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Infrastructure Rationalization in the U.S. Naval Ship Industrial Base

Scot A. Arnold, Project Leader
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PREFACE

The Institute for Defense Analyses (IDA) prepared this paper for the Office of the Deputy Under Secretary of Defense (Industrial Policy) under a task titled "Industry Restructure and Rationalization." The task objective was to evaluate the consolidation and rationalization of the defense industrial base. "Rationalization" refers to the reduction of redundant infrastructure due to lower demand. This paper contributes to that objective by reporting the results of an examination of the cost and financial structure of the major shipyards for evidence of rationalization following a period of consolidation.

Kenton G. Fasana and David M. Tate of IDA were the technical reviewers for this paper. The authors would like to thank them and Jim Woolsey for their guidance and suggestions.

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A. OBJECTIVE

The Department of Defense is interested in the status of rationalization in the defense industrial base following the past 15 years of consolidation waves. "Rationalization" refers to the reduction of infrastructure that has become redundant in response to lower demand. "Infrastructure" can refer to physical assets or labor that does not freely fluctuate with production volume. The focus for this paper is the ship industrial base. IDA examined the cost and financial structure of the major shipyards for evidence of rationalization following the period of consolidation.

In the short run, the costs associated with infrastructure are viewed as fixed costs. In the past, IDA has looked for rationalization in the cost structure of the aircraft and missile sectors of the defense industrial base following their consolidations during the same period. These studies found mixed results: the missile sector rationalized with significant annual savings to the government, while the aircraft industry did not rationalize.

B. DEFENSE CONSOLIDATION AND RATIONALIZATION

The 1993 bottom-up review of the U.S. defense posture concluded that a restructured defense industry with fewer assets would be more responsive in the face of declining demand.[1] At this time, during a Pentagon dinner referred to as the "Last Supper," Deputy Secretary of Defense William J. Perry signaled to the industry that the Department would support consolidation.

The main goal behind the change in policy was to reduce the fixed overhead costs that had accumulated during the cold war. There were two mechanisms through which the Department could facilitate mergers: by supporting transactions through reviews conducted by the Federal Trade Commission and Department of Justice as a result of the Hart-Scott-Rodino Antitrust Improvements Act of 1976; and by allowing the post-merger company to recover restructuring costs. The Department allows contractor reimbursement for restructuring; however, prior to 1993, restructuring associated with novated (i.e., where the contractor entity changes) contracts was not reimbursable.[2] Under this system, contractors

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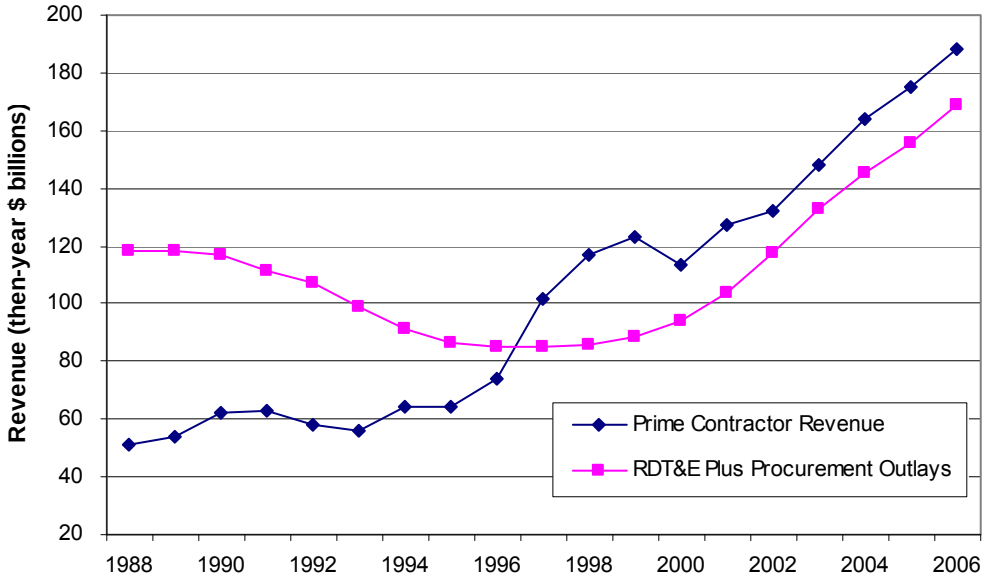
1 John M. Deutch, "Consolidation of the U.S. Defense Industrial Base—Opinion," *Acquisition Review Quarterly*, Fall 2001; and Kenneth Flamm, "Post-Cold War Policy and the U.S. Defense Industrial Base," *The Bridge*, Volume 35 (1), Spring 2005.

2 Karen L. Manos, *Government Contract Costs and Pricing*, Volume 2, Chapter 86, p. 249.

who cut fixed costs receive less revenue after the restructuring, since most operate under cost reimbursement contracts. To encourage mergers, reimbursement for novated contracts was added to the Federal Acquisition Regulation and was later termed "pay-offs for lay-offs."[3] Between 1993 and 1998, the number of contractors dropped precipitously.

In 1998, the government effectively reversed its policy, bringing a halt to mergers. At the same time, the government also revised its policy on novated contracts by requiring the Secretary of Defense to certify either that the restructuring savings to the government would be greater than 2:1 or that the savings would be substantial and the restructured entity would maintain critical capabilities. This dramatically raised the barrier towards recouping restructuring costs and effectively ended the government's encouragement of mergers.

Figure 1 shows the revenue for the top six defense contractors (Boeing, Lockheed Martin, Northrop Grumman, General Dynamics, Raytheon, and L-3 Communications) against the DOD outlays for research, development, test and evaluation (RDT&E) and procurement since 1988. The revenue line increases while the DOD spending line decreases through the early and mid-1990s because these companies are the survivors of the industry consolidation wave. After the consolidation wave, the top prime contractors' revenue increased almost lockstep with DOD expenditures.



Source: Compustat and DOD USD Comptroller.

Figure 1. Top Six Prime Contractors by Revenue Since 1988

3 While the government facilitated mergers, it also acted to prevent monopolies. For example, General Dynamics was prevented from buying Newport News and United Defense.

1. Mergers and Acquisition Basics

Aswath Damodaran identifies five strategies behind mergers and acquisitions:[4]

1. Acquiring an undervalued business
2. Diversification
3. Synergy
4. Value for control
5. Catering to managerial self-interest

With respect to strategy 1, the justification for buying an underpriced asset is clear, although it is by no means a sure bet since valuing a business is highly uncertain. General Dynamics was able to acquire two shipyards—Bath Iron Works and NASSCO—below book value at what in retrospect appears to be a relatively good price. Northrop paid considerably more for Newport News and Litton, although it is probably too soon to determine whether the price was too high.

With strategy 2, basic financial theory says that companies will not be rewarded for actions that reduce diversifiable risk, i.e., investors will not pay for an investment that diversifies itself when they can diversify their own portfolios more efficiently. For this reason, most conglomerates receive a valuation penalty. For defense contractors, however, diversifying by buying businesses that make different types of weapons systems—say, an aircraft manufacturer buying a shipbuilder—provides an efficient mechanism for reducing inter-contract risk. Inter-contract risk is the financial risk to the firm of losing any one contract. Since the government generally has a one-year purchasing horizon, inter-contract risk is a major source of earnings instability for defense contractors.[5] By increasing the number of different contracts and governmental agencies to which it sells products and services, the government can dramatically

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4 From a working version of Aswath Damodaran, *Damodaran on Valuation*, 2nd Edition, Wiley Finance, 2006. We discuss only the first three strategies in the context of defense industrial base consolidation. Strategy 4, value for control, refers to acquisitions where the buyer believes there is value in gaining control of the target's assets. For example, a cash-rich firm with few project ideas buys a cash-poor firm rich in potential projects. Strategy 5, managerial self-interest, applies to managements that display an almost irrational appetite to grow through acquisitions whether or not the acquisitions appear accretive to earnings.

5 From a defense contractor's perspective, inter-contract uncertainty is probably the most difficult risk to manage. Other risks: operational, liability, credit, market, and liquidity are significantly lower than other capital goods industries from the close relationship with the Defense Department.

improve its earnings stability. The large prime contractors are also adept at managing the acquisition relationship with the government, which implies some level of efficiency in their diversification strategy.

"Synergy," strategy 3, is what acquirers call the value accretion created through eliminating overlapping functions in the combined firm. The government was hoping it could benefit from the synergies that would be gained as the defense industrial base shrank to meet the lower demand of the foreseeable future. An important feature of synergy savings is that achieving them requires considerable management effort, investment, and risk—the strategy may not work. Synergy savings usually require an initial investment such as new technology or facilities, severance, asset disposal, and clean-up costs. The transitions involved are usually difficult, but they are necessary to justify the transaction costs and the premium the acquirer often pays for the target company.[6] Commercial companies often use rationalization of redundant fixed assets and labor to justify mergers, such as the 2002 merger of Hewlett-Packard and Compaq, which promised about $2–3 billion in synergistic cost savings.[7] Defense firms are no different from commercial firms in that they must provide additional value for shareholders to justify the acquisition expense.[8] In the case of defense industrial base consolidation, however, the government's requirement that it receive the synergy savings means that those savings cannot go to shareholders.

2. Possibility of Rationalization from Mergers and Acquisition

Before the 1993 regulation changes, if synergistic savings lowered cost-based revenue, and hence contractor profit, only the government gained.[9] This situation was clearly unacceptable to contractor shareholders. Investors would demand that rationalization benefits flow to shareholders first.

The government hoped that, with the policy changes, firms would consolidate, make the appropriate investments and asset write-downs, and get smaller. The

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6 The purchase premium to the target's book value is booked to the acquirer's goodwill account.

7 "H-P, Compaq Agree to $25 Billion Merger," CNN.com Business News, September 4, 2001 (available at http://archives.cnn.com/2001/BUSINESS/asia/09/04/hp.compaq/).

8 The expense includes transactions and restructuring costs plus the premium paid to acquire the target company.

9 Even in the pre–1993 environment, the contractor kept the savings temporarily, until forward pricing rate agreements were renegotiated, which could be 18 months or more.

government was prepared to pay for restructuring, such as severance payments and asset impairment expenses, in order to lower the ballooning overhead rates that resulted from lower procurement levels. The government expected contractors to be indifferent to slightly lower absolute profits if they recovered their restructuring costs and maintained their profit margin on a lower business base. The surviving contractors were expected to continue to show revenue and earnings growth while the overall industry declined in revenue.[10]

Presumably the government expected consolidation at the subsector level of the industrial base where competitors combined into a single firm with excess capacity. Then the firm could reduce capacity without disrupting production. In fact, the firm might enjoy "supra"-normal profits if it could rationalize much faster than its forward pricing rate agreements (FPRA) were adjusted to capture lower overhead costs.

As a result of the consolidation wave, the defense industry became very concentrated. Each of the large prime contractors dramatically broadened its scope of products. For example, Lockheed grew its aircraft, missile, and space businesses and entered into electronics and information technology services, all through acquisition. Boeing, General Dynamics, Northrop Grumman, British Aerospace, and Raytheon all grew and diversified through ambitious acquisition.

Each of those six companies now appears to be a defense conglomerate that is able to provide a complete set of products and services to a customer. These diversified companies have less incentive to reduce their assets. The prime contractors now have thousands of contracts at any given time. Inter-contract risk is greatly reduced. Lower inter-contract risk will lead to higher earnings stability that increases the value of assets on the balance sheet by reducing the rate at which assets are discounted. Furthermore, less-than-fully utilized assets provide valuable options on more business in the future. As long as there is the potential to eventually yield positive net present value, there is little incentive to dispose of underutilized assets in this business, particularly as the cost to carry these assets declines.

In the next section we discuss how the ship industrial base restructured after the cold war.

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[10] It is hard to understand how the Defense Department expected the defense mergers would be accretive if they were passing the synergy savings to the government.

C. SHIP INDUSTRIAL BASE CONSOLIDATION

Figure 2 shows new ship construction levels (represented by tons of lightship)[11] from 1985 to 2006 for surface combatants (constructed by Avondale Shipyard, Bath Iron Works, and Ingalls Shipbuilding), submarines (constructed by Electric Boat and Newport News Shipbuilding), auxiliary vessels (constructed by National Steel and Shipbuilding and Avondale Shipyard), and aircraft carriers (constructed by Newport News Shipbuilding).

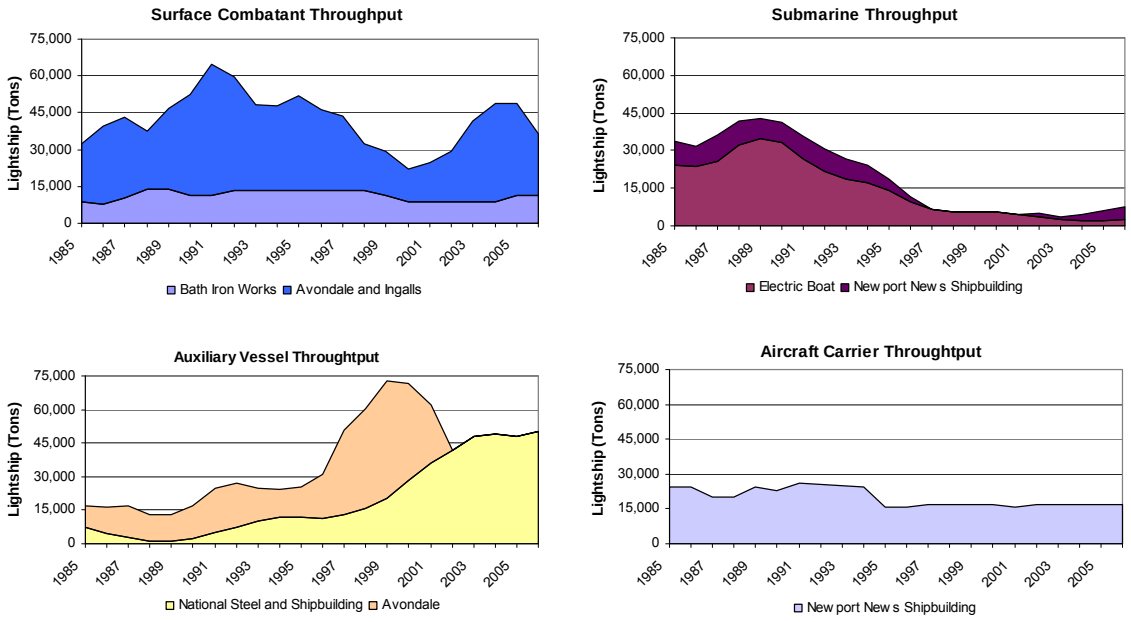

Figure 2. New Ship Construction Throughput by the Major U.S. Naval Shipyard Industrial Base

The throughput for all but auxiliary vessels declined in the 1990s until around 1999, representing the Navy's dramatic reduction in fleet size. All of the shipyards have seen some production recovery since 2000. Aircraft carrier throughput is fairly constant now at about 20 percent of a new carrier per year. The plot for auxiliary vessels does not tell the entire story since Marinette Marine Corporation and Sun Shipbuilding and Dry Dock Company have also built auxiliary ships for the Navy.

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11 Lightship weight equals: hull; mechanical, electrical, and weapon systems; permanent ballast; and liquids in machinery at operating levels. It excludes the crew and their effects, ammunition, and consumables or items with variable load.

Of the six large yards that belong to General Dynamics and Northrop Grumman, only Avondale and National Steel and Shipbuilding Company (NASSCO) have a significant amount of commercial business. Thus, only two yards had much potential to offset the reduced Navy procurement with commercial business.[12]

Figure 3 tracks the history of the six major U.S. shipyards. All six yards remain active today in spite of being consolidated under two corporate entities: Northrop Grumman Shipbuilding and General Dynamics Marine Division. Northrop Grumman bought Newport News and Litton, which owned Avondale and Ingalls, in 2001. General Dynamics started out as Electric Boat and then acquired Bath Iron Works in 1995 and NASSCO in 1998.

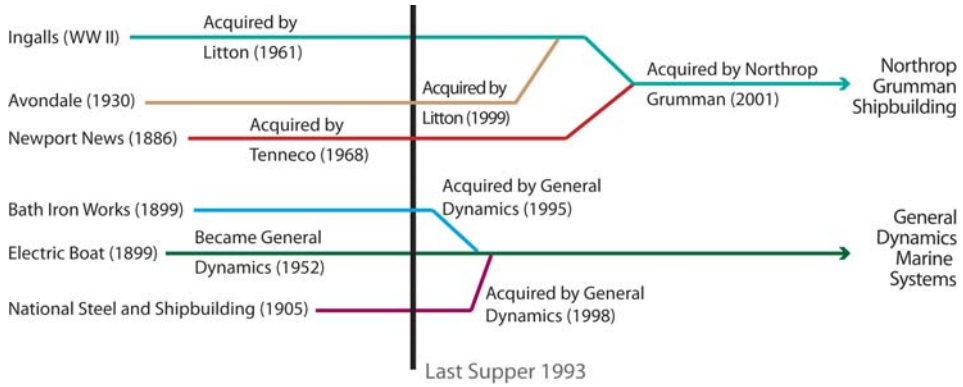

Figure 3. Consolidation of the Major U.S. Naval Shipyard Industrial Base

The resulting industry structure possesses the product capabilities summarized in Table 1. General Dynamics's early consolidations were largely unfettered by government intervention. It was not until General Dynamics bid for Newport News that the government intervened and prevented the merger from occurring. In 1999 Litton almost won the approval by the government to buy Newport News; however, it was not until 2001, with a new administration, that Northrop Grumman ultimately bought the whole package when they acquired Litton and Newport News separately. There appear to have been overriding anti-trust considerations applied to the mergers in the ship sector that resulted in duplicate capabilities.

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12 NASSCO is presently the most aggressive in its bid for commercial work. It has developed a commercial tanker in conjunction with Daewoo to meet demand for cabotage trade fleets covered under the Jones Act. Most of the yards claim to be willing to bid for commercial work that is compatible with their focus on higher-value Navy business.

Table 1. Current Major U.S. Shipyard Product Capabilities

	General Dynamics			Northrop Grumman		
	Electric Boat	Bath Iron Works	National Steel and Shipbuilding Company (NASSCO)	Newport News Shipbuilding Company	Ingalls Operations	Avondale Operations
Aircraft Carriers				**CVN-68**		
Surface Combatants		**DDG-51** DDG-1000 LCS			**DDG-51** DDG-1000 CG-47	
Submarines	**SSN-774** SSN-688 SSGN-726 SSBN-726			**SSN-774** SSN-688		
Amphibious Ships					**LPD-17** **LHA-6** **LHD-8**	**LPD-17** LSD-41 LSD-49
Auxiliary Vessels			**AKE-1** AOE-6 AKR-310			AO-187 AKR-300

Note: Bold indicates ships in current construction. Blue indicates ships in development.

The notable characteristics of the industry are duplicative capability in submarines and surface combatants. Both companies at two yards, Newport News and Electric Boat, make submarines and presently share the production of the SSN-774 nuclear attack submarine. Each yard builds one half of the ship and alternates the final assembly and integration. The Navy briefly ended submarine construction at Newport News in the mid-1990s, but production there was reinstated by Congress with the SSN-774. As well, both companies at two yards, Bath Iron Works and Ingalls, make surface combatants, including DDG-51 and the DDG-1000 destroyers. Similar to the SSN-774 submarine, NGSS and Bath Iron Works share development, and will share production, of three DDG-1000 destroyers.

Only Newport News builds aircraft carriers. Both Ingalls and Avondale—the two yards that together make up Northrop Grumman Ship Systems (NGSS)—are capable of constructing amphibious ships, and Bath Iron Works had capability to produce the LPD-17 prior to the sole-source award to NGSS. NGSS has unique capability to produce composite structures important in state-of-the-art ship designs, such as the LPD-17 and the DDG-1000.

Clearly there is no evidence of plant shutdowns after the consolidation. In the next section we look more closely at whether rationalization occurred, short of closing plants, as a result of the ship industry consolidation.

D. EVIDENCE OF RATIONALIZATION IN THE SHIP SECTOR

U.S. Naval shipyards suffered from overcapacity and sagging demand in the early 1990s. For example, in early 1992, the government cancelled the Seawolf submarine, leaving General Dynamics with a large production gap until the next planned submarine, the SSN-774 Virginia class. While it continued to build the remaining two ships, General Dynamics worked to eliminate a substantial amount of its fixed overhead cost. This included eliminating 11,442 jobs throughout the General Dynamics Electric Boat division and 6,612 jobs at the yard alone.[13]

Similar demand-driven reductions occurred at Newport News and Bath Iron Works. While it was probably anticipated that firms would reduce direct labor as demand fell, it was expected that they would continue to carry fixed overhead by increasing the rates on direct costs for ongoing business. By encouraging mergers, the government hoped contractors would be motivated to eliminate physical locations and, thus, recurring fixed overhead.[14]

1. Overhead Analysis

We looked at private and public data for evidence of rationalization in the ship industrial base. Using the companies' labor and overhead cost data from FPRAs, we followed a methodology used in prior IDA studies.[15] Figure 4 shows a notional view of these data where overhead cost is plotted as a function of direct labor cost. The data represent costs for a series of years normalized to a constant dollar year. In most cases there is a linear relationship between overhead and direct labor; though restructuring, dramatic production output changes, or accounting changes will occasionally disrupt the linear trend. Restructuring includes eliminating duplicate functions after a merger while a

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13 Joan Cavanagh, "Jobs, Jobs, Jobs, and the Defense Industrial Base," in *The Changing Dynamics of U.S. Defense Spending*, edited by Leon V. Sigal, Westport, Connecticut: Praeger Publishers, 1999, p. 137.

14 Eliminating fixed assets would not provide immediate savings to the government since they would end up reimbursing the asset write down. However, the government would eventually save the eliminated recurring fixed costs that are linked to the asset location.

15 Institute for Defense Analyses, "Defense Aircraft Manufacturing Capacity Study: Findings," presented to Secretary of Defense for Acquisition, Technology and Logistics, January 19, 2001; and Institute for Defense Analyses, "Missile/PGM Industrial Sector Results," presented to Deputy Under Secretary of Defense (Industrial Policy), Limited Distribution, August 2002. General Dynamics and Northrop Grumman's FPRA overhead costs were obtained from NAVSEA 017.

disruptive accounting change might be the reclassification of maintenance cost from direct to indirect labor.

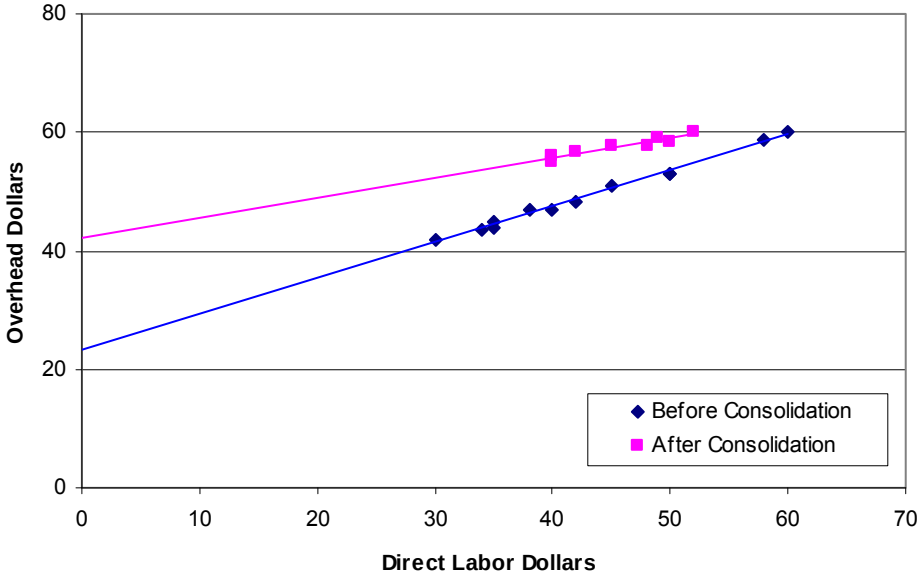

Figure 4. Overhead Dollars versus Direct Labor Dollars (Notional Data)

In the linear model of labor and overhead, the slope of the line represents variable overhead cost, while the intercept represents fixed overhead. Variable overhead cost elements are functions whose size scales with unit output, such as quality control or maintenance. Fixed overhead cost would include elements that are invariant with small changes in production volume, such as buildings or plant management. If consolidation led to rationalization, we would expect to see a disruption in the trend corresponding to the time of the merger. Statistically, the Chow test is used to determine whether the time series can be explained better by two lines or a single line. The two lines in the former case apply to consolidation-led rationalization, where the points on the two lines are before and after the merger. In the notional case depicted in Figure 4, the Chow test provides evidence that consolidation did not lead to rationalization in the form of lower overhead costs.

It is not possible to display the Chow test analysis, because the data we used are proprietary. We found evidence of rationalization in some cases; however, the rationalization did not appear to be driven by consolidation. We saw evidence of what appeared to be years of distinct reductions in overhead; however, there was no case of a statistically significant trend lower for any of the mergers.

We also used private labor and overhead data to measure whether the government has realized any savings from the consolidation-driven rationalization. To make this assessment, we used the linear model of overhead cost and direct labor cost discussed previously. We examined historical labor and overhead cost data from the six yards over the course of the consolidations.

We used the Chow test to determine whether the data was modeled best with a single line for the entire period or by breaking the periods into shorter groups. If rationalization was driven by the consolidation we should see that two lines, one for the period before the consolidation and one for the period after, would fit the data better than one line for the entire period. We found that the overhead and direct labor data for the period (roughly 1985–2005) did not fit two lines. As a result, there did not appear to be significant evidence of rationalization savings associated with the yard consolidations during this period.

2. Financial Statement Data

The public financial statements filed by General Dynamics and Northrop Grumman are also a source of evidence of merger-related rationalization savings.[16] Company-owned or leased floor space is tracked by most defense contractors and is an indication of rationalization over time. Figure 5 shows the leased and owned floor space attributable to the marine segments of Northrop Grumman and General Dynamics. We looked at the time series data to attribute dramatic changes to consolidation-related transactions. While General Dynamics shows dramatic reduction in leased space that was attributed to facilities in San Diego, this action was not ultimately attributed to the consolidation of NASSCO.[17] From the available data (2003–2006), the amount of Northrop Grumman's floor space has remained constant or slightly increased. Thus, floor space provides no evidence of rationalization.

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16 These financial statements are Forms 10-K and 10-Q, reported annually and quarterly, respectively, to the Securities and Exchange Commission.

17 Leased space may not be owned but it represents a fixed asset and its financing is usually viewed as debt even if it is "off-balance sheet." The NASCCO representative did not attribute the changes in leased space to shipyard activity.

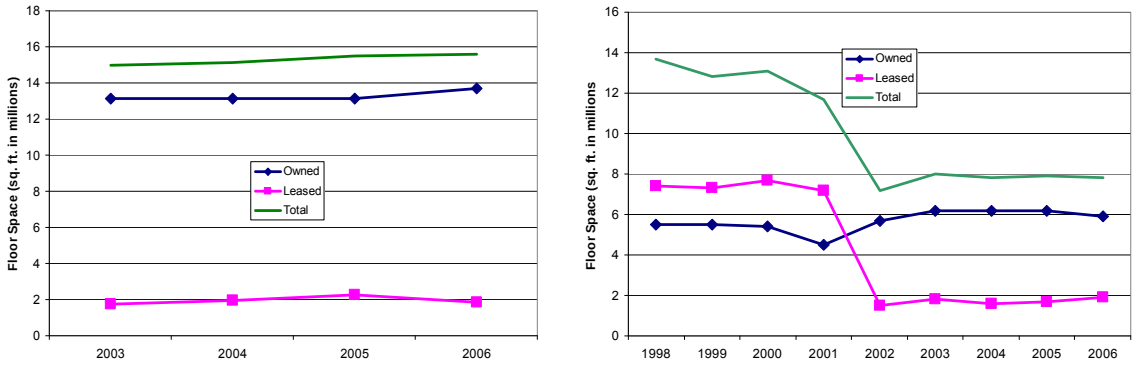
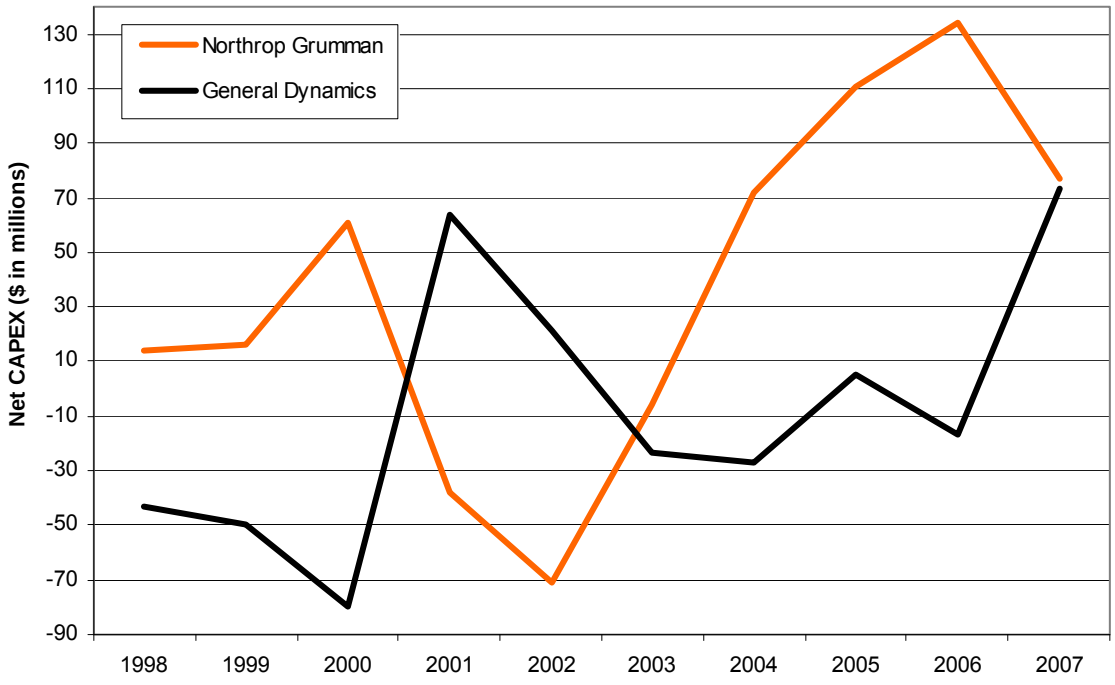


Figure 5. Northrop Grumman (left) and General Dynamics (right) Leased and Owned Floor Space by Year (Company 10-K data)

Other evidence of rationalization is the extent to which the companies are depreciating and buying new assets. Figure 6 shows the net capital spending (capital spending minus depreciation) for General Dynamics and Northrop Grumman marine divisions. We would expect to see net capital spending decline as firms rationalize. Since 1998, when General Dynamics made its last major shipyard acquisition, its assets have depreciated about $200 million more than it has invested in new capital. Since Northrop Grumman acquired Newport News and Litton in 2001, we see that its net capital spending has exceeded depreciation by about $200 million. This trend is complicated by the rebuilding at NGSS in 2005 and 2006 that was driven by Hurricane Katrina.

General Dynamics's cumulative asset write-offs have exceeded capital spending for more than 10 years. Since General Dynamics has clearly not shut down any of its yards since 1993, these net asset reductions appear to represent gradual incremental facilities rationalization.

Given that there was no dramatic merger-driven restructuring, it appears as though the government's desire to reap savings through asset rationalization and the industry's desire to make accretive acquisitions were not aligned. The government may have viewed the potential desirable mergers as mergers among companies with the same product—e.g., two shipbuilders—leaving less shipbuilding capacity. What actually happened was that large multi-product companies absorbed the shipbuilders, leaving large companies with full product lines.



Note: Calculated from Capital IQ data.

Figure 6. General Dynamics and Northrop Grumman Marine Divisions' Capital Spending Less Annual Depreciation

Consider the 2007 year-end key financial metrics of the two prime shipyard companies General Dynamics and Northrop Grumman in Table 2. Both company divisions derived most of their revenue from the Defense Department with some limited new ship construction from the U.S. Coast Guard and commercial customers. Both businesses were close in revenue, operating profit, and free cash flow; however, General Dynamics had higher returns on invested capital because it purchased Bath Iron Works and NASSCO below book value, while Northrop Grumman had considerable goodwill associated with the Newport News and Litton acquisitions. Both the Northrop Grumman and General Dynamics shipbuilding businesses are healthy and delivering free cash flow. They have little incentive to conduct dramatic rationalization, since revenue from DOD contracts is based on cost. Figure 7 shows that the free cash flow between 1998 and 2007 has been positive[18]—though more erratic for the Northrop Grumman yards.

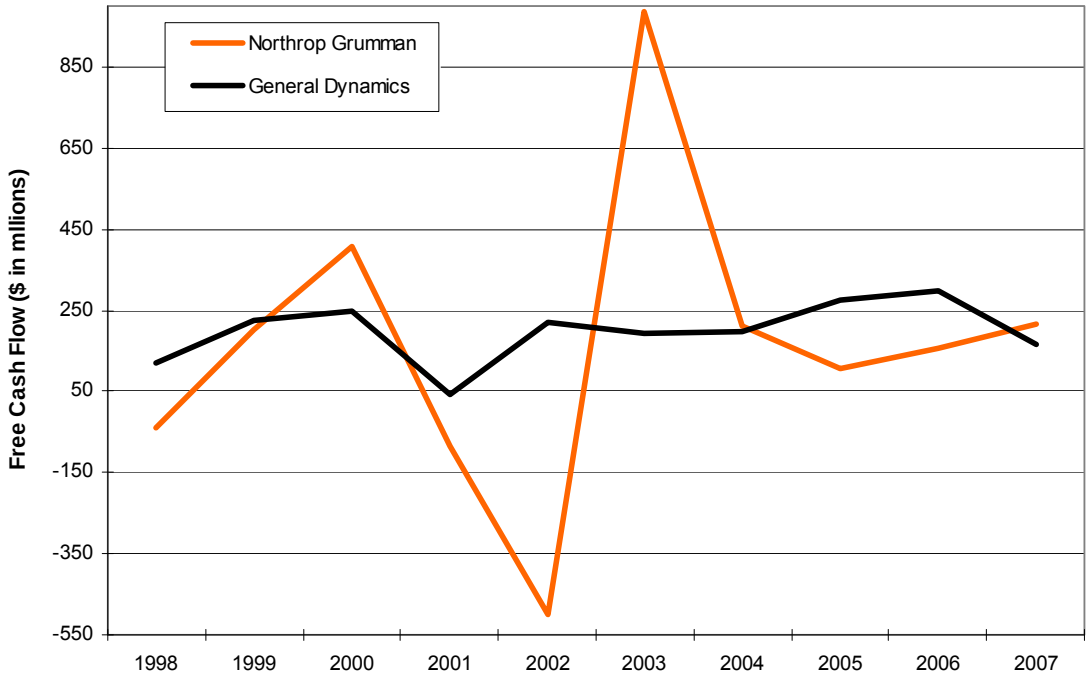
18 Prior to 2001 Northrop Grumman Shipbuilding was Newport News and Litton Industries.

Table 2. Key Financial Metrics for Marine Segments of General Dynamics and Northrop Grumman, 2007

	Marine Segments ($ Millions)	
	Northrop Grumman	General Dynamics
Revenue	$5,788	$4,993
Operating Profit	$538	$421
Free Cash Flow	$214	$166
Assets	6875	2243
Net Capital Spending	$77	$73
FCFROIC	3% (6%)*	11%
Total Company		
Revenue	$33,373	$27,240
Operating Profit	$2,686	$2,716
Average Northrop Grumman/General Dynamics Cost of Capital	7–9%	7–9%

Sources: Company financial reports and Capital IQ.

Note: The number in parentheses is the FCFROIC excluding goodwill.



Note: Calculated from Capital IQ data.

Figure 7. Historical Free Cash Flow of the Marine Divisions of Northrop Grumman and General Dynamics

To further measure the profitability and investment efficiency of these businesses we look at the free cash flow return on invested capital (FCFROIC).[19] We compare the recent historical FCFROIC vs. the weighted average cost of capital (WACC) for the marine divisions of Northrop Grumman and General Dynamics. This comparison measures the annual return on the prior year's invested capital. If the FCFROIC is greater than the WACC, the company is increasing shareholder wealth; if it is below the WACC, shareholder wealth is declining.

In Figure 8, we see that since 1998 General Dynamics's FCFROIC (black line) has steadily exceeded its WACC (band in blue).[20] Clearly General Dynamics has achieved a solidly performing business model with its shipyards, yielding healthy shareholder returns. Northrop Grumman's performance is not as stable. We added a band for its recent FCFROIC performance: the lower line represents the actual capital spending, while the upper line assumed its longer term average. Two factors are contributing to Northrop Grumman's lower FCFROIC. First, its higher capital spending is reducing its free cash flow. Some of this spending is linked to rebuilding the Ingalls yard after hurricane Katrina. Second is the high level of assets Northrop Grumman carries on its books relative to General Dynamics. About half of the assets represent the goodwill associated with the actual cost of the acquisitions. This relative difference is related to the high price-to-book-value multiple Northrop Grumman paid for Newport News and Ship Systems. In contrast, General Dynamics paid less than book value for Bath Iron Works and NASSCO.

In Table 2 we show FCFROIC without goodwill. By this measure, Northrop Grumman is close to returning its cost of capital. However, as long as the assets are not deemed impaired, there seems to be little Northrop Grumman can do to reduce its marine FCFROIC denominator. On the contrary, it is relatively early in the execution of Northrop Grumman's plan to build its marine business. We yet may see profitability in line with General Dynamics in the future. Figure 9 shows Northrop Grumman's estimated FCFROIC with spending adjusted to its longer-term average; thus, eliminating

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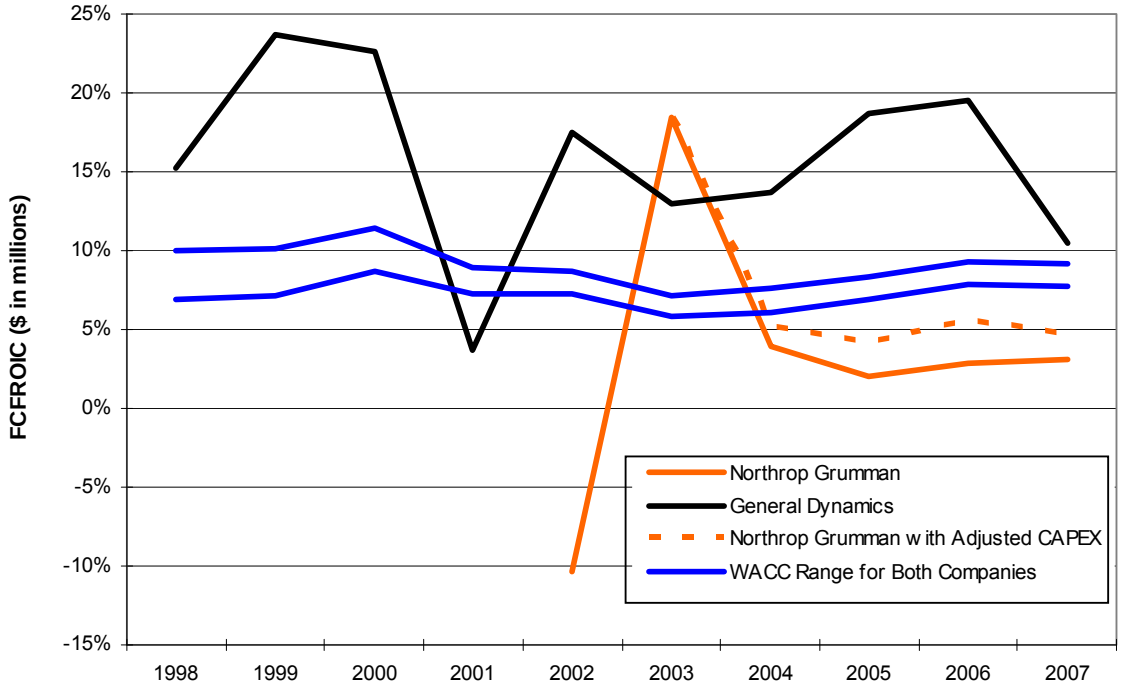
19 See the appendix for an overview of the financial terms used here.

20 The upper line represents an upper risk premium of 6 percent, while the lower line represents the long-term implied risk premium of about 4 percent. The WACC band applies to both companies since they have roughly the cost of capital.

the post-Hurricane Katrina jump in capital spending. However, this is not enough to exceed the cost of capital on Northrop Grumman's much larger asset base.



Note: Calculated from Capital IQ data.

Figure 8. Historical FCFROIC and WACC for the Marine Divisions of General Dynamics and Northrop Grumman

3. Conclusions on Shipyard Rationalization

Our analyses show the major shipyards had no incentive to take the necessary steps to rationalize their cash-generating businesses beyond achieving the efficiencies they needed to make their profit goals. In the face of the declining demand of the early and mid-1990s, General Dynamics rationalized *independently from its shipyard mergers and acquisitions*. Rather, the consolidations appear to have been driven by a quest for value, particularly for General Dynamics.[21] We should expect further rationalization only in response to lower ship demand.

[21] For example, Damodaran's M&A strategy 1.

For most of the past 10 years, the Defense Department has been increasing development and procurement budgets for shipbuilding. Rising or steady budgets combined with the effective elimination of the "pay-offs for lay-offs" reimbursement will limit the incentive for the industrial base to eliminate capacity in the future. The shipyards do appear to be aggressively trying to improve operating efficiency. However, with constrained budgets, the government acquisition system is more likely to use the savings to fund more technology in the program or additional ships.

We believe the ship industrial base has underutilized assets that are contributing adversely to costs. However, to date and in the foreseeable future, there appears to be enough DOD business to profitably support the present business base. General Dynamics reported marine backlogs of about $12 billion, while the Northrop Grumman ship segment has $13.6 billion each at year end 2007. More competition could drive costs down; however, the barriers to entry in shipbuilding are steep. Furthermore, the government has clearly decided to keep excess capacity in the ship sector when it awarded the SSN-774 Virginia-class submarine and the DDG-1000 to both Northrop Grumman and General Dynamics in the interest of maintaining existing competition.

E. COMPARISON OF SHIP SECTOR TO OTHER DEFENSE SECTORS

IDA has also analyzed industrial base restructuring in other weapon system sectors. Based on these studies, we found that the ship sector followed the behavior and outcome of the aircraft industry more closely than that of the missile industry. Roughly the same number of aircraft plants and shipyards remained open before and after their respective consolidations. Similarly there appears to have been little consolidation-driven rationalization savings to the government in either case. Table 3 summarizes the key consolidations in the three industry sectors. The table tracks the number of firms and plants before and after the sector consolidation. When the consolidation occurred relative to 1998 is important in determining whether the early version of "pay-offs-for-layoffs" was a contributing factor to whether the sector saw rationalization.

Table 3. Rationalization in Key Sector Consolidations 1990–2002

Defense Industry Sector	Number of Companies Before/After Consolidation	Change in Number of Plants	When Consolidation Occurred	Did Rationalization Occur?
Aircraft	7→3	>+1	Before 1998	No
Missiles	8→3	>–20	Before 1998	Yes
Ships	6→2	0	After 1998	No

In contrast to the ship and aircraft sectors, the main firm in the missile sector, Raytheon, closed several plants following its acquisitions of Texas Instruments and Hughes Aircraft. Prior to being purchased by Raytheon, Hughes had acquired General Dynamics's missile segment and had closed plants in southern California. The Defense Department received the savings from the missile sector because physical assets and their associated fixed labor were eliminated after consolidation. Conversely, the aircraft and ship sector were able to maintain their asset base by rolling the underutilized capacity into a higher overhead wrap rate.[22]

How do we reconcile the lack of consolidation-driven rationalization with the ship and aircraft sectors with the rationalization associated with the missile sector mergers? We explore this comparison here by contrasting General Dynamics and Northrop Grumman with a case study on Raytheon. Raytheon reinvented itself in 1997 as the top missile contractor by absorbing first Texas Instruments Defense Systems and Electronics Group for $3 billion in cash and then, a few months later, Hughes Aircraft for $9.5 billion in assumed debt and stock. In many ways these acquisitions created a distinct opportunity for Raytheon and the government that was not possible for the ship sector. Table 4 summarizes several *ex post* distinctions between the ship sector and Raytheon that help explain how merger-driven rationalization was possible for missiles and not for ships.

Table 4. Metrics Explaining Level of Post-Merger Rationalization

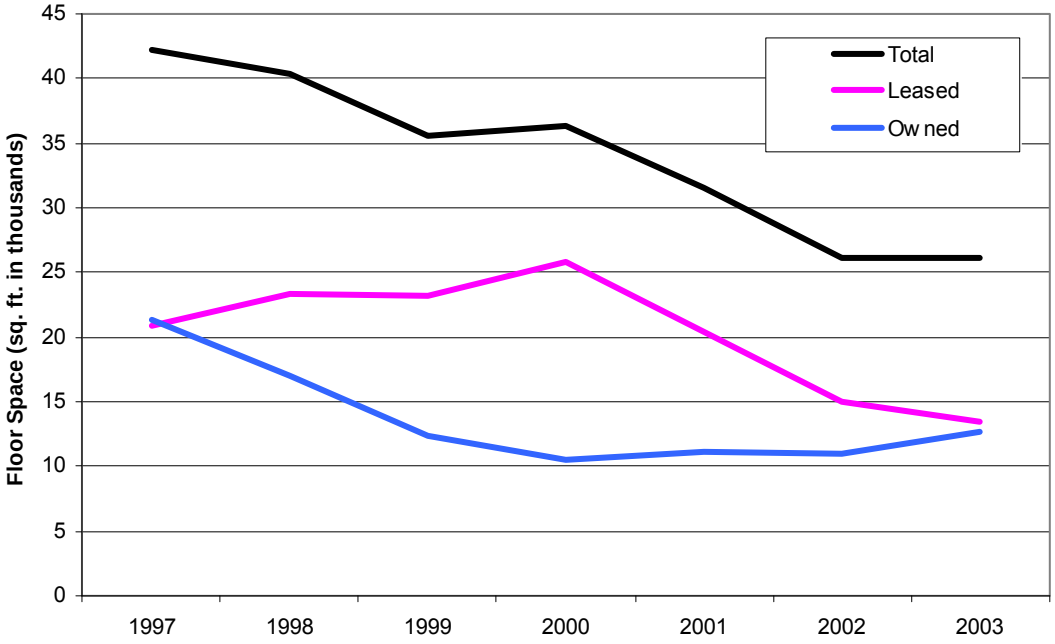
	Missile Sector (Raytheon)	Ship Sector (Northrop Grumman and General Dynamics)
Extent of Rationalization	Extensive	Not Observable
Post-Merger Changes:		
Manufacturing Plants	Eliminated >20 plants	No change in number of yards
Floor Space	Decreased	No change
Head Count	Decreased	Decreased prior to mergers
Product Lines	No change	No change

The entire industrial base eliminated thousands of jobs in the 1990s, but few companies eliminated plants.[23] Raytheon, however, partially or completely closed over 20 plants and consolidated its existing and newly acquired missile production into a

22 This statement is based on our examination of company proprietary data. The wrap rate is the fully burdened cost per hour that is applied to direct labor hours.

23 Eugene Gholz and Harvey M. Sapolsky, "Restructuring the U.S. Defense Industry," *International Security*, Vol. 24, No. 3, (Winter, 1999–2000), pp. 5–51.

single facility.[24] Figure 9 shows the decline of both owned and leased floor space held by the electronics segment, of which missiles are a major component.[25] At the aggregate level, Raytheon steadily reduced its headcount from 119,000 just after the mergers in 1997 to 76,400 in 2002. Even though not all of this reduction was related to the missile division, it was a strong contributor to the headcount reductions in the late 1990s.



Note: Missile systems are a major component of Raytheon's electronics segment.

Figure 9. Raytheon's Electronics Segment Floor Space (Company 10-K data)

Fungible duplicate capacity is the key requirement for rationalization: the firm rationalizes by maintaining its production deliveries at the efficient plant and shutters the duplicate inefficient one. With fungible duplicate capacity, these firms could efficiently produce in parallel until firms have demonstrated that production can be seamlessly met in a single plant without disrupting quality. Combined firms without fungible duplicate capacity can still rationalize but they need to set up duplicate production in the sites they seek to keep

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24 George Roth, "Case Study Report: Raytheon Paveway^{tm} – Lean Enterprise Change," Lean Aerospace Initiative, Massachusetts Institute of Technology, February 28, 2005, available from http://lean.mit.edu.

25 Since Raytheon restructured frequently following the mergers, we have aggregated several divisions into an electronics segment that tracks the original missile segments and maintains continuity. Raytheon's numerous restructurings after the Hughes and Texas Instruments mergers make tracking the original missile segment impossible.

before they can eliminate sites they want to shutter. The difficulty and expense of setting up duplicate production are likely to be prohibitive.

For example, when Lockheed purchased General Dynamics's F-16 business, Lockheed added a plant to its portfolio of factories. However, it did not move the C-130 from Marietta, Georgia, or the F-117 from Palmdale, California, to Fort Worth, Texas, the location of the new F-16 plant. While it may have been possible to move these product lines to a common facility in Georgia or Texas, the investment and risk to ongoing production would have been great. This same reasoning applies to General Dynamics when it bought Bath Iron Works and NASSCO.

On the other hand, after the combination with General Dynamics's missile segment, Hughes shut several plants. Raytheon continued to shut facilities after it acquired Hughes and Texas Instruments. The difference is that the combined missile company had acquired fungible duplicate capacity that ranged from flexible manufacturing centers to duplicate assembly lines for the same missile, e.g., the Advanced Medium-Range Air-to-Air Missile (AMRAAM). Consequently, Raytheon, though still facing a difficult task, could restructure its asset base with far less investment and risk and far more quickly than aircraft companies. The faster restructuring speed translates directly into profits to the bottom line, since the contractor is able to keep the savings only temporarily. Once the government negotiates new forward pricing rate agreements to reflect the lower depreciation cost, the rationalization savings start to flow to the government.

All of the sectors were able to consolidate and seek restructuring cost reimbursement from the government. As well, all sectors had the motivation of additional sales from the Foreign Military Sales (FMS) program to drive their fixed costs out. Only Raytheon, however, was able to consolidate multiple product lines into a single facility and better utilize floor space and facilities that previously were only 30–40 percent utilized through the elimination of fungible excess capacity discussed earlier. In this way Raytheon could truly benefit from a synergy-driven acquisition of its sole competitor for two major product lines, the AMRAAM and the Standard Missile, among other compatible products.

With fungible excess capacity, Raytheon could rationalize and keep the savings on existing and novated fixed-price contracts until the government re-negotiated the forward pricing rate agreement to recognize the lower overhead cost. According to the Government Accountability Office, it took the Defense Contract Management Agency an average of 21

months to renegotiate these rates.[26] In the intervening time, Raytheon's profit margin temporarily increased. With the reorganization cost of missile assembly and component fabrication plants relatively small, rationalization became affordable even in the context of defense contracting. With a lower cost path towards rationalization, Raytheon could also benefit from the restructuring cost reimbursement and opportunities to compete for FMS and with other precision guided munitions on price. As shown in an earlier study,[27] some of the savings were ultimately passed on to the customer with lower overhead as new contracts were won.

Debt also helped force Raytheon's post-acquisition strategy to succeed. As debt more than doubled in 1997, it caused net interest expense to triple. Leveraging the balance sheet this much is risky for an industry in decline, since the debt forces firms to maintain strict discipline with its cash and costs. While operating margin for Raytheon's missile segment, as well as the ship sector, declined following the acquisition, it's impossible to attribute this to any one event. Figure 10 tracks the operating margins of Raytheon missile division and the marine divisions of Northrop Grumman and General Dynamics. Part of Raytheon's decline in operating margin is attributable to post-merger restructurings, which split off higher-margin groups from the missile segment into new segments, such as integrated defense and space and airborne systems, which have consistently higher margins than missiles.

While profit margins have declined for all three defense company sectors, Figure 10 indicates that Raytheon's missile division suffered no more than the rest of defense industrial base that did not rationalize. As mentioned previously, FCFROIC is a more accurate measure of these firms' financial performance. FCFROIC for the three business sectors is depicted in Figure 11. With this metric, Raytheon and General Dynamics track pretty close to each other, even though the former paid considerably more for its acquisitions and reduced its asset base. Raytheon's cash flow returns represent the ratio of relatively high margin missile business to the high acquisition cost of Hughes and Texas Instruments. This ratio is initially lower than General Dynamics's returns from moderate margin ships but very low asset costs. Northrop Grumman is in the less enviable position of having paid a relatively high price for the low-margin businesses of Newport News and Litton.

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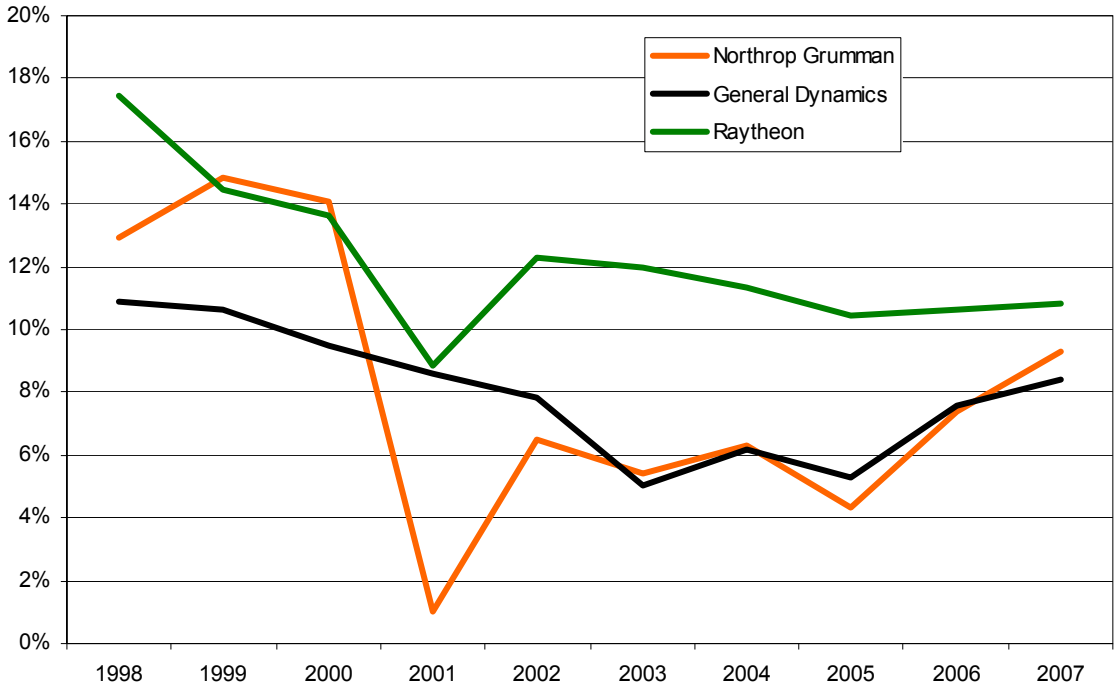
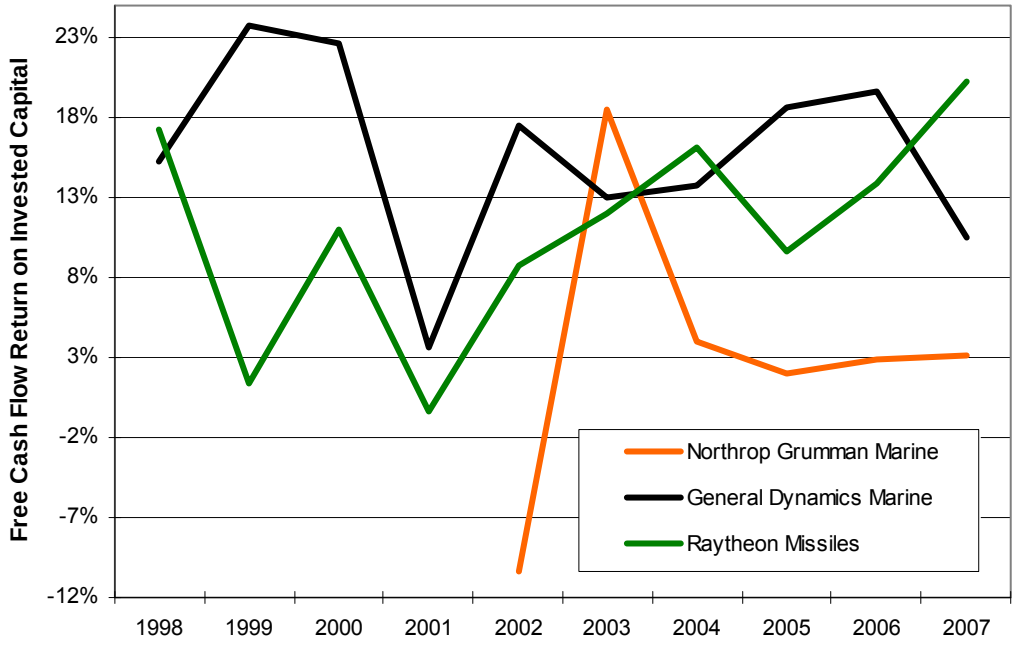
26 United States General Accounting Office, "Defense Contractor Restructuring DOD Risks Forfeiting Savings on Fixed-Price Contracts," GAO/NSIAD–98–162, July 1998.

27 Institute for Defense Analyses, "Missile/PGM Industrial Sector Results," presented to Deputy Under Secretary of Defense (Industrial Policy), Limited Distribution, August 2002.



Note: Calculated from Capital IQ data.

Figure 10. Operating Margin for General Dynamics's and Northrop Grumman's Marine Divisions and Raytheon's Missile Segment



Note: Calculated from Capital IQ data.

Figure 11. Free Cash Flow Return on Invested Capital for General Dynamics's and Northrop Grumman's Marine Divisions and Raytheon's Missile Segment

In summary, there are two main reasons that the ship sector did not rationalize as a result of the mergers. First, the individual shipyards had already rationalized about as much as they could before they were acquired. Second, unlike missile manufacturing, which could be rerouted into new plants at manageable investment, naval shipyard construction requires shipyards specialized to particular ship types. General Dynamics could not cost effectively move production from one yard to the other and shut down the less utilized yard.

Despite that one sector closed facilities and the other did not, both are working to improve operating efficiency and reduce costs. During our study, we saw clear successes towards achieving lower labor and overhead costs; however, these efforts are not directly the result of the mergers. As we stated above, the ship sector has substantial back orders and is generating positive cash flow. Since the Navy continues to send business to the yards, the companies have no reason to eliminate capacity.

The government expected substantial savings associated with the rationalization or reduction of infrastructure subsequent to industry consolidation. However, instead of combining companies with like capabilities, which could have rationalized with less disruptive change, the defense industry developed into broadly diversified, multi-product companies. Only in the missile sector were conditions right for rationalization: there was adaptable duplicate capacity that could be shut down, and industry had the opportunity to benefit from the savings.

If the government looks to consolidation as a path to lower costs in the future, it should look closely at the post-merger plan to see what specific fixed assets will be eliminated from the system. It then needs to assess the realistic likelihood that these assets will be removed. Based on these results, we believe that the successful rationalization resulting from the missile sector consolidation was the rare exception and not what to expect as a rule.

APPENDIX:
FINANCIAL TERMS

In the financial analysis of the marine segments of both General Dynamics and Northrop Grumman, we examined the industry profit margin and free cash flow returns on invested capital. Profit margin is defined as the operating profit or earnings before interest and tax (EBIT) divided by revenue. Free cash flow is defined as cash flow less capital spending less the change in non-cash working capital from the prior year (non-cash working capital is accounts receivable less accounts payable). Specifically we looked at un-levered free cash flow that is based on EBIT rather than net income.

Un-levered free cash flow (FCF) to the firm is cash available to bond holders and equity owners. FCF return on invested capital (FCFROIC) is FCF divided by the average of the present and prior years' invested capital or, alternatively, the denominator could be total liabilities plus book equity less non-debt liabilities (e.g., accounts payable).[1] Here, however, we have limited visibility into the liabilities side of the marine segment balance sheet. In lieu of using liabilities plus equity, we estimate invested capital with segment assets less an estimate of the segment's portion of non-debt liabilities. We estimate non-debt liabilities as the total company amount times the percentage of total assets represented by the segment.

This FCFROIC can be compared to the firm's weighted average cost of capital (WACC). WACC is the cost of debt plus the cost of equity both weighted by the market values debt and equity, respectively.[2] The cost of equity is estimated using the Capital Asset Pricing Model (CAPM). In the CAPM, the cost of equity equals the risk-free interest rate plus the industry beta times the equity market risk premium. The risk-free

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1 FCFROIC = Free Cash Flow/Prior Year's Invested Capital

2 $WACC = r_d * D/A + r_e * E/D$
E = market value of equity
D = market value of debt
A = E+D
r_d = average cost of debt (%)
r_e = cost of equity (%)

rate is an interest rate that is free from credit default or other risks. Typically in the United States, we can use a Treasury bill or note with a maturity similar to the investment horizon. The industry beta is the average beta for the companies in the defense industry; where beta is the slope of the line when the monthly returns of the company or industry index are regressed against the monthly returns of the market (e.g., the Standard & Poor's 500)—alternatively, beta is the covariance between the company and the market returns divided by the variance of the market returns. The market risk premium is the difference between the market rate of return and the risk-free rate. The market risk premium can be estimated from historical returns or from the rate implied in the price of the market index.

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ABBREVIATIONS

AMRAAM	Advanced Medium-Range Air-to-Air Missile
CAPEX	Capital Expenditure
CAPM	Capital Asset Pricing Model
DOD	Department of Defense
EBIT	earnings before interest and tax
FCF	free cash flow
FCFROIC	free cash flow return on invested capital
FMS	Foreign Military Sales
FPRA	forward pricing rate agreement
IDA	Institute for Defense Analyses
NASSCO	National Steel and Shipbuilding Company
NGSS	Northrop Grumman Ship Systems
RDT&E	research, development, test and evaluation
U.S.	United States
WACC	weighted average cost of capital

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Because of decreased demand for new ship construction, the number of U.S. shipyards capable of handling new construction and conversion programs for the U.S. Navy decreased through the 1970s and 1980s. In 1993, the Defense Department established a policy to consolidate and rationalize (reduce infrastructure) within the defense industry in the face of the lower demand experienced following the end of the cold war. IDA looked at infrastructure rationalization in the major ship industrial base. Before the 1993 consolidation wave, the six major shipyards were owned by five independent companies. After the last major acquisition in 2001, the same six shipyards were owned by just two companies. We examined the financial and economic implications of the ownership consolidations since 1993. In particular, we measured the extent of infrastructure rationalization that has occurred as a direct result of industry restructuring. We also explored factors and barriers that encourage or discourage rationalization of the defense industrial base generally, by comparing the results of the ship industry consolidation with consolidations in the aircraft and missile industries.

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