within the Navy – the carrier community feared it would challenge the need for a carrier's firepower, the surface community was uninterested in commanding a minimalist ship whose weapons could be fired remotely, and even the submarine community saw it as a challenge to its own land attack mission growing with the increasing numbers of VLS-equipped attack submarines[21] – it was ultimately terminated before it began.

Later, in 1999, another new and different concept emerged: the Streetfighter. Vice Admiral Cebrowski, at that time the head of the Naval War College and Naval Warfare Development Command, advocated a more diverse fleet structure composed of both large and small combatants. He envisioned small craft with payloads of 160 tons and 400 tons that could assist in sensor emplacement, fire support, and logistics in scenarios in which an enemy had developed a fleet to deny the U.S. access to its littoral waters. Furthermore, these small "Streetfighters" would be modular in that their payload could be rapidly

[21] Work, 21-22.

reconfigured to adapt to changing scenarios. Though initially rejected by the surface community, who felt that such a ship threatened to draw funding away from its beloved DD-21 (discussed below), the concept of a small, modular vessel eventually found support in the new Administration and the new CNO, Admiral Vern Clark, in 2001.[22] It is currently known as the Littoral Combat Ship, or LCS, and will serve as a complement to the DDG 1000 in the future fleet.

The new ship concept that found the most support, however, in the surface navy was the DD-21. DD-21 was originally intended to be the first in the SC-21 family of ships. Like the largest surface ships of the Cold War, it was to be a multi-mission destroyer, with a significant focus on land attack in order to meet the fire support needs of the Marine Corps and implement the new littoral/land attack strategy detailed above. DD-21 was also supposed to be smaller, less expensive than existing surface combatants, and incorporate stealthy features such as reduced radar cross section and quiet operation. Though the SC-21 program was initiated in 1994, the development of the DD-21, and eventually the DD(X)/DDG 1000, was influenced by the concepts of the Arsenal Ship and Streetfighter/LCS as entities within the Navy argued over the best makeup of the future fleet.

Section 4: The Role of the Surface Navy

Implicit in the discussion of what capabilities and makeup any Navy should have is the question of what that Navy should actually do, which is in turn ultimately dependent on the grand strategy of the U.S. The United States' first Navy was intended to conduct commerce raiding against the British to weaken their supply lines from England

[22] Ibid, 45-50.

and steal supplies and provisions for the Continental Army, as the main goals of the now independent Colonies were to eliminate the British presence and establish a new government. For most of the United States' early existence, while the young nation expanded across the continent, the Navy continued roles similar to this one: protecting U.S. trade, defending the nation's coastal waters, and conducting commerce raiding during times of war. Occasionally the Navy would group together to blockade an enemy's port or conduct amphibious operations, such as in the Mexican and Civil Wars, but generally it served a limited purpose.[23] At the end of the 19th Century, the Navy expanded to match the growth of its home nation. Under the doctrine put forth by its foremost strategic thinker, Rear Admiral Alfred Thayer Mahan, it constructed a fleet to achieve complete control of the seas and take its place beside the other imperialist nations of the world. During both World Wars, the Navy expanded even further to defend Allied shipping, maintain sea lines of communication by controlling the seas, provide massive fire support for amphibious operations, and retake the Pacific. During the Cold War, the Navy maintained its massive size to provide a forward deterrent against aggression and track Soviet vessels.

Without the presence of any global threat, however, the question of the proper role of the Navy has again been raised, and the answer is again strongly tied to the nation's grand national strategy. Neo-isolationists, as described by Barry Posen and Andrew Ross's 1996 paper on competing grand strategies, would argue that with the Soviet Union gone, the U.S. finds itself very secure. They would argue that the only vital interest of the U.S. is "the protection of 'the security, liberty, and property of the

[23] Hagan, 389.

American people.'"[24] Without another global power to upset it, the balance of power in Eurasia would be preserved by the regional powers themselves, without U.S. influence. Therefore, the U.S. should not intervene in any foreign wars. Doing so only expends valuable resources, most notably American lives, and threatens national security by earning the enmity of at least one side in the conflict, which in turn can cause increases in terrorism. The implications of such a strategy are significant, but not devastating to the size of the military. In order to continue to protect U.S. trade and borders, the nation would need to continue to have a sizeable Navy, "perhaps a third to a half the current size."[25] Such a strategy would be a throwback to the original conception of the Navy, focusing on domestic and commercial security.[26]

However, there are problems with the neo-isolationist strategy, and it does not seem to be the direction the country is heading. For one thing, the absence of the U.S. from the international stage could result in increased military competition among regional powers for security. This competition would in turn likely lead to an increased proliferation of weapons of mass destruction, and more war. In the event the balance of power shifted, and the U.S. needed to reengage in global affairs, it might not be able to change its policy in time to prevent the kinds of costs experienced with the rise of Nazi Germany. Finally, the U.S. would lose a significant amount of international influence at a time when its prosperity is increasingly tied to other nations.[27] As a result, the strategy that the U.S. is following now and is likely to continue to follow is a form of primacy. Primacy is a grand strategy in which the global hegemon acts to maintain its position of

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[24] Barry R. Posen and Andrew L. Ross, "Competing Visions for U.S. Grand Strategy," *International Security* 21, no. 3 (Winter 1996/1997): 12.
[25] Ibid, 15.
[26] Ibid, 9-15.
[27] Ibid. 15-16

global supremacy (by preventing any potential competitor from rising to a position that could actually challenge the hegemon), reserves the right to engage at will in regional affairs, and has a broad conception of what the nation's critical interests are (as opposed to neo-isolationism, which has a very narrow view).

President Bush's second National Security Strategy, published on March 16, 2006, outlines an aggressive strategy that will "deal with challenges now rather than leaving them for future generations, ... fight our enemies abroad, ... [and] seek to shape the world."[28] The Strategy promises to "seek and support democratic movements and institutions in every nation and culture, ... [and] stand with and support advocates of freedom in every land."[29] Similarly, the 2006 Quadrennial Defense Review (QDR), a comprehensive review of the U.S. military prepared every four years, stated that the military would "need to operate around the globe and not only in and from the four regions called out in the 2001 QDR (Europe, the Middle East, the Asian Littoral, and Northeast Asia)." [30] The 2006 QDR thus explicitly shifted from a strategy focused on a few selected regions to one that dealt with the entire world. By promising to use the nation's resources to fight for freedom and democracy, and against terrorism the world over, President Bush made commitments that will require a continued forward presence around the globe and the large force structure to support that presence. And by promising to dissuade "potential competitors,"[31] a central tenet of primacy, and to "maintain a military without peer,"[32] President Bush was committing the nation to this strategy.

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[28] President, *The National Security Strategy of the United States of America* (Washington, D.C.: The White House, March 2006), ii.
[29] Ibid, 1, 6.
[30] Department of Defense, *Quadrennial Defense Review Report* (Washington, D.C.: The Pentagon, February 6, 2006), 36.
[31] Ibid, 43.
[32] Ibid, ii.

President Bush, however, will only be in office for three more years. Should a Republican candidate succeed him, one can assume that his or her national strategy will be similar to the current Administration's. If, on the other hand, the Democratic candidate wins the election in 2008, that strategy could change. As it happens, any security strategy currently put forth by Democrats is similar in many ways to the Bush Administration's, suggesting that the country as a whole is more supportive of primacy than any other grand strategy or combination of grand strategies. For example, the Democrats' "Real Security" plan to protect America, published in March of 2006 by the Democratic National Committee promised to "project power to protect America wherever and whenever necessary," "destroy terrorist networks like Al Qaeda," and "lead international efforts to uphold and defend human rights." Like the current National Security Strategy, the Democrats assert the right to intervene at will to defend the U.S. (defined broadly) and promise to destroy terrorist networks, which requires military operations throughout the world.[33]

Thus, both parties seem to agree that primacy is the right strategy for the United States, so it seems likely to be the guiding strategy for at least the next decade. For the Navy, primacy means that the U.S. will have to maintain a fleet large enough to provide a constant forward presence in any region of the world, though it does not mean that the fleet needs to be identical to the fleet of the Cold War. Under the old six-month rotational system described above, a fleet of 100 surface ships could provide 25 ships, or 10-15 ships in two different theaters, forward deployed at any given time. Using new deployment techniques, such as Sea Swap, an even smaller fleet could provide the same

[33] "Real Security," The Democratic National Committee (accessed April 12, 2006); available from: http://www.democrats.org/a/2006/03/real_security_t.php#flash.

presence. However, those ships do not necessarily need to be as massive or capable as the current cruisers and destroyers since the Navy does not face the same kind of superpower naval threat that it once did. What is clear, though, is that in order to fulfill the needs of a grand strategy of primacy, the Navy needs to maintain a sizeable fleet of ships that can keep a permanent forward presence, and that has the capabilities and surge capacity to deter any potential competitor from attempting to compete. The current ships of the fleet will not last forever, and naval leaders at the end of the 21st century needed to decide how to shape the fleet of the future or risk having an undersized fleet as current ships are retired before new ships can be constructed. If the Navy stopped procuring new ships, only completed those that are currently under contract, and retired its existing ships at the end of their nominal service lives, the size of the surface fleet would gradually decrease as shown in Figure 2.1.

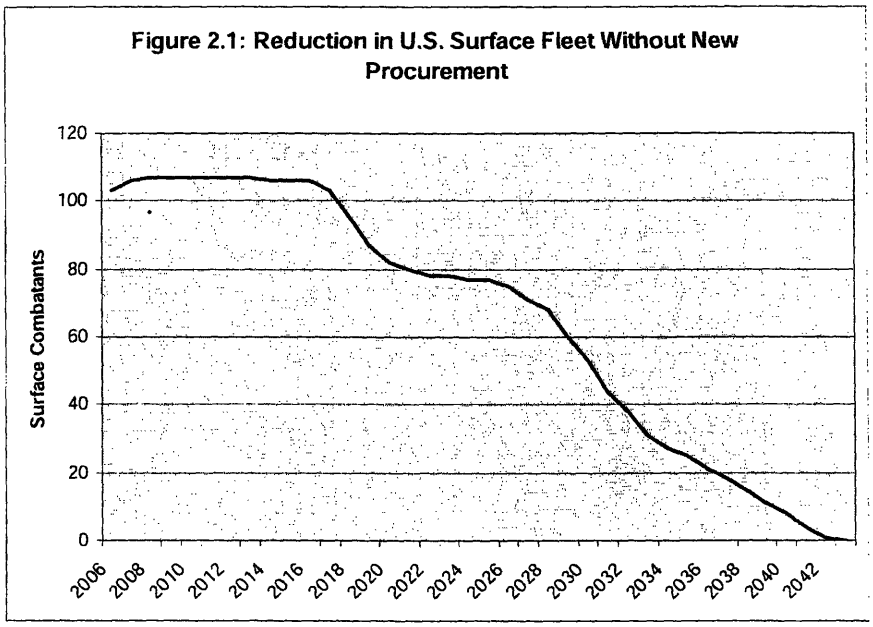

Figure 2.1: Without the procurement and construction of new ships in the next few years, the Navy will begin to see significant declines in its battle force starting around 2017.[34]

[34] Source of data: Author's calculation based on GlobalSecurity.org ship lists and expected commissioning/decommissioning times. Available from:

Though the first serious reductions in fleet size do not come until 2017, because warships of this size take 5-6 years to construct, the Navy only has a few years to begin procurement before it will start seeing the reductions illustrated below. At the same time, in order to preserve its primacy, the United States needs to maintain its military superiority. One aspect of that will require containing the expansion of any potential peer competitor. Another will require keeping America's own forces ahead of any other nation's in strength, technology, and concept of operations. Currently, the U.S. seeks to maintain that superiority in large part through military transformation.

Section 5: Military Transformation

Though the idea of military transformation has been advocated by President Bush and Defense Secretary Rumsfeld, in reality the basic concept existed under different names long before they ever took office. Military analysts in the USSR during the Cold War referred to "fundamental changes in warfare that are brought about by major new technologies" as "Military Technical Revolutions." [35] Building on this concept, and expanding it to include not only technological changes, but also changes in concepts of operation and organization, defense analysts in the West coined the phrase, "Revolution in Military Affairs" (RMA). RMAs are essentially rapid changes in military doctrine that make previous military strategies obsolete. They are frequently associated with technological or organizational developments. Historical examples of RMAs include Iron

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http://www.globalsecurity.org/military/systems/ship/cg-47-list.htm,
http://www.globalsecurity.org/military/systems/ship/ddg-51-unit.htm, and
http://www.globalsecurity.org/military/systems/ship/ffg-7-unit.htm.

[35] Ronald O'Rourke, "CRS Report RL32238: Defense Transformation: Background and Oversight Issues for Congress" (Washington, D.C.: Congressional Research Service Updated February 17, 2006), CRS-5.

Age Infantry, Artillery/Gunpowder, Napoleonic (universal conscription), Dreadnought/Submarine, Blitzkrieg (Air Superiority/Armored Warfare), Naval Air Power, and Nuclear Warfare.[36] The terms RMA and transformation can be used interchangeably, but they can also be used to describe two subtly different concepts: RMA can be a major change in how wars are fought, while transformation can "refer to the process of changing military weapons, concepts of operation, and organization in reaction to (or anticipation of) an RMA."[37]

RMA/transformation was embraced explicitly in the United States well before President Bush took office. The 1997 Quadrennial Defense Review, published during President Clinton's second term in office, had an entire section dedicated to military transformation that included many of the same concepts as Rumsfeld's later transformation efforts. The 1997 QDR emphasized improvements in information superiority, maneuver, and network-centric warfare, particularly for the Navy. It also sought to take advantage of the RMA driven by information technologies, and identified specific platforms as transformational, much like current transformation literature. In addition to the section on transformation, the 1997 QDR had a separate section on improving military infrastructure that again included many of the transformational moves attempted by the current Administration, including base closures and infrastructure reforms to lower costs.

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[36] A more detailed description of each of these RMAs, along with other examples, and how they were revolutionary can be found in "Revolution in Military Affairs," Center for Strategic Budget Analysis (accessed April 12, 2006), available from http://www.csbaonline.org/2Strategic_Studies/1Revolution_in_Military_Affairs/Revolution_Military_Affairs.htm.

[37] O'Rourke, "CRS Report RL32238: Defense Transformation: Background and Oversight Issues for Congress," CRS-5.

Though the Bush Administration did not generate the concept of transformation, its early rhetoric called for placing much greater emphasis on it. This rhetoric was so compelling, in fact, that the military departments felt significant pressure to change their programs and strategies to be transformational or risk having them cancelled. To expand on the explanation given at the start of this section, transformation is supposed to be the generation or exploitation of an RMA to improve the military's capability, possibly while reducing costs.

The claimed purpose of transformation is to maintain the United States' "competitive advantage in warfare"[38] – to maintain the United States' primacy. The events of 9/11, the changing international strategic environment, a growth of asymmetric threats – the ability of enemies to threaten U.S. forces or interest despite U.S. military superiority, and developing regional powers who threaten stability of areas vital to U.S. interests are all changing the way the U.S. will need to wage war in the future. Concerned that historically, victorious countries became complacent while defeated countries quickly learned from their loss and were subsequently able to overturn the victorious country with new military capabilities, U.S. military leaders are seeking to stay ahead of the curve in order to preserve U.S. superiority. In addition, they argue that periods of military dominance and political stability are ideal times to pursue transformation as there is relatively less risk than during periods of war or instability.[39] Finally, defense planners see transformation as an opportunity to make U.S. forces more efficient – increasing U.S. capability while decreasing costs.

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[38] O'Rourke, "CRS Report RL32238: Defense Transformation: Background and Oversight Issues for Congress," CRS-3.
[39] Ibid.

The defense department has several objectives that help to define its own vision of transformation. First, the scope of U.S. military transformation is supposed to encompass all facets of the DoD – how it does business, how it works with other agencies and allies, and how it actually fights. Specifically, the Department has identified six "'critical operational goals:' ... '(1)Protecting critical bases and defeating chemical, biological, radiological, and nuclear weapons; (2) Projecting and sustaining forces in anti-access environments; (3) Denying enemy sanctuary; (4) Leveraging information technology; (5) Assuring information systems and conducting information operations; and (6) Enhancing space capabilities.'"[40] In order to effect these changes, the Department will build a military characterized by network-centric warfare (NCW), and effects-based operations (EBO).[41] "NCW refers to using networking technology ... to link U.S. military personnel, ground vehicles, aircraft, and ships into a series of highly integrated local- and wide-area networks capable of sharing critical tactical information on a rapid and continuous basis."[42] EBO refers to a new type of military strategy that focuses on destroying critical elements of an enemy's military structure, such as its leadership, command-and-control systems and the most critical political and military elements in order to collapse the enemy's ability to fight. EBO is an alternative to attrition-style warfare in which one seeks out an enemy's military forces and destroys them piece-by-piece until the enemy is no longer able to wage war. The Marine Corps' concept of ship-to-objective maneuver, that the DDG 1000 is supposed to support, is an example of EBO – bypassing unimportant enemy forces to attack critical ones. Additionally, DoD wants to

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[40] Ibid, CRS-6.
[41] Director, Office of Force Transformation, Office of Secretary of Defense, *Elements of Defense Transformation* (Washington, D.C.: Department of Defense, October 2004), 8.
[42] O'Rourke, "CRS Report RL32238: Defense Transformation: Background and Oversight Issues for Congress," CRS-4.

make units smaller and faster so they are more mobile, and (eventually) cheaper so that the same level of defense can be offered at decreased cost. These five characteristics: network-centric warfare, effects-based operations, smaller size, faster speed, and cheaper costs are the most easily identifiable and most commonly cited traits of transformation today.

Despite the Defense Department's insistence on the importance of transformation, it has many critics. Some might argue that transformation is unnecessary and expensive. They could argue that the U.S. is already the most powerful nation in the world and does not need to be spending additional money to make itself more powerful when it faces no realistic threats to that superior status. These critics are not convinced by DoD calls to transform to ensure continued U.S. dominance; they see this dominance as inevitable, at least for many years into the future. Others go even further to claim that transformation is actually an excuse to continue high levels of defense spending on a military that faces no threats and has no real role after the fall of the Soviet Union. They do not see the massive military apparatus as the proper way to combat terrorism or preserve national security. Still others might see military transformation as a threat to U.S. dominance – that reduction in the size of the military to make it quicker and lighter will weaken U.S. defense capabilities.[43] Regardless of whether or not transformation is justified, however, the country faces two realities. First, the nation is committed, at this point, to executing at least some degree of military transformation. The DoD has established policies that are forcing the military departments to conform to its concept of transformation, and the overall process of transformation has gained considerable organizational inertia. Furthermore, there is no evidence to suggest that over the course of the next three years,

[43] Ibid, CRS-17 – CRS-19.

while the Bush Administration is in office, the DoD will alter its drive for transformation. Therefore, the Navy will have to attempt to transform itself under the regime described above, and any analysis of its behavior must necessarily take that into account. Second, setting aside for the moment whether or not transformation has the potential to lower defense costs, the current process of transforming is costing huge amounts of money to develop and procure new technological systems, and to implement new organizational concepts.

Section 6: Conclusion

Thus, these three major factors – the age of the current generation of surface combatants and the significant similarity among those combatants, the changing global strategic environment and lack of a naval peer competitor, and the drive for transformation from within the DoD (whether or not it is truly justified) – are all compelling the Navy to redefine and transform itself. Like each of the other services, the Navy has been required by the DoD to define its own roadmap for transformation within the context of the overarching DoD vision. Naval transformation fits most closely with the goals of projecting and sustaining forces in anti-access environments, denying enemy sanctuary, leveraging information technology, and assuring information systems and conducting information operations. Naval transformation focuses on several key elements: a shift from a blue-water navy designed to fight on the open ocean to a brown-water navy designed to operate in the littoral waters; reduced manning on ships; sea

basing to launch and support joint expeditionary operations; and more flexibility in both naval formations and ship-deployment methods.[44]

The shift to operating in the littorals will make the Navy more capable of ensuring access to coastal waters even when adversaries would seek to deny U.S. presence,[45] supporting the DoD goals of projecting and sustaining forces in anti-access environments and denying the enemy sanctuary (i.e. in their own coastal waters). The goal of projecting and sustaining forces in anti-access environments is also supported by the use of sea basing to launch, direct, and support joint operations "directly from a base at sea, without necessarily establishing an intermediate land base."[46] Sea basing would allow the U.S. to launch joint expeditionary operations even in situations when land basing rights could not be obtained politically. It will also make joint forces less vulnerable as fixed land bases become more susceptible to "enemy anti-access/area-denial weapons such as cruise missiles and theater-range ballistic missiles."[47] In order to achieve the Navy's goal of reduced manning on ships, it will increasingly rely on information technology to command-and-control those ships with smaller crews. Similarly, information technology will enable the Navy to operate in new and flexible formations by enhancing communication between ships. Finally, the combination of reduced manning and new deployment schedules, such as Sea Swap, which allows ships to remain on station longer by switching crews overseas, will support the larger goal of reducing costs and making the military more efficient.

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[44] Ibid, CRS-9.
[45] Owen R. Coté, Jr., "Buying '... From the Sea,'" in *Holding the Line: U.S. Defense Alternatives for the Early 21st Century* ed. Cindy Williams (Cambridge, MA: The MIT Press, 2001), 154.
[46] Ronald O'Rourke, "Naval Transformation: Background and Issues for Congress" (Washington, D.C.: Congressional Research Service Updated June 2, 2005), available from: http://history.navy.mil/library/online/naval%20transformation.htm, 4.
[47] Ibid.

The DDG 1000 is intended to be a centerpiece of the Navy's transformation strategy, as will be demonstrated in more detail in Chapter 4. Briefly, the Zumwalt's reduced radar cross section and quieter operation are designed to increase its survivability in the littorals close to enemy shores, while its VLS armament and two advanced gun systems will allow it to strike the enemy and support joint expeditionary forces ashore. Additionally, its enhanced sonar, radar, and combat systems will allow it to perform a defensive role, protecting the sea base from enemy attack. Finally, it is intended to have significantly improved computer and communications systems to help transform the Navy into a network-centric battle fleet. These systems will allow ships to better share sensor data and tactical pictures, and to better communicate with joint forces. The extent to which the DDG 1000 will meet those roles, and the costs in terms of both money and time will be evaluated in Chapter 4.

Chapter 3: Theory

Section 1: Introduction

Designing and building a new weapons system is a huge undertaking. The research and development stage can take years, and especially in the case of naval warships, the actual construction of a single unit can take several more years. From the beginning of any program, people want to know how much the system is going to cost. The leaders of the military departments want to know whether it will fit within their budgets, the Administration and Congress want to know whether it is worth the taxpayers' dollars, and citizens want to know that their government is spending their money effectively. The decision to go forward with a given system typically must be made early in the process, before large amounts of money are spent and before multiple stakeholders become deeply invested in the project. Thus early cost estimates can be very important in approval decisions. Because these programs are complicated and span many years, however, many factors will affect their ultimate price tag. Some of these factors result in cost growth, or the increase in cost estimates for a given program over time. Other factors do not result in an increasing price over time, but do introduce economic inefficiencies that push the cost of a system higher than it would otherwise need to be. The former include pressure from industry, immature technology, initial underestimations, and actual growth in labor and materials costs. The latter – the forces that result in overly expensive weapons systems – include gold plating, inefficient procurement strategies, and pork barrel politics.

The factors related to the real growth in labor and materials costs are addressed in a GAO report published February 2005 entitled, *Improved Management Practices Could Help Minimize Cost Growth in Navy Shipbuilding Programs.*[48] In that report, the GAO found that material cost increases contributed 38% of the cost growth of the eight ships studied, while labor hour increases contributed 40% of the cost growth observed. Because these two factors and the growth in labor rates contribute to cost growth during the actual construction of a ship, and because the GAO has already examined these issues in depth, they are not the focus of this thesis. However, it is important to note that the GAO found that growth in materials costs were partly due to the actual price of materials rising during construction, but were also "due, in part, to the Navy's and shipbuilders' underbudgeting of these costs."[49] This initial, low estimate is a key step that takes place prior to the start of construction and that will be addressed again in the section on bureaucratic politics, below. Labor hour increases were largely due to design modifications after construction began, which required rework of already completed areas, the GAO found. These design modifications were in turn caused by a lack of design maturity in new technologies that were being introduced, another key factor that will be addressed below.

The other causes listed above are systemic issues that can result in significant growth of cost estimates during the design phase of a project, before construction. They can also have long-lasting effects that contribute to cost growth during construction, as indicated by the discussion above. This thesis primarily addresses these factors.

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[48] Government Accountability Office, *Defense Acquisitions: Improved Management Practices Could Help Minimize Cost Growth in Navy Shipbuilding Programs* (Washington, D.C., February 28, 2005).
[49] Ibid, 3.

This chapter looks at four theories that might explain the key decisions made during the development of the DDG 1000. The first theory is the "Rational Actor" or strategic requirements theory. That is, the nation/the Navy, acting as a single entity, observed its environment and made decisions that served the best interests of the nation in that environment. The second theory is the bureaucratic politics model. It describes government action as the outcome of many different actors arguing and bargaining with one another. Each actor in this model has a different set of interests and objectives based largely on his/her position in the bureaucracy and each has a different amount of power in the system based on personal skills and position. Under this model, entire organizations can sometimes also be single actors. The third theory is based on industry pushing new technology on the warfighter who may or may not actually have a need for it. The idea under this theory is that contractors, eager for lucrative defense contracts, come up with new technologies that they can sell to the Navy to secure future contracts as the only company that can produce said technologies. The Navy may not actually have had a need for the new features, but once offered, will accept and support them. The final theory is based on "pork barrel politics." It states that members of Congress will represent the concentrated interests of their constituents over the diffuse interests of the nation, for example supporting weapons programs to bring business to their districts even if those programs are not in the interest of the nation as a whole. Through log-rolling and trading votes, representatives can get these programs passed by Congress as a whole. Unfortunately, pork generally means much higher costs for the nation's taxpayers.

Section 2: The Rational Actor

The Rational Actor model is frequently used by political scientists, and especially those studying international relations, to analyze state actions. It has also been elucidated explicitly by Graham T. Allison. This model views a nation as a single entity selecting the course of action it sees as being in its best interest. In other words, under this model, the rational state selects from among a number of options the single course of action that will maximize utility. For issues of defense and defense procurement, one using the Rational Actor model to analyze national action would expect weapons programs and strategies to fulfill some existing strategic requirement. For example, one could use this theory to explain why the United States began producing submarine-launched ballistic missiles (SLBMs) and the submarines capable of launching them in the late 1950s and early 1960s. During the Cold War, the Navy had a need for a strategic arsenal to counter the Soviet's nuclear missiles under the concept of mutually assured destruction (MAD). Additionally, there was a fear that a Soviet first strike could cripple fixed air bases (from which strategic bombers would launch) and missile installations, preventing the U.S. from responding with a counterstrike assault. By placing nuclear weapons underwater on a mobile, undetectable submarine that could not be easily targeted by Soviet forces, the U.S. fulfilled this strategic requirement with a virtually ensured second-strike capability.[50]

However, the Rational Actor model is relatively simplistic. By assuming that the nation is a unitary actor, it does not take into account the massive organizations and bureaucracies that comprise national governments. It assumes that the single decision-

[50] Harvey Sapolsky, "The U.S. Navy's Fleet Ballistic Missile Program and Finite Deterrence," prepared for Henry Sokolski, ed., *GETTING MAD* (Cambridge, MA: Massachusetts Institute of Technology), 2.

maker can act quickly with total information about the situation and its options, when in fact national leaders must frequently make decisions with very imperfect information. Furthermore, the organizations that execute those decisions are large, complex, and conservative and thus slow to act. Finally, the Rational Actor model assumes that the single decision maker acts only with the best interests of the nation as a whole in mind. In reality, the individual actors within the nation's organizations may have more parochial institutional interests that motivate their actions. Despite these limitations, the Rational Actor can frequently explain the coordinated action of nation-states, shedding insight on why decisions were made as they were.

Section 3: Bureaucratic Politics

Bureaucratic politics is a theory of governmental decision-making that was illuminated in Graham T. Allison's study of the Cuban Missile Crisis.[51] It has been studied by Harvey Sapolsky, Barry Posen, and Owen R. Coté in other contexts. In his study, Allison identified several different conceptual models that could be used to explain the actions of states in the arena of international relations. Allison utilized these theories to explain the moves of both the Soviet Union and the United States during the Crisis, but since they are ultimately theories that rationalize government actions, they can be applied similarly to domestic decisions, such as ship procurements. (The first model Allison described is the "Rational Actor" model, described above.)

[51] Graham T. Allison, "Conceptual Models and the Cuban Missile Crisis," *The American Political Science Review* 63, no. 3 (Sep., 1969), 689-718.

3.1: Bureaucratic Politics

The bureaucratic politics model sees the government as a complex combination of players within organizations, each bargaining with the others in order to accomplish a variety of different goals: national, organizational and personal. From the political interaction and negotiation among these players emerges government action.

Government behavior can thus be described as a complicated game. Each of the bureaucratic actors constitutes a player in this game with shared responsibility over, but separate objectives for, the outcome of the game. The hierarchy, relationships among players, and permitted negotiations comprise the rules, and each player's national, organizational, and personal goals are that player's objectives in the game. Furthermore, there are, at any given time, hundreds of issues played out in several different games along multiple channels in which each player has an interest. Therefore, it must be recognized that the single issue analyzed here – naval ship procurement – is in fact just one of the issues in this larger environment. Because those who hesitate to argue for their position may be preempted by another player, and because those who are certain that they are correct have an inherent advantage in bargaining over those who are unsure of themselves, players have a natural tendency to choose one side in a seemingly close issue and champion it to the end.[52] Since the outcome of the game results in enhanced effectiveness to the winning player(s), players fight hard for their issues.

Because government action is represented by the outcome of this type of complicated game, that ultimate action depends not only on the reasons that support such an action, nor on the established organizational routines that govern it, but also on the political and negotiating power and skill of the proponents and opponents of that choice

[52] Ibid, 710.

within the government. Much of that power comes from position – the President of the United States will obviously have more political power than a junior naval officer. But some of that power will also come from the individual player him- or herself. Certain individuals are naturally more convincing, or may better understand how to navigate the public and political environment to achieve their objectives.

Within the structure of the game, the player's position defines the rules for his play. His position defines what he may do as well as what obligations he must fulfill. However, players in this game have several obligations at once – for example, the head of a given organization has obligations to the nation, to his organization's mission, to his direct superior, and to all of his subordinates within the organization. These obligations are not separate and distinct. A player's performance in one will affect his reputation and power in another. For instance, the Chief of Naval Operations (CNO) could not realistically advocate a ship class that his subordinate officers despised without alienating them and undermining his authority over them. A player's position also defines a significant share of his goals. His organizational goals are obviously defined by the organization of which he is a part (see next section), and his personal goals will be tied to his position as well. This will affect his perception or point of view on the issues around which games are played. One can frequently predict much about an individual's goals from his position alone.[53]

Because each player has an interest associated with his position and an interest in preserving his stock of power, he will work to defend those interests and especially that power in any games played, even those in which he might not otherwise have a significant interest. Therefore, decisions that do not threaten the power of major players

[53] Ibid, 709.

will be more likely to succeed,[54] regardless of their superior or inferior strategic results. This factor will play out in conjunction with the organizational behaviors described in the next section. All organizations have an inherent interest in preserving their stake of wealth, power, and autonomy, so the bureaucrats tied to those organizations have the same interests and will use their negotiating power to preserve those interests. Thus, in order for an individual or group advocating a particular type of ship to successfully navigate the procurement process for that ship, they will need to obtain buy-in from all interested stake-holders. Those stakeholders include not only the Department of Defense (especially its Secretary), the President, the Congress, the Navy's officer corps (in the case of DDG 1000, particularly Surface Warfare Officers, those who actually serve on surface ships), but also the contractors who will construct the ships, and the other Military Departments whose power, prestige, or budget share may be threatened by the capabilities of the new ship.

The ultimate political power holders within the Navy itself are its senior officers. While the top of the Navy's bureaucracy or parties outside the Navy could attempt to force new policies on the officers, they will ultimately fail without the support of this group. These are the players who will actually run the development program and eventually command these ships and while they are explicitly obligated to and will follow the orders they are given, they can resist these instructions in more subtle ways. Stephen Rosen has argued that it is impossible to force changes down on the armed forces because of the resistance that will be met from existing officers. Instead, he argues, one must instill new ideas in young officers so that when they are promoted to positions of power,

[54] Ibid, 716.

they will implement those ideas.[55] On the other hand, Barry Posen argues that without strong outside leadership, military officers will never change anything in their service.[56] Through their organization's traditions and training (again, see below), they have simply become too locked in to their existing ways.

To summarize, then, under the bureaucratic politics model governmental behavior is the resultant of many bargains and negotiations between individual actors trying to promote their own (national, organizational, and personal) interests. The result of this behavior is rarely intended by any individual or group within the government. In addition, positions matter. It is important to note that this and all phenomena described under the bureaucratic politics model can occur at several levels of the bureaucratic hierarchy. The same example mentioned in the Rational Actor model section can be analyzed using the bureaucratic politics theory: the development of submarine-launched ballistic missiles and their associated submarines. This analysis was performed by Harvey Sapolsky in 1972. In that study, Sapolsky found a series of bureaucratic political factors that affected the development of the *Polaris* (the name of the first SLBM) system. First, he demonstrates how *Polaris* was a way for the Navy to carve out a share of the strategic nuclear budget for itself. Because of a disagreement between a Navy Admiral and the mobilizing civilian scientists at the start of U.S. involvement in World War II, the Navy was initially excluded from the Manhattan Project and the subsequent strategic programs after the war. *Polaris* was thus a way for the Navy to push itself into that part of the defense budget. However, other factors were also at play. Pressure from the Eisenhower Administration limited the budget for and number of strategic missile programs that

[55] Stephen Rosen, interview by author, Cambridge, MA, October 12, 2005.
[56] Barry R. Posen, *The Sources of Military Doctrine* (Cornell University Press, Sept. 1986).

would receive priority support. This put the Navy in direct competition with the Army and Air Force to obtain a high-priority program. Initially, the Navy teamed up with the Army's Jupiter missile program, but technical features of that missile made it ill-suited for deployment on a submarine. As a result, the Navy obtained the support of the Air Force, which felt more threatened by an Army missile program than a Navy program, to outvote and defeat the Jupiter program in the Joint Chiefs of Staff. With the Jupiter program eliminated, the Navy was able to obtain priority support for its own missile program. In addition, although *Polaris* was always intended to be deployed on submarines, the Navy maintained a position that it should also be deployed on other naval platforms in order to preserve funding for those other platforms. Though there were certainly strategic requirements that justified the development of a submarine-based nuclear missile system, as described in the previous section, the actual development of that system required, and was greatly impacted by, a variety of bureaucratic forces among and within the armed forces.[57]

The organizational and personal interests emphasized by the bureaucratic politics theory have several implications for naval ship procurement. Individuals involved in a weapons program will have a strong interest to ensure that their program is approved by higher authorities. Thus they will go to great lengths to obtain that approval, including downplaying initial cost estimates and emphasizing new technological features. Additionally, the individual interests of officers for more capabilities to command can cause gold-plating, or overloading a ship platform with increasing amounts of technology and capabilities that are, in many cases, unrelated to the original mission of the ship. Such additions only serve to make the ship's cost unmanageable as it is developed. The process

[57] Sapolsky.

can take place in the origin of the ship's concept, in which case it results in overly expensive ships, or it can take place during the design phase of the ship, after the original concept and mission are defined, in which case it results in cost growth. If the technology added is immature (see section on Contractor Forces), it can further increase the cost of the ship and delay the delivery schedule.

3.2: Organizational Behavior

Allison's second theory is one he originally termed, "organizational process." Though not the primary theory used in this analysis, this thesis will combine certain aspects of this model with the model on bureaucratic politics, especially to help explain the motivations and constraints of the bureaucratic actors described by that model. Such a synthesis is not without precedent, as Allison himself combines aspects of these two models in a later paper.[58] Under this theory, a government is described as "a conglomerate of semi-feudal, loosely allied organizations, each with a substantial life of its own."[59] The behavior of a government is then the output of these organizations as they act according to their "standard operating procedures." Government leaders do not have total control over the behavior of the governments they lead. Instead, they can trigger existing organizational routines and may be able to trim or adjust the ultimate output, but they cannot force any part of the government to do something completely new – their

[58] Graham T. Allison and Morton Halperin, "Bureaucratic Politics: A Paradigm and Some Policy Implications," *Theory and Policy in International Relations*, eds. Raymond Tanter and Richard Ullman (Princeton: Princeton University Press, 1972) 40.
[59] Allison, 698.

options are limited.[60] These tenets have several implications for government actions, including defense procurement.

First, because organizations are the entities that actually execute government action, each organization's goals have significant constraints on the actions that can realistically be taken. One of the most important of these constraints is the health of the organization, usually defined in terms of wealth (budget allocation), power (including the number of people assigned), and autonomy. Assignments that counter an organization's existing goals can be expected to meet resistance; those that support them will run more smoothly. Thus, for example, a ship that has implications for changing the role of the fleet against the Navy's existing goals is likely to meet more resistance than one that does not. In addition, the behavior of sub-organizations within the Navy must be considered in any question of ship procurement. The Navy is organized into warfare communities that comprise the different ways that the Navy projects its power: Surface Warfare, Submarine Warfare, and Aviation Warfare, among some other, smaller communities. Though each of these has distinct missions and roles, there is significant overlap. All three, for example, are capable of strike capabilities ashore. (Strike refers to the delivery of ordnance to ground targets to destroy them.) Aircraft can carry and drop bombs, while both surface ships and submarines can launch ground attack missiles. Therefore, there is a power struggle among these communities for power, wealth, and autonomy. Any action taken by or for one community that could significantly affect another could face significant resistance.

Another implication of an organization-centric view of government action is organizational inertia. Since governmental organizations are so big, they require a high

[60] Ibid, 699.

degree of organization and standardization in order to do anything effectively. In order to coordinate their many people to take effective action, they require standard operating procedures (SOPs) that they can train their people to execute when an order is given. Organizations, especially military organizations, therefore have a long history of traditions and standardized training protocols to teach their SOPs to their people. All of these factors combine to make organizations very difficult to change quickly or easily. This is not to say that organizations cannot change, as new ideas can gradually influence and change training plans and standard protocols, but this process takes time and effort since the individuals in the organization who will be required to implement the changes are accustomed to the existing standards. Therefore, organizations have limited flexibility and change very slowly. This is of particular relevance to budgets, which typically change only incrementally in terms of both totals and intra-organizational splits, as no organization will easily give up its share of a budget.[61] For example, one consequence of this tendency is that the shares of the defense budget devoted to the Departments of the Army, Air Force and Navy were "held nearly constant during the Cold War... [and] the demise of the Soviet threat did not change this allocation,"[62] despite significant strategic changes in that time. Another consequence of the limited flexibility and change of an organization is related to organizational investment. Once undertaken, organizational stakes in projects carry them beyond the point at which objective costs outweigh benefits. In order to maintain their power and autonomy, organizations will often continue projects well beyond the loss point.[63]

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[61] Ibid, 702.
[62] Cindy Williams, "Introduction," in *Holding the Line: U.S. Defense Alternatives for the Early 21st Century* ed. Cindy Williams (Cambridge, MA: The MIT Press, 2001), 7.
[63] Allison, 703.

Organizational inertia has several implications for naval ship procurement, including organizational culture, gold-plating, and technological immaturity. All organizations naturally develop cultures that grow out of the environment in which they operate, strong leaders, or some other less tangible factor. Military organizations have fundamentally different cultures than civilian organizations. These are natural and expected phenomena. Because of the inertia of organizations, these cultures are very slow and very difficult to change, even more so than how an organization operates or is structured. During the Cold War, defense planners had to constantly consider how to gain an advantage over the Soviet Union which was, in turn, continuously trying to establish a military advantage over the United States. Thus, out of the national security fears of the Cold War, the Department of Defense developed a culture of "the newest and most advanced weapons at any cost."[64] When the Soviet Union collapsed and the Cold War ended, the defense budget naturally shrank as the existing threat no longer existed. However, the culture that the DoD had developed did not disappear as easily, despite repeated efforts to enforce serious cost targets. Moreover, because of the propensity of bureaucratic actors to champion their own programs, there is a culture in the Pentagon to make optimistic initial cost estimates, in the hopes that a relatively low cost will attract higher authorities in the Administration and Congress.[65] Organizational inertia and pork barrel politics (see below), furthermore, make these programs very hard to terminate later in the process.

The tendency to make such optimistic estimates is worsened by one of the most common methods of making cost estimates in the first place: summing an exhaustive list

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[64] Donald Srull, ed., *The Cost Analysis Improvement Group: A History* (McLean, VA: Logistics Management Institute, 1998), 8.
[65] Ibid, 7.

of the program's constituent parts. While this may seem logical, in fact it is seriously flawed. "If necessary pieces of the program are unseen or inadvertently left out, or if unplanned program activity is required (for example, a test fails and must be repeated, or it uncovers a design flaw that must be corrected), the estimate will be low."[66] Such a system of estimating costs also makes it easier for individuals in the DoD to lower estimates by making optimistic assumptions, as opposed to parametric estimates which draw on historical cost data. Therefore, much of what is regarded as "cost growth" is actually due to unrealistic initial estimates that, when compared to final actual costs, make it seem as though weapons systems have grown in cost many times. The natural organizational inertia of the Defense Department has perpetuated these cultures through procurement programs that experienced wild cost growth.

Organizational inertia can also help to facilitate gold-plating and the insertion of technologically immature features by making it difficult for programs to be terminated after they have started, even if the service outgrows the original concept or if technological features are simply not ready for deployment. Technological immaturity can also grow out of the DoD's culture of "the newest and most advanced weapons at any cost."

Section 4: Contractor Forces

In the United States, there is an entire industry sector dedicated to producing weapons systems for the Defense Department. Some of those companies also produce products for the civilian market, but many are completely dependent on defense contracts for their existence. Even those that do have civilian components to their business make

[66] Ibid, 9.

large amounts of money from their lucrative defense divisions. The two major shipbuilders that produce surface combatants for the U.S. Navy, Northrop Grumman's Ingalls Shipbuilding, and General Dynamics' Bath Iron Works are two examples of companies that are totally dependent on defense contracts for their survival. As a result of this dependency in both types of company, contractors have an enormous interest in securing those critical contracts for themselves.

As a result, they will go to great lengths to ensure that they get defense contracts. One way in which they do so is by lobbying Congress. Contractors will argue that there is a strategic need for a weapon system they produce, even when that need is questionable, to try to increase Congressional support for it. They may also lobby members of Congress from the districts in which they operate to increase the spending (see next section) that flows to that district. The net effect of this lobbying is that Congress will be more likely to support expensive weapons programs that the nation may not truly need. This issue is addressed in more detail in the next section on pork barrel politics, but it is important to recognize the role that industry plays in that process.

Contractors will also try to push new technology on the military services that they may not truly need. By generating a new concept and convincing Congress, the Administration, or the individual service that it is necessary when it may not be, the contractor can induce the government to commit to that technology, thus securing the future contracts that involve the technology since only that company can produce it. This is sometimes known as a "technology push" as opposed to a "requirements pull" since the technology is pressed onto the warfighter by the contractor rather than requested from the contractor by the warfighter to fulfill some strategic requirement. This force may be more

common today than it might have been in the past because of the relatively fast current pace of technological development, and because of the current Administration's drive for transformation. As described in the previous chapter, that drive for transformation favors systems that feature network-centric, information technology and miniaturization. This factor is another contributor to gold-plating, which in turn can cause both cost growth and overly expensive programs.

"Technology push" is particularly problematic when the technology is immature. The less understood or mature a technology is when one tries to implement it in a platform's design, the more cost growth is likely to result as the platform and technology are developed. New technology is expensive. It requires a significant amount of time and money to develop, and even more to properly implement and test in a complex technological system. In addition to cost increases, trying to make new technology work in military platforms will usually result in significant delays as time is expended to mature the technology. Any system that is developed ultimately needs to be integrated into a ship and made to work with all of the other systems on that ship. Trying to make several different complicated systems work together in a confined space that will eventually be floating at sea and possibly serve in combat is not an easy task. The less understood a technology is, the more time it will take to make those systems work together. As indicated by the GAO report mentioned at the start of this chapter, immature design and technology are significant causes of reworking completed areas on ships and higher costs.

Like their program office counterparts, contractors will frequently underestimate costs at the beginning of the program in order to obtain buy-in for their products. This

allows the contractor to commit the military and Congress to the program. Gradually, those cost estimates will rise to become more realistic, but because of the money already invested, the establishment of invested stakeholders, and organizational inertia, programs are rarely cancelled, even those that would not have gained initial approval had the initial cost estimates actually been realistic. This is a significant factor that affects perceived cost growth.

Finally, contractors and their Congressional supporters will frequently argue that maintaining the industrial base for weapons systems is critical to national security. Allowing the industry base to shrink to just one company would make that industry more vulnerable to a terrorist attack or natural disaster, which would completely destroy the nation's capacity to produce that type of system. Additionally, such advocates argue that maintaining multiple companies in a given sector allows for competition between them, increasing quality and lowering costs. This factor is especially powerful among the shipbuilders who frequently cite these reasons for maintaining both surface combatant shipyards. However, this argument is somewhat questionable, as will be explored in greater depth in the subsequent chapters.

Section 5: Pork Barrel Politics

The second theory that will be applied in the analysis of the DDG 1000 procurement program is a security externality. An externality is an economic phenomenon in which an action or decision results in costs or benefits to stakeholders that had no part in making the decision. A security externality is then an externality that affects national security or national defense. In the analysis of the DDG 1000, the

security externality of pork barrel politics will be considered as a possible cause of inefficient procurement strategies which result in an overly expensive system. Pork barrel politics is a term that describes decisions by politicians to appropriate money for projects of questionable or inefficient value in order to give money and jobs to their constituents in exchange for their political support, either in the form of campaign contributions or votes. However, since the primary motivation for the project is the creation of wealth in a particular area, the projects may not be (and often are not) efficient or cost-effective, and they may not even be completely necessary. Thus, they are externalities because the taxpayers of the nation as a whole must bear the cost of programs they had no input in accepting, and from which they do not derive the primary benefits. Instead, those benefits are focused on a small subset of the taxpayers – those whom the politician who supported the pork spending represents. As one of the largest parts of the federal budget, the defense budget is home to billions of dollars of pork barrel spending. In the defense budget, pork barrel spending comes from appropriations that benefit specific Congressional districts, or that purchase something at a higher cost than otherwise available. Pork can usually be found in the budgets for procurement, research, and base construction and operations within the defense budget.

Identifying which programs are pork and which are legitimate is not always a simple matter. Senator John McCain of Arizona has several criteria he uses to identify pork. One of them is, "An appropriation that is not properly authorized by the Senate and not requested by the Administration."[67] In other words, he sees any addition beyond what the DoD (through the President) requested and that has no basis in the Defense

[67] "News Center: Pork Statements," Official Senator John McCain website (accessed May 4, 2006); available from http://mccain.senate.gov/index.cfm?fuseaction=NewsCenter.Pork.

Authorization, the act that defines policy for the defense budget, as pork, since if it were truly necessary for defense, the DoD would have requested it or the Senate would have explained the need for it. However, there are some problems with this criterion. First, a member of Congress may have serious, legitimate concerns that the DoD or the Authorization may have overlooked a program, the absence of which could significantly weaken national security. Additionally, the members of the DoD are players in the game described by the bureaucratic politics model above. Therefore, they may know that if they omit a particular program that is very important to one or a group of Congressmen, it will be put back into the budget in the legislative part of the process. The initial omission could allow the DoD to fit other programs into the budget that it would otherwise be unable to include. Thus, by this one criterion alone it is difficult to identify true wasteful spending.

Another criterion that Senator McCain uses to identify pork is "An unauthorized and unrequested, locality-specific or facility-specific earmark (including those funds that are above the Admin. request)."[68] This is very similar to the first criterion, discussed above, but with the addition of the "locality-specific or facility-specific" and "earmark" descriptors, focusing the search for pork on those programs that benefit a specific locality and that were added as an earmark. An earmark is a designation that appropriated funds be used for a very specific purpose. These are good additional qualifications for pork because pork will generally benefit a particular representative's constituents (so it will be focused to that locality), and because an earmark directs that the money gets spent as the representative in question desires. However, it is still subject to the same problems as the

[68] Ibid.

first of McCain's criteria discussed above. There is no certainty that programs identified by this criterion are pork.

Fortunately, other indicators can reveal the presence of pork-barrel politics. Cindy Williams looked at submarine production lines and submarine construction schedules since the end of the Cold War. In doing so, she identified a lack of a need for two production lines given the number of submarines that the U.S. was procuring. Nevertheless, both lines have stayed open. Since keeping two lines open increases overhead costs and lowers the savings available from learning curves, this is likely a pork provision advocated by the Congressional representatives of the districts where one or both lines operate.[69] Eugene Gholz and Harvey Sapolsky agree with this method. They analyzed the entire defense procurement industry since the end of the Cold War and found that there exists a much greater production capacity than the U.S. truly needs. They explain this disparity between capacity and actual production by the existence of pork-barrel protection of industry and production lines.[70] Of course, counterarguments to this line of thinking exist as well. Specifically, many argue that it is in the interest of national security to have a domestic defense industry apparatus. Shutting down one submarine production line, for instance, would leave the nation vulnerable should something unexpected happen to the only remaining line. Additionally, some argue that maintaining two lines allows for competition between the shipyards, thus lowering costs. As will be seen in the analysis of DDG 1000 procurement, though, true competition between firms often does not occur.

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[69] Williams.
[70] Eugene Gholz and Harvey Sapolsky, "Restructuring the U.S. Defense Industry," *International Security* 24, no. 3 (Winter, 1999-2000), pp. 5-51.

A final indicator of pork is the quality of technology in a particular program and the history of that program. For example, Cindy Williams examined the V-22 Osprey program and found that the aircraft's technical problems were so severe that it would not survive without the helping hand of pork-barrel politics. Tracing the history of the program, Williams noted that the V-22 had been cancelled by the first Bush administration in 1989 after two prototype crashes. However, in a campaign promise to workers in Pennsylvania, then-Presidential candidate Bill Clinton committed to revive the V-22 program if he were elected.[71] Since Pennsylvania was a swing state in that election, this seems a clear example of a pork provision in that it was motivated for political rather than national security reasons.

There is no one, clear-cut method that can be used to identify pork spending. Each of the indicators described above has problems with its reliability in identifying pork. However, when used in combination to identify probable sources of pork for closer examination (such as the V-22 program), it is sometimes possible to determine whether pork is present.

None of these identifiers of pork, however, help to explain why pork exists. In fact, there are many sources and, to a certain extent, pork is inevitable in a representative democracy. The first source of pork spending can be explained by Mancur Olson's basic theories on the overrepresentation of concentrated interests and the underrepresentation of diffuse interests. Essentially, Olson argues that smaller groups (concentrated interests) will more easily and readily act to bring about their collective interest than will large

[71] Williams.

groups (diffuse interests).[72] When applied to the U.S. system of representative government, this has several implications. A given member of Congress has many different interests he or she represents. In the case of defense spending, two can be quickly identified. On the one hand, the member represents the diffuse interest of the nation for an effective national defense system at the lowest/most efficient cost. On the other hand, the member represents the concentrated interest of his electorate for money and jobs. In fact, many politicians are actually evaluated on the basis of how much money and how many jobs they can bring to their constituents.[73] Because his or her constituents get a much larger share of the benefits from the money and jobs (since they are split only among those local constituents, rather than the nation at large) than they do from the national interest for an efficient defense, the localized benefits from the jobs outweigh their share of the diffuse costs from an inefficient and unnecessary defense apparatus. Therefore, the representative, in turn, has an interest in overrepresenting the concentrated interest and underrepresenting or neglecting the diffuse interest as such behavior will better ensure his or her reelection. This results in support for defense programs that may not be very efficient but that will bring wealth to a given constituency.

The overrepresentation of concentrated interests alone, however, cannot explain how pork spending is approved by the entire Congress. After all, since, by definition, only one or a few constituencies are benefited by such programs, only a few representatives should support them. The explanation to this apparent paradox is logrolling. Legislators will trade votes for projects in other districts in order to secure

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[72] Mancur Olson, *The Rise and Decline of Nations: Economic Growth, Stagflation, and Social Rigidities* (New Haven: Yale University Press), 17-35.

[73] In many ways, this is not a bad result: people are benefited and their representatives serve their interests, as well they should. Taken to the extreme, however, the nation as a whole pays the price.

support for projects and industries in their own districts. Through this process, enough votes can be amassed to push through a large number of pork programs.

However, the legislative sources of pork are not the only ones. The bureaucratic mechanisms described earlier can give rise to pork spending even before the legislative stages of the budget process. First, as described previously, organizations have an interest in wealth, power, and autonomy. The individuals involved with specific programs (e.g. procurement programs) also have a personal interest in the success of their programs, regardless of the national interest. Therefore, there are personal and organizational interests to continue programs even if they are not in the national interest of the most effective, efficient national defense. The bureaucratic actors involved will use their power in the "game" described earlier to maintain these programs. Second, the nature of organizations to change only slowly and incrementally makes them less likely to give up existing programs when they become too expensive or obsolete. This generates a tendency to keep programs that are not completely in the national interest to keep or, in other words, to keep pork programs. Finally, the tendency of organizations to resist uncertainty and to negotiate environments of certainty whenever possible leads them to use standard scenarios to describe uncertain futures, and it leads them to form agreements and coalitions with industry to stabilize their environment. The use of standard scenarios allows them to control information concerning threats, roles, missions, and capabilities, and therefore the need for a given weapons program or other defense instrument. The agreements with industry result in contracts that cannot easily be broken and additional stakeholders who will fight to maintain or increase weapons programs (including fighting via lobbyists in Congress). All of these factors combined result in millions of dollars of

pork spending each year, driving up the cost of essential defense programs and resulting in the creation of non-essential ones.

Section 6: Conclusion

This chapter has outlined the various factors that can result in the cost growth of ships in the design phase. In the next chapters, these theories will be applied to the DDG 1000 next-generation destroyer in order to identify which theories (if any) contributed to the various stages of development of this ship.

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Chapter 4: The DDG 1000

Section 1: Introduction

In any ship procurement program, there are three fundamental issues that must be resolved in order to actually achieve delivery of the new system: (1) that a need for a new ship exists; (2) what the capabilities and characteristics of that ship will be; and (3) how the ship will be procured. This chapter will examine each of the questions above with respect to DDG 1000 procurement through the lenses of each theory from Chapter 3 in order to demonstrate how those theories affected the ultimate decision made. In the end analysis, several of the theories interacted to generate the decision reached in each of the three issues. However, in all three cases one force can be identified that dominated the others. In deciding whether or not to design and procure a new ship type at all, strategic requirements evidently dominated the decision. On the other hand, bureaucratic politics appear to have shaped the design of that ship. Finally, the procurement strategy seemed to be influenced most by Congressional pork-barrel politics.

Section 2: The Decision to Design a New Class

What eventually became the DDG 1000 program began in 1994 under the SC-21 program as the DD-21. SC-21 was meant to develop a new family of ships that would transform the surface Navy as it entered the 21st Century. The DD-21 was to be the first ship of this family as a multi-mission platform with specific capabilities for advanced

land attack and battlespace dominance in the littorals.[74] Advanced land attack refers to an improved capability to strike ground targets with ordnance (missiles or artillery) launched from the sea. Battlespace dominance in the littorals is the ability to gain access to, and control littoral, or coastal, waters. The traditional blue-water Navy was not specifically designed for, nor exceptionally capable of this dominance. In 2001, with the arrival of the new Bush Administration, the DD-21 program was cancelled as a remnant of the Clinton Administration. Immediately thereafter the DD(X) program was initiated, but was, for all intents and purposes, a continuation of the earlier work.

2.1: The Rational Actor

The "rational actor model" explanation for the decision to design and build a new ship type grew largely out of the situation described by the Background chapter above. It hinges on three main concepts: the need for ships, the changing strategic environment, and the United States' desire to maintain its military superiority.

First and foremost, the Navy clearly needs to have ships. Without any ships, the Navy would cease to exist, and the U.S. would be unable to wield power on, or project power from, the sea. The specific quantity of ships required depends significantly on national objectives. A Navy designed merely to protect home waters and shores needs fewer ships than a Navy designed to protect U.S. shipping around the world, which in turns requires fewer ships than a Navy designed to maintain a constant forward presence with a capacity to surge additional ships if a conflict arises. Other factors also affect the requirement for the number of ships in the Fleet, such as deployment cycles (to allow for

[74] John F. Schank, et. al., *Acquisition and Competition Strategy Options for the DD(X)* (Santa Monica, CA: RAND Corporation, 2006), iii, 1.

maintenance and upkeep of ships), and personnel management systems (such as Sea Swap – see Background chapter). The Navy currently says that it needs to sustain a Fleet of 313 ships, including 143 surface combatants (of which 55 are the smaller LCSs).[75] Though there were several changes in the interim, the stated requirement in 1995 just after the start of the DD-21 program was similar to today's.[76] Because ships age and eventually can no longer function, even with overhauls and modernizations to upgrade weapons systems (which are themselves very expensive), the Navy must constantly build ships to ensure that it will still have a fleet in the future. For example, assuming that ships last an average of 35 years before they are decommissioned, the Navy must build an average of just over four ships per year to maintain a steady-state surface fleet of 143 ships. In order to prevent bloc obsolescence – the wholesale aging of a large portion of the fleet during a period of a few years – and to avoid large variations in the Fleet from year to year, the Navy should try to procure ships as evenly as possible. In other words, using the example above, the Navy should try to procure four ships every year, rather than procuring eight ships one year and none the next. However, it should be noted that this is simply a strategic argument for why the Navy needs to procure ships at all, even when its current fleet is adequate to meet the current threat environment. Based on this argument, one could surmise only that the Navy at the end of the Cold War should have merely continued building ships. The ships chosen could have been the Arleigh Burke-class which, even today, has open production lines.

The second factor that influenced the decision to begin designing a new ship, under the rational actor model, was the changing strategic environment. All of the

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[75] U.S. Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2007* (Washington, D.C., February 7, 2006).
[76] Labs, 8.

existing ship classes in the Navy's Fleet (to this day) were designed during the Cold War to counter the immense Soviet Navy on the open ocean and establish control of the seas. With the collapse of this threat, no Navy that could realistically challenge the U.S. existed. Thus, the purpose for which these ships were designed no longer existed. This is not to say that these ships couldn't be adapted for other missions, especially since each of them was a multi-mission platform with many capabilities. However, they were probably not the most efficient way to meet the new threat environment, and they may lack certain capabilities that would significantly enhance their performance in the new environment because fighting on the open ocean is so different from operating in the littorals. On the open ocean, a ship's freedom of movement is restricted only by tactics and the enemy's movements, while in coastal areas it is constrained by these factors in addition to land mass and water depth (which is much shallower). Additionally, the open ocean has very little that can reflect radar other than other ships, and air traffic is very low, so radar pictures are relatively clear, even those looking near the surface of the water. This makes it easy to pick up other ships and low-flying planes. On the other hand, in littoral areas, land itself and a much higher frequency of air traffic makes radar pictures more confusing, especially those looking for other ships and low-flying aircraft. These factors played a role in the *Vincennes* incident, discussed in the Background chapter, in which a cruiser fired on a commercial aircraft it mistook for a fighter. Thus a shallow-draft ship with advanced computer systems and radar to see through the littoral clutter would be better suited to operate in littoral areas than a deep-draft ship without those features. It is certainly logical to conclude that a Fleet of ships optimized to battle another superpower's Navy on the high seas would not be the most efficient or effective way to

gain access to a regional power's denied littoral area. Thus, new ship classes were justified.

The third and final facet of the rational actor model as applied to this decision relates to the U.S. objective to maintain its global military dominance. There is a fear among military strategists that being the only remaining superpower will allow the U.S. to become complacent in its superiority. While the U.S. is resting on its laurels, another power could develop a new way of waging war through a Revolution in Military Affairs (RMA) that could displace the U.S. from its position of dominance. In order to defend against such a contingency, RMA advocates argue that the U.S. needs actively to seek out ways to improve and transform all branches of its military so that it can effect the next RMA itself. This, along with the desire to maintain or improve the military's effectiveness while lowering its cost in the budget-constrained environments of the post-Cold War era is the motivation behind the RMA/transformation drive that started under President Clinton and has been especially championed by the current Administration.

However, the Navy recognized the need for that transformation even earlier, when it found itself with a big, powerful Fleet and no adversary in sight. The SC-21 program was specifically designed to "transform America's surface combatant fleet." In addition to the objectives described above, it was supposed to take advantage of advances in information technology for automation and "disseminating information to widely dispersed and dissimilar units"[77] – in other words to begin to implement network-centric warfare (NCW), a central tenet of transformation. Thus the need for continual ship construction, a changing strategic environment, and the maintenance of U.S. supremacy were all factors in the decision that a new surface combatant ship was necessary at the

[77] Schank, et. al., 1.

end of the Cold War. After an analysis of this decision through the lenses of each of the other theories, it will be demonstrated that this theory appeared to predominate.

2.2: Bureaucratic Politics

Bureaucratic politics have always played a role in decisions about the Navy's ships. The Navy is one of four military services that compete for budget share and power within the DoD. And within the Navy, powerful communities, including the aviation, submarine, and nuclear communities, in addition to the surface community, have had to vie for power and budget. In the early 1990s bureaucratic politics clearly influenced the decision to design a new ship for the surface Navy, which was complicated in 2001 by the increased involvement of the Office of the Secretary of Defense (OSD). The primary bureaucratic actor is the Navy's surface warfare community itself. Without a superpower adversary to counter, the surface community might have found itself largely without a purpose in the immediate post-Cold War environment. In order to ensure that it did not lose its share of the budget, admirals, people, or power within the Navy, jeopardizing its livelihood, the surface navy needed a new mission to justify its existence.[78] The surface force found that new mission by apparently allying with the Marine Corps, which wanted an increased capability for naval surface fire support (NSFS).[79] NSFS is essentially artillery and missile support for ground operations from ships stationed in coastal waters near the ground theater. At the time of this alliance, due to its success in the first Gulf War, the Marine Corps had just recently grown in prestige and stature within the

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[78] Pasztor, "Mismanagement, Budget Cuts, Doubts Over Role Have Navy Sailing Against the Wind in Congress."
[79] Sean O'Keefe et. al., "...From the Sea," *Navy News Service* (October 6, 1992). John H. Dalton et. al., "Forward...From the Sea, " *Navy News Service* (November 9, 1994).

Department of the Navy, forcing the Navy to accept it as more of an equal partner. Additionally, the acceptance of land attack as a primary mission is suggestive of the Navy's concern for self-preservation at the time. Land attack has never been a particularly desirable mission for surface officers,[80] who have traditionally favored large battleships and engagements at sea, so their adoption of it as a central mission is telling of their need to secure the Navy's future. Regarding land attack capability, generally speaking, existing surface combatants have extensive missile capability in their VLS cells to support ground forces at long range, and they have five inch guns that can fire to a range of 13 nautical miles. The Marines wanted a platform that had larger guns to offer increased fire support (i.e. bigger rounds at longer range with higher frequency), and some capability to support V-22s (in design at the time) as they transferred troops from ships off shore to the battlefield, which would require an intermediate range (up to 200nm) missile. The V-22 Osprey was, at the time, a new type of aircraft known as a tilt-rotor. The V-22 could take off like a helicopter, but rotate its rotors 90 degrees forward to fly forward like a fixed-wing aircraft. This technology was supposed to allow it to have the vertical take-off capability of a helicopter, with the speed and range of a fixed-wing transport. The Marine Corp's image of its future centered around this craft and the tactical maneuvers it would allow, so it was the USMC's favorite, most protected program. As a result of the Marines' requirement, the surface warfare community took on this mantle of land attack and littoral operations (to get in close enough to use their NSFS capability). In order to meet that need, they argued that they needed a new ship type with the proper capabilities to execute this mission.

[80] Civilian employee of DD(X) Program Office, interview by author, telephone communication, Boston, MA, February 27, 2006.

The surface navy's desire for survival was reinforced in 2001 by the Bush Administration and Defense Department's push for transformation. This push forced leaders in all branches of the military to generate new weapons, systems, and ideas in order to show that they were being transformational. At the very least, it pushed those leaders to claim that their systems were transformational to justify their continued existence. This created an environment ideal for the creation of new ship classes, adding cover to the surface community's drive for a new type of ship. While these bureaucratic justifications for the decision to design and construct a new class of surface combatant are valid and certainly played a role, in this case the strategic/rational actor explanation is legitimate and therefore more powerful.

2.3: Industry Forces

The motivation from the contractors for a new ship type is not very compelling. The prime shipbuilders need a steady supply of ship construction work in order to stay in business. Large variations in the number of ships procured each year affect shipbuilders very negatively – sudden increases force them to expand capacity, resulting in greater overhead and higher costs when later procurement is reduced. These shifts also force ship contractors to hire and fire shipyard labor year-to year. Long enough periods with little or no ship construction contracts will force shipbuilders out of business permanently.[81] Therefore, it seems logical to conclude that shipbuilders' primary objective is to secure ship contracts of any type, and preferably long-term contracts that will ensure their vitality for many years. Additionally, because most shipbuilding contracts award a fixed fee plus an incentive system for cost, schedule, and quality control to the contractor, and

[81] Schank, et. al., xvii, 71.

because most ship programs experience significant cost growth, there is little reason that a new ship type should be favored by the contractor over an existing ship type. Therefore, this argument is one for continuing to construct any type of ship, not for designing and constructing a new ship class.

2.4: Congressional Pork Barrel Politics

Finally, the pork barrel politics theory, like the one above concerning contractors, is not very compelling. Congress' primary motivation, because of the motivation of the Senators from Maine and Mississippi (where the two shipyards for surface combatants are located), is to keep work going and people employed in those two shipyards. Because, as explained above, the shipyards do not require new ships – they merely require a minimum level of some ships of any type – to stay in business, Congress probably played only a small part in the decision to begin design and construction of a new ship class.

Section 3: The Design of a New Class

Once the decision was made to design and build a new type of surface combatant, the relevant stakeholders had to decide what that ship would actually look like and what capabilities it would have. This "decision" is actually an amalgam of many smaller decisions: How big should it be? What sort of armament should it have? What type of hull? What type of sensors? The list goes on. SC-21, including the DD-21 ship, was initiated in 1994. As of March 2006, the start of fabrication of the first and second DD(X) hulls were both scheduled for sometime in FY 2007. This leaves about twelve years during which the design of the DD-21/DD(X)/DDG 1000 was created and modified many

times over. Many changes occurred in that time. The original concept of the DD-21, in 1993 before SC-21 was even officially created, described the ship as a "smaller, cheaper and more capable destroyer"[82] than the existing class of DDG 51 destroyers. Documents published with the initiation of SC-21 in 1994 described it as having an advanced level of land attack, multi-mission capability to meet forward presence requirements, littoral warfare capability, and self-defense against the threats of the 21st Century.[83] It was also supposed to take advantage of advances in information technology for automation and communication with other diverse, dispersed units. Today's DDG 1000 design is characterized by a 14,000 ton displacement, a reduced radar cross section 50 times smaller than that of the DDG 51 and quiet operation (as quiet as a Los Angeles class submarine) for increased stealth, 80 VLS cells, two 155mm Advanced Gun Systems (AGS) capable of firing the Long Range Land Attack Projectile (LRLAP) up to 97nm, and a magazine of 920 rounds for the AGS. It also has an improved radar system optimized for the near-land clutter environment and better electronics that give it better communications capability for NCW with other platforms, as well as allow it to have a reduced crew size of approximately 150 sailors.[84] Since personnel costs are the most expensive component of a ship's total life-cycle cost, reducing the crew size through technological innovations could significantly reduce the Navy's operating costs. One of the most significant changes from existing ship classes is the DDG 1000's integrated, all-electric power system. Instead of connecting gas turbine engines to a drive shaft via reduction gears, the DDG 1000 uses gas turbine generators to generate electricity, which

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[82] "Navy Considering Turn of the Century Destroyer," *Defense Daily* 179, no. 26 (May 7, 1993).
[83] Schank, et. al., 1.
[84] DD(X) Future Surface Combatant Program, Program Executive Office Ships, Naval Sea Systems Command, *DD(X) Media Roundtable* (June 30, 2005).

is then used to drive an electric motor to propel the ship. This system allows for a quieter and more flexible power system that could eventually provide the energy needs for future weapons systems such as rail guns or even lasers. Finally, the DDG 1000 has incorporated features such as Peripheral VLS[85] and automated fire suppression to increase ship survivability in combat. The differences between the DDG 1000 and the existing DDG 51 and CG 47 classes are summarized in Table 4.1, below.

Table 4.1: Comparison of Surface Combatant Capabilities.

	CG 47	DDG 51	DDG 1000
Displacement	9957 tons	9200 tons	14,264 tons
Draft	33 ft	31 ft	27.6 ft
Crew	364	323	150
Maximum Speed	30+ kts	31 kts	30 kts
Land Attack Armament	127 VLS Cells 2 Five-inch guns	96 VLS Cells 1 Five-inch gun	80 PVLS cells 2 AGS w/ 920 rnds

Source data: GlobalSecurity.org.

3.1: The Rational Actor

The rational actor model would predict that the DDG 1000's land attack, stealth, reduced manning, and information technology capabilities reflect genuine strategic requirements for the Navy and the United States in the future threat environment. The land attack capability will allow the Navy to support joint operations ashore in areas where access to land bases from which to launch those operations was denied or unavailable. Furthermore, the stealth capabilities, improved radar, VLS firepower, and increased survivability will allow the Zumwalt class to gain access to littoral regions being denied by enemy naval forces, as illustrated in Figure 4.1, in order to allow the

[85] PVLS describes VLS tubes located near the outer hull of the ship rather than clustered in the center of the ship so that a sympathetic explosion of a missile set off by an enemy hit will blow outward, rather than further damage ship systems.

joint campaign to launch in the first place. The integrated power system will allow the DDG 1000 to upgrade to new and better weapons systems as they become available. The DDG 1000's communications capabilities will allow it to become a more integrated part of a future networked force. All of these capabilities together will help to transform the Navy from a battlegroup-centric, blue-water Fleet to a network-centric, brown-water (littoral) Fleet. Finally, the reduced manning of the DDG 1000 will allow the Navy to reduce its costs, in line with post-Cold War budgetary requirements.

Figure 4.1: DDG 1000 Expanded Safe Operating Area

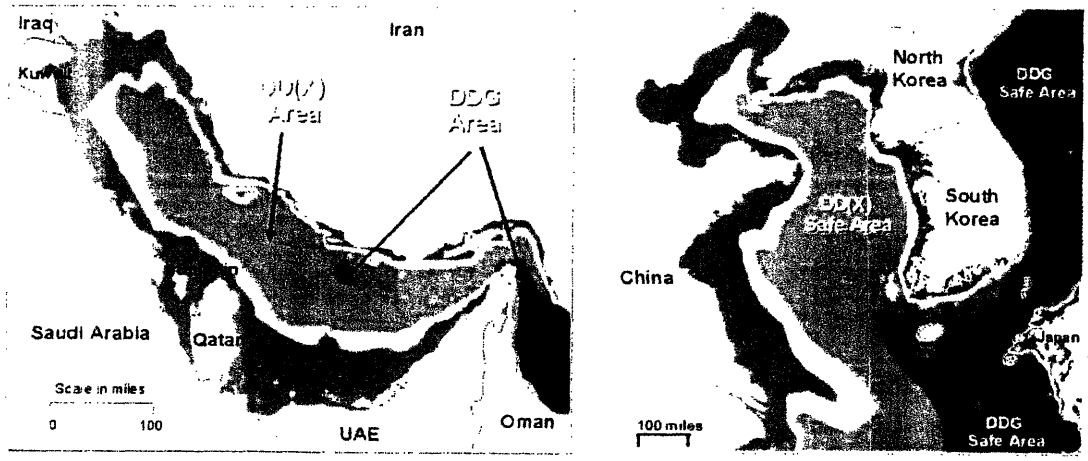

Figure 4.1: Because of its reduced Acoustic and Magnetic signature, the DDG 1000 (listed as the DD(X) in this figure) has a significantly expanded safe operating area in coastal waters.[86]

Several inconsistencies in the design of the DD-21/DD(X)/DDG 1000 cannot be explained by the rational actor model, however. First, the current design of the DDG 1000 does not take into account the limitations of the nation's current defense budget. With the close of the Cold War, the U.S. no longer required as large or expensive a military as it did during the Cold War, since it did not have a superpower adversary against which to fight. Therefore, procurement budgets began to shrink. The early

[86] This figure was taken from the June 30, 2005 *DD(X) Media Roundtable* presentation given by the DD(X) Future Surface Combatant Program.

documentation about the DD-21 reflected the need for a smaller, less expensive surface combatant (see above) in order to maintain the Navy's capability in this budget-limited environment, yet current DDG 1000 plans do not reflect this strategic requirement. The 14,000-ton DDG 1000 is over 50% larger than the DDG 51 destroyer or even the CG 47 cruiser. Worse, the estimated cost of the DDG 1000 has increased dramatically. 1996 plans called for a $1.06 billion target cost, and $1.23 billion (both in FY 2007 dollars) threshold cost (or maximum acceptable cost) for the fifth ship in the line. The Navy's current estimate for the fifth ship is $2.3 billion (FY 2007 dollars), while the Congressional Budget Office's probably more accurate estimate is $3.4 billion. For comparison, the average unit cost for the DDG 51 class is about $1.4 billion.[87] Thus the DDG 1000 has grown to be larger and cost more than the DDG 51, contrary to both the original program goals and the strategic environment in which it was born.

Furthermore, the capabilities of the DDG 1000 do not truly match the land attack requirements it is supposed to fulfill. The Marine Corps has a stated NSFS requirement for guns with a range of 41-63nm in the near-term, 63-97nm in the mid-term, and 97nm to the range limits of technology in the far term. In addition, it has a requirement for some sort of non-gun, non-cruise missile NSFS system with a range of 200-220nm. The 200nm number comes from the development of the V-22 and emerging Marine Corps amphibious tactics. Rather than establish a beachhead and move inland gradually, the Marines want the capability to use the V-22 to land far inland (up to 150nm from the amphibious lift ship that launched the V-22) to attack inland enemy installations directly. In order to accomplish this type of ship-to-objective maneuver (STOM) tactic, they require fire support to suppress enemy artillery up to 50nm from the V-22 landing zone,

[87] Gilmore, 4.

or 200nm from the ships off-shore, while the V-22s maneuver and land.[88] This latter requirement was originally supposed to be met by an adaptation of the Army's Tactical Missile system (ATACMS) called NTACMS. In the late 1990s, NTACMS was cancelled in favor of the Land Attack Standard Missile (LASM), which would have had similar capabilities. However, funding for the LASM was zeroed in the FY 2003 budget and never replaced with another system with the same capability. Thus though the DDG 1000 may be able to meet this demand in the future with the development of a rail gun weapon system, it currently cannot meet this fire support requirement, one of the critical requirements for which it was created. Additionally, while the Long Range Land Attack Projectile (LRLAP) in development for the DDG 1000's 155mm AGS guns does meet the mid-term requirement for gun range, a detailed examination of the system reveals that it will not meet the Marine's true needs. The LRLAP is essentially a rocket-assisted projectile with wings and a guidance system. As a result, it is relatively expensive at $100,000 per round. With the AGS's fire rate of 10 rounds per minute, each gun will expend $1 million per minute. Because of this cost, each DDG 1000 will carry only 70 LRLAP rounds in its over 900 round magazine, offering only seven minutes of long-range fire. There is also some question regarding the effectiveness of the size of the 155mm rounds for the needs of the USMC. Some critics believe that they are too small for the needs of the Marines and should be replaced with a larger diameter system.[89] While some strategic justifications for the design of the DDG 1000 can be made under the rational actor model, the inconsistencies highlighted above show that this model is insufficient to fully explain how the DDG 1000's features evolved.

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[88] Mike Milligan, "U.S. Marine Corps Naval Surface Fire Support Requirements," (Quantico, VA: Marine Corps Combat Development Command, 2002).
[89] William L. Stearman, "Marines Lose the Battleships' Firepower," *Marine Corps Gazette*, March 1, 2006.

3.2: Bureaucratic Politics

The bureaucratic politics forces in determining the characteristics of the DDG 1000 were significantly stronger than any other theory involved. In fact, the design of the Zumwalt seems a classic example of decisions determined by bureaucratic politics in which multiple actors have differing constraints and the resultant action is something that none of the actors precisely wanted or intended. In this case, the three main actors were the surface warfare community within the Navy, the Marine Corps, and the Office of the Secretary of Defense (OSD). A fourth and secondary actor was Congress for imposing budget restrictions on the program, though of course Congress cannot be held responsible for the fact that the U.S. has limited resources and cannot spend all of them on defense.

For a variety of reasons not examined here but including strategic requirements, a change of amphibious tactics, and a need to support the V-22 program, the Marine Corps established a need for an increased level of NSFS unavailable from existing surface ships. The details of that requirement are described in the previous subsection. Normally a request for improved land attack from the Navy might have fallen on deaf ears, as previously it was not a priority for the surface community or even the Navy as a whole, both of which focused more on open ocean engagements. However, changes in the strategic environment and the resulting concern in the surface warfare community over loss of prestige and budget share after the Cold War seems to have made this a very important bureaucratic force. The USMC's key requirements for the new surface ship included larger guns, an increased sustained rate of fire, and the ability to deliver fire support further inland than previously attainable (see above). The Marines also

maintained a requirement for 28 of these ships to provide enough support in multiple areas of the world if necessary.[90]

The Marines' NSFS requirement became significant because of concurrent changes in the surface warfare community that were also taking place. As described above, the surface warfare community after the end of the Cold War found itself without a clear mission to justify its existence, or at least to justify its hefty share of the Navy's budget.[91] The surface community also wanted large, multi-mission cruisers to command, much as it had during the Cold War. By apparently allying with the Marines to deliver a platform capable of getting close to enemy shores and providing increased ground support, they found a way to legitimize their bureaucratic motivations. Furthermore, the surface warfare community hoped that the design and construction of the DD-21, which itself was already larger than even the existing cruiser class, would allow for the spiral development of an even larger and more capable CG-21 cruiser class in the future.[92] In other words, the surface navy intended to apply the technology developed for the DD-21 to the design of the future CG-21. The surface navy's key conditions were for a large, multi-mission surface combatant that would ensure their survival as a powerful community for decades to come. However, they cared less about the specific land attack capabilities so long as they could continue to use some land attack capability to justify their efforts, and ultimately they cared the most about the eventual design and

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[90] Ibid.

[91] Budgetary information regarding the surface community's entire share of the Navy's budget (including personnel costs, operating and maintenance costs, research and development, etc...) was unavailable. However, for the purposes of illustrating the significance of the surface Navy's budget, it consumes 35% of the Navy's overall procurement budget. The author is very grateful to Eric J. Labs of the Congressional Budget Office for providing this information.

[92] "DDG-1000 Zumwalt / DD(X) Multi-Mission Surface Combatant" from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/systems/ship/dd-x.htm. "Program History" from Program Executive Office Ships – DDG-1000 (accessed April 12, 2006); available from http://peoships.crane.navy.mil/ddx/history.htm.

construction of the future CG-21 class.[93] As time went on, many of the technological improvements such as stealth, which would protect their sailors, and reduced manning, which would allow them to save in operating costs, also became important.

The third and final major bureaucratic actor in the decisions regarding the design of the DD(X) was the OSD under Secretary of Defense Donald Rumsfeld, whose effects were felt after 2001 when the administration took office. From the very beginning of President Bush's first term, Defense Secretary Rumsfeld pushed for military transformation, as described in detail earlier. Much of that transformation was a push to make the military smaller, faster, and cheaper, and to dramatically change the way it organized itself and operated. Based on President Bush's rhetoric during the 2000 election campaign[94] and on statements made by Secretary Rumsfeld just after taking office,[95] some observers assumed that the entire DD-21 program, along with several other ongoing defense programs, seemed in jeopardy. Nevertheless, the leaders of the program were able to convince OSD that through a variety of different methods, they had achieved a sufficient level of innovation in the design of DD-21 to describe the program as transformational.[96] As a result, it was saved, modified slightly, and renamed DD(X). However, the newly named DD(X) was still in many ways simply the next generation of the existing large, multi-mission surface combatants, and so limits were placed on it by OSD. One of those key limitations was on its size. Since the Administration had such a keen focus on making military platforms smaller and faster, the large size of the DD(X) was troubling to OSD. OSD specifically put displacement caps on the DD(X), and as it

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[93] Civilian employee in the DD(X) program office, February 27, 2006.
[94] George W. Bush, "A Period of Consequences" (speech given to the students of The Citadel, The Citadel, South Carolina, September 23, 1999).
[95] Robert Burns, "Bush Mulls Pentagon, Nuclear Arsenal Cuts," *Athens News*, February 10, 2001.
[96] Civilian employee in the DD(X) program office, February 27, 2006.

started to increase beyond those caps, Deputy Secretary Wolfowitz went so far as to threaten to cancel the program altogether. Compromises were reached between OSD, the DD(X) program office, and the Assistant Secretary of the Navy for Research, Development, and Acquisition, John J. Young, and the current 14,000 ton displacement has been approved.[97] Thus, OSD's key objectives were that the new platform meet its understanding of transformational systems, or in other words: smaller, network-centric, and incorporating new operational procedures.

Each of these factors can be seen to have played a role in the ultimate design of the DDG 1000. The Marines' requirements for increased fire support and OSD's requirement for decreased size are, for all intents and purposes, at odds with one another. The two AGS guns and the large magazine required for sustained high-volume fires were the most important factors affecting the size of the DDG 1000. As an illustration of this point, many analysts have suggested putting the DDG 1000's technology on the DDG 51 class. However, the DDG 51 could support only a single AGS and a magazine of only 100-150 rounds (10-15 minutes of sustained fire), and would require the removal of the existing five-inch gun and VLS cells.[98] The DD(X)'s size could not be decreased while the ship maintained the same capability for firepower. To increase the firepower of the DD(X), by either adding other systems or by increasing the size of the guns itself would require an even larger ship. Such a concept was infeasible, given OSD's emphasis on constraining the ship's displacement. Since the surface Navy's primary concerns were the construction of a multi-mission platform that could serve as a stepping stone to a larger cruiser class, they simply wanted to ensure that they could justify this ship (using the land

[97] Ibid.
[98] *DD(X) Media Roundtable*, 19.

attack rationale), and that it wouldn't be terminated by OSD. That meant watering down (but not eliminating) its land-attack capabilities in order to keep its size as low as possible, and maintaining the technologies that could be deemed transformational – its electric drive, reduced radar cross section, and reduced manning systems, all of which have significantly increased its cost. The result is what the Navy has today: a multimission combatant that is larger than OSD really wanted, with a limited land attack capability inadequate to meet stated USMC requirements, and many advanced technological systems that can be used to justify it as transformational, but which have also driven up its cost substantially. Not only do the capabilities of each individual DD(X) not meet any actor's original requirements, but the cost of the DD(X) is so high, in fact, that the Navy currently states it plans to procure 8-12 of the ships[99] (compared with 32 at the beginning of DD-21[100] and 24 with the switch to DD(X)[101]), with some analysts estimating that this number may be as low as 5.[102] Thus, the size of the entire program cannot meet any actor's original objectives. The Marine Corps wanted 28 of these ships, the Navy wanted enough to replace the existing ships in its fleet that would be retiring in the early 21st Century, and 5 (or even 8-12) ships out of a current Fleet of just under 120 surface combatants[103] can hardly be expected to "transform" that Fleet, thus failing to meet OSD's objective. The design of the DD(X) was, therefore, clearly influenced most by a combination of bureaucratic forces that resulted in a ship that could not meet anyone's original objectives.

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[99] Schank, et. al., 67.
[100] "DD-21 Zumwalt – Program" from GlobalSecurity.org (accessed April 12, 2006); available from http://www.globalsecurity.org/military/systems/ship/dd-21-prog.htm.
[101] Weiner, Tim, "Navy of Tomorrow, Mired in Yesterday's Politics," *The New York Times*, April 19, 2005.
[102] Ibid.
[103] Labs, xvi.

3.3: Industry Forces

Industry forces played a larger role in deciding on the design of the DD(X) than they did in the decision to procure a new ship at all, but they were still less significant than the bureaucratic forces explained above. The largest effect that industry forces had on the development of the DD(X) was a contribution to the cost growth of the ship. Because the procurement of this ship was quite simply the livelihood of Bath Iron Works (BIW) in Maine and extremely important if not quite as critical to Ingalls Shipbuilding in Mississippi,[104] both shipbuilders were willing to make huge promises to ensure themselves a piece of the construction. Other contractors were willing to make similar promises regarding ship subsystems in order to reserve some part of this lucrative future project. In some cases this meant promising technology that might or might not actually be deliverable on schedule, as in the case of the permanent magnet motor originally intended to be the propulsion system for the DD(X). In other cases it meant promising that it could produce systems at costs that were not at all realistic in order to secure contracts.[105] The original design for DD-21 was produced by competition between two industry teams: the Gold team led by Ingalls, and the Blue team led by BIW. Since the cost objectives for the program were well-known at the time, it is not surprising that the cost proposals submitted from each team were almost identical, showing that each was driven more to come in under the Navy's cost goals than to perform a realistic cost

[104] Schank, et. al., 71.
[105] Weiner.

analysis.[106] The result of these promises was part of the 200-300% cost increase observed as the original cost estimates gradually met reality.[107]

3.4: Pork Barrel Politics

Congress appears to have played a very limited role in the decisions surrounding the specific design of the DD-21/DD(X)/DDG 1000. While individual Congressmen/women and Senators most likely were involved to support the contractors from their home districts/States, specific instances where this occurred were not apparent. On the other hand, as will be illustrated below, Congress played an immense role in determining how the ship and its various subsystems would be procured.

Section 4: Acquisition Strategy

Procuring a weapons system as complicated as a large surface combatant is not a simple matter of signing a contract with a shipbuilder to deliver a certain number of ships of a certain specification at a particular schedule. Instead, the process is complex and lengthy, taking years to complete (the DDG 1000 program has existed for over 12 years and has not even started construction on a single ship!), and involving countless different companies to deliver the various parts of the ship, all of which must be integrated to produce the final product. Typically, naval ships have been procured by the Navy contracting individually with each of the major firms involved and the program office within the Navy functioning as the overall system integrator.[108] With regard to surface ship procurement, because the Navy has a stated objective of maintaining the industrial

[106] Civilian employee in the DD(X) program office, February 27, 2006.
[107] Gilmore.
[108] Schank et. al., 49.

base for surface combatants by keeping both BIW and Ingalls in business,[109] this contracting process generally involved a contract with each shipbuilder for some percentage of the total ships to be procured, plus a contract with a warfare system provider such as Raytheon or Lockheed Martin. However, from the beginning, the DD-21 was intended to be done somewhat differently. As described in the Background section, from the beginning of the current generation of surface combatants with the procurement of the DD-963 until now, each new class had either a new hull, or a whole new warfare system, but not both. The warfare system integrates all of the separate systems – sensors such as radar and sonar, human interface control systems, weapons launch systems, damage suppression systems – into one coordinated system so that all aspects of the ship can be used in concert with one another. Not only was the DD-21 intended to have both an entirely new hull and a new warfare system, but it was also an objective of the program office to incorporate significant innovation into the design – innovation that it was felt could not be generated by a non-competitive, governmental program office with no incentive to try new ideas.[110] This desire for innovation led to the creation of the competition in which the design of the ship was produced from very basic preliminary constraints by teams comprised entirely of private companies. The winner of this competition would become the design agent for the detail design phase of the program, and would eventually become the prime contractor to the Navy responsible for total ship integration, with the requirement that it split work between both shipyards to keep them both in business. Northrop Grumman Ship Systems (NGSS), which had bought Ingalls Shipbuilding, won the design competition and took the lead on the detailed design, with

[109] Ibid, xiv.
[110] Civilian employee in the DD(X) program office, February 27, 2006.

the consultation of BIW and the other companies from the Blue team. It would have also become the prime contractor responsible for ship integration if budget constraints had not intervened.

During the process of developing the budget for FY 2005 and FY2006, constraints and rising costs forced the Navy to cut back its planned procurement from 16-24 to just 8-12 ships. This had two effects on the procurement strategy. First, it caused the Navy to request to hold a second competition to pick a single shipbuilder to deliver the entire line of DD(X) ships as procuring such a small number of ships from two contractors would cost approximately $300 million more per ship. OSD postponed approval of this strategy until the issue could be more closely examined. In order to continue work on the combat systems and software development while the potential competition was explored more closely, OSD authorized the Navy to separate the contract for the combat system from the contract for the lead ship procurement, which left no single commercial entity responsible for delivery of the entire ship. This change meant that the program office would have to assume that role. Regarding the possible winner-take-all acquisition plan, Congress intervened before OSD had a chance to render a decision. In the FY 2005 Emergency Supplemental Appropriation Act, Congress explicitly prohibited the use of a "winner-take-all" strategy in the procurement of the DD(X).[111] The Navy, complying with this statutory requirement, developed another strategy that would award dual sole-source contracts to BIW and NGSS for construction of two lead ships to be started at the same time, with another competition to be held to award production of the remaining ships to a single shipyard.[112]

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[111] U.S. Congress, *FY 2005 Emergency Supplemental Appropriation Act.*
[112] Schank et. al., 67-71.

4.1: The Rational Actor

Virtually no argument can be made that this procurement plan was determined by the rational actor model. Under that model, national interest would suggest that the ship be produced in the most cost-efficient manner. The current dual source plan is certainly not the most cost-efficient. First, constructing a single type of ship in two different yards is always more expensive than doing so in a single yard. The same number of ships must split the overhead costs of two administrative apparatuses instead of just one, and in cases such as this, when neither shipyard will be working at capacity, those overhead costs, designed for more ships, must be split between fewer. One using a rational actor rationale to explain the DDG 1000 plan could argue that it is in the national interest to maintain both shipbuilders to preserve the industry. This argument would say that having two shipbuilders allows for some competition between them, keeping costs below what would be extremely high costs in a monopolistic scenario. In addition, by maintaining two shipbuilders, the nation in effect has an insurance policy against natural disasters and acts of terrorism in that an event at either shipyard would not destroy the nation's shipbuilding capacity entirely.

However, this argument is seriously flawed. First, there is little evidence to suggest that the costs incurred with a monopolistic shipyard would be significantly higher than those incurred with two shipyards and a public policy of keeping both shipyards open. With two shipyards, the Navy must pay twice the amount of overhead, as well as additional overhead because neither yard is producing at its capacity. Because the Navy has a stated policy with the intention of keeping both shipyards open, it cannot force them

to engage in true competition with each other, because each knows that even if it loses, it will not go out of business. Essentially the Navy is preserving an option to engage in competition at a single instance in the future, but never exercising it. Furthermore, by increasing government interaction with and regulation of a single shipyard, it should be able to prevent the extremely high costs normally associated with monopolies. Such a system is not without precedent, as aircraft carriers are currently procured from a single shipyard. Moreover, the Navy would not have to procure surface combatants from a single shipyard as there are currently six major shipyards whose operations could be diversified to include the construction of surface ships. Finally, in this case the total procurement of DDG 1000s is so small that it is unclear if, when split between two shipyards, it can actually fully support both.

Even if it were the case that it is in the nation's interest to preserve two surface ship-constructing shipyards, however, the timing of the lead ship construction does not make any sense. Construction of the lead ship of a class is always more expensive than construction of follow-on ships. The effects of learning curves on a task as immense as construction of a 14,000-ton warship are highly significant. When two shipyards are used to procure a single type of ship, it is preferable to begin the second ship well after the first so that the lessons learned from construction of the first ship can be applied to the second. Even then, because this knowledge must be shared across company lines and across great distances, the first ship at the second shipyard is still significantly more expensive than subsequent ships. By synchronizing the start dates, however, absolutely no cost savings can be made from learning curve effects, and subcontractors must supply twice as many

parts (e.g. turbine generators, motors, etc...) at the same time. Clearly, the rational actor theory played little to no role in the procurement strategy of the DDG 1000.

4.2: Bureaucratic Politics

Similarly, bureaucratic politics seem to have played a very limited role in the procurement strategy for the DDG 1000. The only true bureaucratic actor that had any effect in this decision was the Navy,[113] which was essentially trying to follow a rational strategy of procurement: when there were enough ships to justify splitting the work between both shipyards, it did so in order to preserve both shipyards; when there no longer were, it tried to procure the ships as efficiently as possible. One could also argue that the resultant strategy came out of a combination of the Navy's proposed strategy after the perception of the budget constraints, and Congress' action prohibiting a winner-take-all strategy. While this is true, since it is really just the Navy following Congress' orders (as it is required to do), it is hardly an interesting bureaucratic politics result. Congress' action on its own was a much more powerful force in this decision.

4.3: Industry Forces

From the very beginning of the DD-21 program, the shipbuilding industry acted to ensure that neither surface combatant shipbuilder would be put out of business by a lack of DD(X) contracts. When the Navy initially requested the formation of industry teams to propose competing DD-21 designs, BIW and Ingalls Shipbuilding initially combined on a team to try to prevent the Navy from successfully achieving any level of

[113] One could argue that OSD was another actor in this decision, but as it simply approved one aspect of the decision (splitting the combat system from the ship delivery), and was preempted by Congress before it could affect the decision on how to allocate the ships, it had no noticeable effect on the outcome.

competition.[114] The Navy subsequently split that team and did manage to have a design competition, but the point remains that the industry not only actively tried to ensure its survival, but two firms that should have been competitors collaborated on this project. The DDG 1000 would represent the major business to both in the period after the procurement of the DDG 51 class is finished. Therefore, the survival during that period of each shipbuilder depends on the DDG 1000. As a result, the possibility of not getting a share of the DDG 1000 business was much more of a threat to both than the possible reward of getting all the business was to either. Even so, industry forces played a role in this decision only in so far as each shipbuilder undoubtedly lobbied its congressional representatives to ensure that it was not put out of business by a failure to receive a share of the DDG 1000 construction. Since this is a fundamental part of the theory of pork barrel politics as explained in Chapter 3, it is another insignificant effect when compared to Congressional forces.

4.4: Pork Barrel Politics

Finally, the procurement strategy is a classic example of pork barrel politics. The allocation of ships to each shipyard by a Congressional mandate to keep both yards alive is clearly the result of individual members of Congress representing the concentrated interests of their home districts/States over the diffuse interests of the nation as a whole for an efficient defense apparatus.

That one action is not, however, the full extent of Congressional involvement in the procurement process for the DDG 1000. In fact, Congress was involved at many

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[114] "Ingalls, Bath Iron Works to Team Up in Bidding for New Warship," *Associated Press Newswires* (December 4, 1997).

different stages in even detailed aspects of the acquisition strategy. For example, one of the major new technological components of the DDG 1000 is its propulsion system. Instead of using gas turbine engines connected to a reduction gear to turn the shaft connected to the propeller directly, the DDG 1000 is designed to have an all-electric power system in which gas turbine generators will generate electricity which will power an electric motor. There were two options for what type of generator to procure for the DDG 1000: a British-built, Rolls-Royce gas turbine, or the American-built, General Electric LM-6000. These two engines were going to compete against one another to determine which would be used on the DDG 1000. At the time, the Rolls-Royce engine was already a genset in that the gas turbine engine was already modified to be attached to a generator to produce electricity while the LM-6000 was not. However, General Electric did not want to spend the money necessary to develop the LM-6000 as a genset or to meet the Navy requirements for such an engine, so GE went to Congress for assistance. As a result, Congress appropriated a significant amount of money to develop the LM-6000 as a genset so that it could reasonably compete with the Rolls-Royce.[115] Such an appropriation clearly benefits the managers and workers of the General Electric factories where the LM-6000 is produced, while doing a disservice to the U.S. citizenry at large by spending money that could have been saved had the British engine simply been purchased. These smaller examples of Congressional involvement in purchasing decisions, combined with the major decision to force the DDG 1000 construction to go to two yards make pork barrel politics the primary force in the decisions regarding how to actually buy the DDG 1000.

[115] Civilian employee in the DD(X) program office, March 27, 2006.

Section 5: Conclusion

The decision to design and build any major weapons system is a huge undertaking unlike any normal consumer purchase in the civilian world. Naval warships have their own intricacies that must be managed in order to achieve successful delivery of a working warship ready to go into battle. There are many different forces that interact in the various stages of this long process that spans many years. In the case of the DDG 1000 program, the decision to design a new type of ship class was driven primarily by strategic concerns under the rational actor model. On the other hand, the actual design of that ship was determined predominantly by the complex interplay of bureaucratic politics. Finally, the decisions on how to purchase the designed ship were affected most by Congressional action and pork barrel politics.

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Chapter 5: Recommendations

The DD-21 program began as the Navy's response to the changing international strategic and domestic budgetary environments in the aftermath of the Cold War. Without a large, blue-water enemy navy to counter, the Navy, and the surface Navy in particular, needed to redefine itself and its mission in order to maintain its power and budget share in this new era. The Navy seemed to attempt to do that by allying with the Marine Corps and providing an enhanced land attack and littoral capability. The DDG 1000 was originally designed to fulfill that purpose of redefining the Navy. However, over the past 12 years, its capabilities, weight, and cost have grown to the point where the Navy cannot procure it in a large enough quantity to fulfill any of its original objectives.

The problems faced by the DDG 1000 will not only affect the Fleet in the near-term, but also have implications for the long-term future of naval ship procurement. In order to address the immediate problems faced by the DDG 1000, the Navy, the Defense Department, and the Congress should take the following actions:

- **Cancel serial production of the DDG 1000 and use it solely as a technology demonstration platform.**
- **Execute a winner-take-all strategy for procurement of the DDG 1000.**
- **Design and procure a smaller, cheaper frigate-class surface combatant to serve in the fleet of the 21st Century.**

In order to address the longer term problems of ship procurement implicated by the problems the DDG 1000 has encountered:

- **The Department of Defense should set up real competitions between branches of the Armed Forces and offices within those branches for the purpose of assigning funding.**
- **Congress should reduce the amount spent on pork barrel politics by reducing the excess shipbuilding capacity through the establishment of an independent commission for that purpose.**

The following sections explain each of these recommendations in more detail.

Recommendation 1: The Navy should cancel serial production of the DDG 1000 and use it solely as a technology demonstration platform.

The DDG 1000 was originally supposed to fulfill a growing need for increased naval surface fire support, while helping to transform the Navy into a smaller, cheaper, more networked fleet. However, it fails to accomplish these goals. The land attack capabilities on the DDG 1000, while an improvement over those of existing ship classes, are inadequate to meet the stated fire support requirements of the U.S. Marine Corps. The ship is not smaller and nimbler than existing ship classes. In fact it is over 50% larger! And it is certainly not cheaper, with some estimates of the DDG 1000's fifth ship cost at over 140% greater than the average unit cost of the DDG 51 class.

Even if this ship type could truly be considered transformational, since only about 5-8 DDG 1000s can actually be procured in the present budget environment, it would be unable to transform a fleet of surface combatants that currently numbers 100 ships. The ship has simply grown too expensive to be procured in numbers sufficient to significantly

affect the Navy's fleet architecture. However, the ship is not transformational in the first place. The DDG 1000 is simply the newest upgrade of the multi-mission surface combatants the Navy has been operating since 1975. It is about the same size, carries the same basic armament (dozens of VLS cells and about the same size cannon), and is capable of executing the same basic missions – AAW, ASW, ASUW – as, albeit a little better than, the Ticonderoga and Arleigh Burke-class warships. The main differences that distinguish the DDG 1000 from these earlier ships are its propulsion system, hull form, reduced manning systems, and improved mine warfare suite. But these can hardly be considered ship-defining differences that are going to revolutionize the way the Navy does business.

This discussion should not, however, diminish the impressive technological improvements that were made in the development of the DDG 1000. Its all-electric propulsion and stealth characteristics have significant potential implications for future surface and sub-surface ships alike. The reduced manning has potential to significantly decrease personnel costs, which are the highest cost factor in the lifecycle of a ship. Even the novel design scheme that was driven largely by industry may allow for important future innovations.

The current DDG 1000 design is simply too expensive for likely future budget environments. By adding features not truly justified by strategic needs, the Navy has made the ship too costly to be produced in any appreciable numbers. As discussed in the Background chapter, the U.S. does have a need for a surface Navy to maintain a forward presence and protect overseas trade under the grand strategy of primacy which is widely embraced and appears likely to drive military requirements for the foreseeable future.

However, it does not need a warship as large or elaborate as the Zumwalt, and moreover it is unwilling to spend sufficiently to pay for it. Therefore, the Navy should cut its losses while salvaging as much as possible from what was learned in the design of the DDG 1000. It should continue to produce 1-2 DDG 1000s in order to prove these impressive new technologies at sea for use on future platforms, but it should not continue to spend substantial sums of money on an overgrown ship that does not meet the original objectives for which it was designed.

Recommendation 2: Congress should allow, and the Navy should execute, a winner-take-all strategy for procurement of the DDG 1000.

Regardless of whether or not Recommendation 1 is implemented (i.e. whether or not serial production of the DDG 1000 is cancelled), the DDG 1000 should be procured from a single shipbuilder. A single sole-source contract would improve efficiency and significantly reduce costs over the small number of Zumwalts to be procured. For a purchase of 5-8 ships (if Recommendation 1 were not implemented), such a strategy could save over $300 million per ship.[116] Under Recommendation 1, per-ship savings could be even higher as costs drop off the most from the first to the second ship in a series.

This recommendation has the likely side-effect of putting either General Dynamics' Bath Iron Works or NGSS Ingalls Shipbuilding out of business, so it is likely to encounter substantial resistance from contractors and members of Congress in whose districts those shipyards lie. There are three main reasons why this recommendation

[116] Schank et.al., 68.

would be opposed, but none are particularly compelling. The first is pork barrel politics. Representatives and Senators from Maine and Mississippi would not want to see their constituents lose their jobs, so they would most likely oppose implementation of such a recommendation. However, such action would not be in the best interest of the nation as a whole, whose taxpayers will feel the cost of keeping both lines open.

The second reason is economic. Some have argued that moving from two shipbuilders to just one could result in skyrocketing prices by establishing a monopoly.[117] However, the situation the U.S. is currently in with two shipbuilders is little better, and any problems that could arise from a monopolistic contractor can be handled by improved regulation and coordination between the shipbuilder and the government. Furthermore, the U.S. is already in this situation with procurement of its aircraft carriers, which are only produced at a single shipyard, and yet it does not experience the kind of extremely high prices predicted by proponents of keeping both Bath and Ingalls open. With two shipbuilders, the Navy must pay double for twice as much overhead and for additional overhead because neither company is working at capacity. The Navy also does not receive as much in savings due to learning curves as it would with only one supplier. Finally, the Navy does not gain much from competition between two firms because its stated policy of keeping both firms open gives the firms little incentive to truly compete. At higher levels of procurement and spending, competition is beneficial, but with procurement budgets likely to flatten or even turn down, it does not make sense.

The final argument for keeping both shipbuilders open is strategic. Some will argue that closing one of the lines will make the shipbuilding industry fragile and vulnerable to either a natural disaster or an act of terrorism. Should the sole remaining

[117] William Matthews, "Monopoly Money," *Armed Forces Quarterly* (March 22, 2006).

shipbuilder be damaged by either of these events, the U.S. would lose its ability to produce surface combatants. This argument has two problems, however. First, even if one agrees that there is some benefit (in the form of insurance against such catastrophes) to keeping two shipbuilding lines open, there must be some limit to how much the U.S. is willing to pay for that benefit. $300 million per ship, or 8-13% of the cost of each ship seems an extremely high price to pay. Second, even if such a disaster did occur, the nation would not have truly lost its shipbuilding industry. In addition to Bath and Ingalls, there are four other shipbuilders that contract in different ways for the U.S. Navy: some produce aircraft carriers, some produce submarines, and some refit and upgrade existing ships. In a national crisis, surely one of these other shipyards would be able (at some significant cost, to be sure) to modify its operations to produce surface combatants in addition to its other outputs, especially considering that some of them have a history of producing surface combatants.

Despite pork, economic, and strategic reasons to the contrary, the U.S. should end its policy of assigning parts of the job to two shipbuilders simply to keep both in business, and award all procurement of the DDG 1000 to one contractor.

Recommendation 3: The Navy should design and procure a smaller, cheaper frigate-class surface combatant to serve in the fleet of the 21st Century.

The post-Cold War Navy faces no peer competitor that can challenge it on the open ocean. It simply does not need the same number of large surface ships optimized for blue water combat as it once did. Instead, it needs smaller, cheaper, shallow-draft ships

that can operate in and around enemy coastal waters, with enough firepower to provide fire support to amphibious operations ashore and to protect commercial shipping around the world. The Navy also needs ships in enough numbers to continue to maintain a forward global presence. The Navy should, therefore, design a new surface combatant with a real target cost of $800-900 million, one five-inch or AGS gun, and a reduced payload of missiles. 30-40 such ships could be produced under current budget conditions.

The Marine Corps' need for naval surface fire support is relatively simple: subject to the constraints discussed in Chapter 4, it mostly needs low-cost, high-volume fires to force the enemy to stay down while the Marines maneuver.[118] The DDG 1000 cannot meet this need. Under current plans, by procuring the DDG 1000 the Navy would obtain 10-14 AGS guns which would fire very expensive LRLAP projectiles. Since not all 5-8 DDG 1000s would be available for a given operation, the amount of fire support available would be further reduced. On the other hand, under this recommendation the Navy would procure 30-40 guns that could fire conventional and extended range munitions. By combining more of these ships together than available by procuring the DDG 1000, the Marines' fire support needs could be better met.

Additionally, the increased number of these ships would give the Navy more flexibility: they could be used individually to protect shipping and maintain a forward presence globally, or to conduct interdiction near U.S. waters. They could also be used combined with one another as described above to focus firepower. This recommendation offers the Navy a set of capabilities more in line with its strategic need, and at a more realistic cost, than the current plans for DDG 1000 procurement. It should be noted,

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[118] Robert Laurenzo, "SHOOT OFF; U.S. Navy Faces Fire Support Gap for the Marines," *Aviation Week & Space Technology* (March 27, 2006).

however, that there may be some overlap in capability with the Navy's plans for the littoral combat ship and that since the LCS is not analyzed here, this issue should be examined closely before proceeding with procurement of either ship. It might be possible to reduce the number of either or both ships to be procured.

Recommendation 4: Rather than establishing arbitrary constraints on new weapons systems, the Office of the Secretary of Defense should set up real competitions between branches of the Armed Forces and offices within those branches for the purpose of re-assigning roles and missions, and allocating resources.

The design of the DDG 1000 emerged from conflicting bureaucratic forces from the Navy, the Marine Corps, and OSD and resulted in a ship that could not really accomplish the objectives of any of those three actors. Rather than merely acting as a bureaucratic player itself, OSD should attempt to use the bureaucratic forces within and among the services to achieve the best strategic results at the lowest cost. It can implement this change by using real competitions between and within the services, and by effecting paradigm shifts within the services.

OSD's push for transformation has resulted in a set of requirements for what OSD "believes" the future of the military "should" look like, rather than a real set of strategic requirements that match the current global environment. As a result, OSD places arbitrary restrictions on the development of weapons programs, such as the size restriction on the DDG 1000. Though this constraint was motivated by an important consideration – that in today's fiscal environment ships need to be smaller and cheaper – it was promoted for the

wrong reason – military transformation. Instead, OSD should establish true competitions for roles and missions among the military services (when two services could perform the same mission), and within a given military service (when there are different ideas for how such a mission could be executed within a service). One example of the former are the various legs of the strategic nuclear triad: intercontinental ballistic missiles, bombers, and ballistic missile submarines. While there certainly is a place for each of these methods of delivery of nuclear weapons in the nuclear arsenal, it is not obvious that funding should be split equally or in another particular way among the three legs. A competition involving wargames, simulations and cost estimates with real consequences for budget authority, including real future consequences for a failure to meet promised capabilities and costs, could help determine how best to spend the nation's tax dollars.

Similarly, such competition could be used to determine the most effective means of land attack within the Navy: whether submarine-launched Tomahawks, close air support, or surface-based missiles and guns are the best. By directly linking strategic needs as well as realistic cost estimates to a service's, community's, or other military office's budget allocation, OSD can make those bureaucratic actors' natural interests work towards the nation's strategic interests. Of course, such a method can only work if a failure to meet either capabilities or cost estimates results in reduced credibility for future competitions, in order to prevent competitors from making promises they know they cannot keep.

At the same time, OSD needs to work to make real changes in the attitudes of the services to reflect the strategic environment of the post-Cold War era. One area in particular that needs to be adjusted is the mindset of surface warfare officers in the Navy.

Unfortunately, as discussed in Chapter 3, changing big bureaucracies is not easy, and changing military bureaucracies is particularly difficult. Stephen Rosen argued that change cannot be forced on the services, but rather that one must instill new ideas in young officers so that when they are promoted to positions of authority they will be able to implement changes. On the other hand, Barry Posen argued that change will never come from within the military and that it must be forced upon the services by strong civilian leadership. Regardless of which theory is more accurate, a strategy that takes both into account should meet with considerable success. Therefore, OSD should identify young surface officers and instill in them the importance of reducing the size and scope of the surface navy. Without a superpower's blue-water fleet to counter, the Navy no longer has a need for the large, multi-mission combatants of the Cold War. At the same time, the Secretary of Defense should enforce this change through direction from above, ship approvals, and budget authority.

Recommendation 5: Congress should reduce the effect of pork barrel politics by reducing the excess shipbuilding capacity through the establishment of an independent commission for that purpose.

A significant aspect of both the Navy's plans to develop and procure the DDG 1000 as well as Congress' intervention regarding the DDG 1000 procurement strategy hinged on the fact that there are only two shipyards in the U.S. with the capability to build surface combatants. Both the Navy (until DD(X) procurement numbers dropped) and Congress maintained a policy of keeping both shipyards open. Part of the motivation

for that policy seems to be highly political. Another part of the motivation, or at least part of the claimed motivation, was to maintain a healthy industry to promote competition and ensure survival of the industrial capacity in the event of a catastrophe at one shipyard. However, the claim that these shipyards are the only two which can produce surface combatants is not entirely accurate. In reality, the Navy contracts from six major shipyards throughout the United States. Three – the former NGSS Avondale Operations, NGSS Ingalls Operations, and Newport News – are subsidiaries of Northrop Grumman, and the other three – Electric Boat Company, Bath Ironworks, and the National Steel and Shipbuilding Company – are subsidiaries of General Dynamics. Together, these shipyards produce surface combatants, aircraft carriers, submarines, amphibious ships, and other auxiliary ships for the Navy and Coast Guard. While each has some degree of specialization for the type of ships they currently produce, many used to produce ships of a different type than they currently build. For example, Northrop Grumman's Newport News, which currently constructs nuclear-powered aircraft carriers and submarines, has historically produced battleships and cruisers.

The nation currently finds itself in a situation in which it is supporting the existence of six major shipyards without procuring a sufficient number of ships to justify their combined capacity. Though each produces a slightly different type of ship, at some level they are all engaged in the same business: building high-performance vessels for the U.S. Navy that are designed to go into combat. It is unclear why some of these shipyards cannot be closed down, with their tasks being transferred to newly diversified versions of the other shipyards. If this consolidation were to take place, and the surviving shipyards became sufficiently generally capable that they could compete with each other for

production of most if not all types of ships contracted by the Navy, the nation would find itself in a much better position. Currently, the nation is paying high prices to support six shipyards, many of which barely produce enough to keep themselves in business, each of which is certainly not working at capacity, and none of which is forced to truly compete for contracts. Through consolidation of work and a reduction in capacity, the nation would be able to fully support three or four healthy shipyards working at efficient capacity. Moreover, these shipyards could truly compete with one another for each shipbuilding contract, since no one contract would mean the life or death of a given yard. Though the companies that would be closed and the states in which those companies are located (where most of the companies are the largest private employers in the state) would suffer, the nation as a whole would be much better off. Furthermore, there is no reason why the nation should have to artificially support unnecessary industrial capacity. If there is no need for a given business, or it cannot compete, it should not exist.

Therefore, Congress should establish a system, analogous to the Base Realignment and Closure system, to consider and reduce the country's shipbuilding capacity. The Base Realignment and Closure (BRAC) system uses an independent commission, selected by the President with the advice of Congressional leaders, to make recommendations for closing and modifying military bases around the country. The list of closures and changes are given to the President who, if he approves the list, forwards it to Congress which then can vote on the list as a whole. Congress cannot modify any part of the base closure and realignment list – it can only approve or disapprove the list as a whole. If the President disapproves of the list, in whole or in part, he must convey his reasoning to Congress and to the commission, which would then submit a new list for his

approval. The purpose of this system is to isolate the process of closing bases from political forces, since individual Congressmen and Congresswomen are so invested in the bases in their districts that no real closures could happen in that political arena. In essence, Congress acted, through the creation of this system, to protect itself from its own pork barrel tendencies. By establishing a similar process to analyze shipbuilding capacity and allow the Navy to only use certain shipbuilders, Congress can save the country billions of dollars in procurement costs.