INDUSTRY STUDIES 2000

Shipbuilding

ABSTRACT

The U.S. shipbuilding industry continues to design and build the most advanced military vessels in the world. Despite this capability, the industry is not competitive in the world shipbuilding market. The industry has been in decline since the United States withdrew direct shipbuilding subsidies in 1981. The larger, or "first-tier" yards have been unable to compete internationally due to the dedicated industrial policies, greater efficiency, and lower labor rates in other countries. The absence of a robust commercial counterpart to the military shipbuilding sector may prevent these larger yards from operating as efficiently as they could. "Second-" and "third-tier" yards that produce the majority of the ships used in domestic trade have been more innovative, more efficient, and therefore, more successful internationally. However, all shipbuilders must apply modern business practices, processes, and enabling technologies to become more cost-effective and competitive.

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PLACES VISITED

Domestic

Avondale Shipyards, New Orleans, LA

Bath Iron Works, Bath, ME

Bollinger Shipyards, Lockport, LA

Electric Boat, Groton, CT

Friede Goldman Halter Marine Group, Pascagoula, MS

Ingalls Shipbuilding, Pascagoula, MS

LMS Ship Management, New Orleans, LA

National Steel and Shipbuilding Company, San Diego, CA

Naval Surface Warfare Center, Carderock Division, Carderock, MD

Newport News Shipbuilding, Newport News, VA

North American Shipbuilding Company, Lockport, LA

Portsmouth Naval Shipyard, Kittery, ME

Space and Naval Warfare Systems Center, San Diego, CA

Swift Ships, Morgan City, LA

Textron Marine & Land Systems, New Orleans, LA

U.S. Navy Supervisors of Shipbuilding: New Orleans, LA; Pascagoula, MS; and Newport News, VA

International

Chantiers de l'Atlantique Shipyard, St. Nazaire, France

China State Shipbuilding Corporation, Shanghai Shipyard, Shanghai, China

DCN Indret, La Montage, France

DCN Lorient Naval Yard, Lorient, France

French Direction Construction Navale (DCN), Paris, France

Hutchison Whampoa, Ltd., Shanghai, China

Hyundai Heavy Industries, Ulsan, Korea

Samsung Heavy Industries Company, Ltd., Koje City, Korea

U.S. Consulate, Shanghai, China

U.S. Embassy, Paris, France

U.S. Embassy, Seoul, Korea

INTRODUCTION

Throughout history, the ability to acquire ships for military or commercial purposes has been deemed important to a nation's well-being. Within each maritime nation, the commercial sector valued shipbuilding for its ability to retool and meet the need of ever-changing transportation markets. The defense sector of these nations valued a robust shipbuilding industry for its ability to adapt and meet evolving mission requirements, such as refining platforms and integrating new warfighting technologies. The outcome of a robust, competitive shipbuilding industry remains a positive influence on military power, economic well-being, and national security.

Currently, the United States is the preeminent naval power in the world. No other country has a navy with comparable technology, range, endurance, or lethality.

However, despite the ability to build the best warships in the world, the United States is not a major shipbuilding nation. "First-tier" (i.e., the largest) U.S. shipyards are unable to compete successfully in the global commercial marketplace because of a combination of higher labor rates, older infrastructure and facilities, a lack of automation and other efficiency measures, and reduced government subsidization. By contrast, a few "second-tier" shipyards are internationally competitive in niche areas, producing small, specialized vessels and marine structures. The declining U.S. role in the international shipbuilding market is illustrated by its current ranking of 14th in the world with just 1 percent of the world's gross tonnage of new construction.[i]

Major U.S. shipyards are now almost totally dependent on the military for construction, as well as repair, maintenance, and overhaul orders. United States shipbuilders give military customers nearly everything they need—superior quality, weapons, and mission platforms. However, shipbuilders have not offered the customer market prices. In the post–Cold War period, the United States faces the difficult task of sustaining a modern, technologically advanced, and flexible navy in the face of changing threats, a declining fleet, competing defense budget demands, and a shipbuilding industry with too few incentives to reduce costs. The U.S. government gets premium ships, but pays a premium price.

THE SHIPBUILDING INDUSTRY DEFINED

The facilities and shipyards that construct, convert, repair, and overhaul government and commercial ships, barges, other watercraft, and offshore oil drilling and production platforms make up the U.S. shipbuilding industry. The industry comprises a mix of public and private yards. There are five public naval shipyards—Portsmouth, Norfolk, Pearl Harbor, and Puget Sound Naval shipyards, which currently perform repairs of government ships, and the Coast Guard Yard near Baltimore, which performs construction and repair.

The private shipyards of the commercial shipbuilding industry are a multitier business. The first-tier shipyards have construction facilities for vessels of 122 meters (400 feet) or more in length. As of 1999, there were 18 active shipyards within the first tier.[ii] Second-tier yards, producing ships and other vessels less than 122 meters in length, number several dozen.

Six major shipyards, operated by three owners, produce the majority of U.S. Navy aircraft carriers, submarines, surface combatants, sealift vessels, and combat logistics ships. General Dynamics owns three of these "Big Six": Bath Iron Works, Electric Boat Corporation, and the National Steel and Shipbuilding Company. Litton Industries owns two major shipbuilders: Ingalls Shipbuilding, Inc., and Avondale Shipyard. The third, Newport News Shipbuilding, is an independent corporation. These large shipyards are "system integrators"—like general contractors; they

combine the products of hundreds of specialists into a single ship.

There are a number of shipyards in the second tier, such as Friede Goldman Halter Marine; Swiftships, Inc.; Textron Marine & Land Systems; and Bollinger Shipyards. They generally integrate fewer complex systems in order to construct smaller vessels for the Army, Navy, and Coast Guard, as well as a wide range of commercial craft. The shipbuilding industry also includes numerous subcontractors and suppliers—they might be called third- and fourth-tier companies—that provide propulsion, fire control, habitation, and command and control systems, as well as a variety of other systems for military and commercial vessels.

CURRENT CONDITION

The U.S. government is the dominant customer of the domestic shipbuilding industry. The April 2000 order book contains $3.12 billion in commercial orders shared across 37 yards. By contrast, current government orders shared among 14 yards total $24.2 billion, or eight times the commercial order.[iii] There are 14 different types of government ships being built by the 7 largest yards. Newport News Shipbuilding in Virginia is the sole builder and refueler of nuclear aircraft carriers. Submarines are built at Electric Boat in Connecticut and Newport News Shipbuilding. The guided missile destroyers are built in two yards: Bath Iron Works in Maine and Ingalls Shipbuilding in Mississippi. Ingalls also builds the amphibious assault ships. Avondale Shipyard in Louisiana is building amphibious transport ships and sealift ships. The National Steel and Shipbuilding Company, the only West Coast private yard building Navy vessels, is building sealift ships. Marinette Marine is building two classes of buoy tenders for the Coast Guard.

The Big Six shipyards employ 90 percent of all U.S. workers engaged in the construction of oceangoing vessels. These six hold contracts for $23.7 billion of the total $24.2 billion government outlay and rely on the Navy for 9 of 10 revenue dollars. They have not been able to build large commercial ships competitively without government support. The last container ship made in the United States was built in 1992 at a cost of $129 million. A similar ship built in an Asian yard might cost as little as $25–$30 million.

The current U.S. shipyard commercial order book includes 3 large tankers worth $496 million; 2 cruise ships worth $880 million; and 120 miscellaneous vessels, including offshore supply vessels (OSVs), barges, rigs, ferries, tugs, pusher boats, crew boats, tour boats, and other products worth a total of $1.75 billion. Commercial orders (i.e., options, Letters of Intent) are pending for 8 tankers worth $591 million and OSVs, tugs, barges, rigs, and other such vessels worth $5.33 billion.[iv] Of these potential commercial orders, $810 million worth depend on funding assistance under the Maritime Administration's Guaranteed Loan Program (Title XI). If that assistance is approved, construction will begin on six small tankers, two ferries, a car carrier, a semisubmersible drill rig, and 39 barges.

The ship repair and conversion section of the U.S. shipbuilding industry is vigorous and has been successful in competing for work in domestic and foreign markets. The firms involved have parlayed location, timeliness, and competitive prices in attempts to compete with foreign repair yards. The work obtained from foreign markets has been critical to their survival because of the decreased amount of Navy repair work resulting from a downsized fleet.

CUSTOMER PERSPECTIVE OF THE U.S. SHIPBUILDING INDUSTRY

Military Customer

Investment in defense equipment has dropped by 70 percent since the 1980s with a corresponding adverse impact on the defense industry.[v] From the perspective of the Department of Defense (DOD), the United States is nearing the end of a phase of "living off the fat" of the aggressive ship and aircraft procurements of the 1980s. Downsizing of the respective fleets has reached the point where retiring ships without replacing them comes only at a cost to national security.

Thirty-three percent of the U.S. Navy combatants and 60 percent of the Coast Guard deep-water fleets are due for recapitalization in the next 10 years. These obsolete ships are more than 30 years old and have crewing and maintenance requirements that exceed the service's ability to operate them efficiently. If this recapitalization occurs, it could require an additional annual expenditure of $7–$10 billion in shipbuilding programs. The exact amount depends on the final course of action chosen by Congress and the President.

These developments can be better assessed in the light of three important conditions within the military shipbuilding industry:

1. Military downsizing has turned the corner, as both national political parties favor a modest increase in DOD acquisition funding, including increased spending on shipbuilding programs.

2. There will be an increase in the number of military ships ordered from the Big Six defense shipyards over current levels. As a result, work levels will be higher than they have been in the last 10 years. Production, however, will continue to be limited to only a few hull configurations.

3. Shipbuilding capacity in the United States exceeds current work orders by more than 30 percent, despite workforces that have been streamlined to record low levels.

Commercial Customer

Surface ships dominate global transportation of goods—measured in tonnage, volume, or value—and yet increasing demands for shipping are in prospect. A significant reduction in trade barriers among nations has made of the world a veritable "global marketplace." Economies are becoming more interdependent, and products are manufactured and traded across geographical boundaries more frequently. This increase in trade will require a corresponding increase in capacity for the shipping industry.

General estimates indicate that the demand on transoceanic shipping will more than double over the next 10 years. The logical extension of this estimate is that the emerging worldwide demand will require a doubling of hull volume, vessel speed, or a combination of the two. There is a real need within the shipping industry for new construction or rebuilds of existing hulls that will afford ship managers:

- More efficient container vessels
- Multipurpose vessels
- Larger hulls
- More durable construction
- Reduced maintenance
- Longer useful life
- Safer vessels with fewer accidents

The commercial shipping business will meet the projected demand for increased throughput by purchasing new vessels that afford some combination of these enhancements. But an increase in the overall number of hulls in use is unlikely. While the U.S.-flagged fleet is the 11th largest in the world, its average age (23 years) is 50 percent older than the remainder of the top fleets.[vi] Despite this combination of increased demand and an aging fleet, orders for U.S. commercial yards are limited. Cost is, of course, a major factor; it compels ship owners to extend the life of current ships rather than order new hulls from U. S. shipbuilders.[vii]

There are three factors of major consequence for the domestic commercial shipbuilding industry:

1. Foreign shipbuilders have accurately assessed the world shipping market, and the current supply of tanker ships is adequate to meet the demand over the next 10 years. That period will allow for the complete phase-in of the double-hulled tankers required under the U.S. Oil Pollution Act of 1990.

2. In terms of sheer volume, the same foreign yards can meet the demand for increased cargo-carrying capacity by producing low-technology, high-volume hulls for international trade.

3. Jones Act compliance will create a short-term demand for domestic shipbuilding, but the target ship size will be below the threshold of economic feasibility for first-tier yards. These yards may compete for the work, but experience shows they could not do so profitably using current business practices and technologies.

More hulls or more efficient mediums could meet the current and projected international demand for ship hulls. United States competitiveness in the international shipbuilding market will most likely be tied to an innovative breakthrough (e.g., something affecting speed, container handling, or fuel requirements) that affords greater life cycle efficiency to the ship operator. Even with such a breakthrough, however, the first-tier yards would have to invest in reestablishing ties with the commercial sector that have been dormant for nearly two decades.

The preceding discussion suggests that customer orders from the combined military and commercial markets are going to be near current levels for the next 10 years. That is, given no significant change in customer demands, a slight rise in military orders will probably offset a lack of large commercial orders. But this trend does not imply continuation of the same levels of earnings for first-tier shipbuilders. In keeping with the current tendency to fiscal constraint in ship procurement, the Navy and Coast Guard are crafting innovative acquisition processes to try to get "more steel for the same dollar"[viii] or "more capability for the same dollar."[ix]

Thus, if shipyards are to remain viable, provide an acceptable return on investment, and enhance national security, they must introduce certain variables in the way that they currently do business. They must promote and sustain vitality in the major business lines of the shipbuilding industry: supply, manufacturing, transportation, outfitting, and delivery.

CHALLENGES

For the past 10 years, shipyards have been "running to stay in place." Mergers, automation, rightsizing, outsourcing, and the introduction of new technologies have not resulted in significant savings to the customer, have not increased competitiveness in the international market, and have not made it easier to attract capital.

One industry study suggests that the amount of current work and the excess capacity across the Big Six yards should lead to a reduction from six yards to four.[x] The Navy and Congress see this market force as an unhealthy evolution and have introduced unnatural forces, such as split contracts and build shares, to keep the Big Six intact.

Consolidation of companies within defense industries has created a new core competency. That competency is the ability to manipulate contracts to give the government contractor what it wants, how and when it wants it.[xi] That competency does not help the industry compete in the world market, however. So while it ensures short-term survival, it is a long-term liability that fosters dependence on defense contracts.

During the current 10-year lull in government orders, shipyards have been developing management strategies to retain viability in three key areas: protecting human capital, renewing manufacturing capital, and managing a monopsonistic relationship with the U.S. government.

Human Capital

Economies achieved through an industry-wide reduction of six yards to four would come at the expense of approximately 20,000 workers.[xii] Big Six employment has already dropped from 82,000 to 54,000 in the past 10 years.[xiii] Further reductions in the number of public or private yards would put the human capital of the industry below critical mass. Accordingly, shipyards are struggling to retain the human capital necessary to maintain profitable production levels, assuming orders come in.

An aging workforce, a lack of sufficiently educated people at the entry level, turnover in the medium-skill positions, and union resistance to cross-training and cross-employment—all combine to further complicate the human capital issue. These conditions, and the training and education costs to address them, militate against the successful cost-saving initiatives introduced in the traditional business lines of steel bending and module integration.

Between 35 and 60 percent of U.S. ship cost is labor-related. By comparison, labor constitutes only 20–30 percent of the cost of foreign-built ships. Asian yards display a greater adherence to Fredrick Taylor's motion control principles and have translated process measurement to their automation efforts. This creates labor efficiencies for those foreign yards. Additionally, workers in U.S. shipyards receive an average of $18.08 per hour, whereas the hourly wage in Chinese shipyards averages less than $1.00; South Korean yards, $8.32; and Italian yards, $16.89. Only Japan's hourly wage of $26.15 exceeds U.S. labor costs.[xiv] It is important for U.S. shipbuilders to keep labor rates and related costs—for training, turnover, and the like—low in order to achieve competitiveness internationally. This compounds the human resources challenge. Additionally, compared with other skilled workers in the United States, shipyard workers receive lower pay and experience higher cyclical layoff rates. These two factors, combined with the rather high skill requirements of naval ship construction, make it difficult to attract and retain skilled workers.[xv]

A number of shipyards, including Newport News, Ingalls, and Bath Iron Works, have developed 4-year apprenticeship programs with local vocational/technical schools or community colleges. The programs combine academic instruction, technical trade training, and periods of on-the-job training. Participants in the programs usually receive an associate degree and, in some cases, Department of Labor and Department of the Navy Certificates of Apprenticeship. Yet difficulty in attracting high-quality entry-level personnel persists.

Manufacturing Capital

The Big Six yards lack the capital investment and sufficient operational area characteristic of foreign and second-tier U.S. yards. In fact, certain physical constraints translate to inefficiencies in the layout of their production facilities. Furthermore, despite the higher cost of labor in the United States, the level of automation lags behind that observed abroad and at smaller, competitive U.S. yards. That the existing yards are aging only exacerbates these inefficiencies.

The high levels of automation and capital investment abroad are in part attributable to more favorable industrial policies. Asian nations view shipbuilding and heavy industry as an engine of growth, whereas U.S. policy toward heavy industry seems to be *laissez faire.* There is also more horizontal integration across heavy industries in Asia. Technologies and equipment are shared among construction, shipbuilding, automaking, and other divisions within the same corporation. In the United States, smaller yards, such as that of Textron Marine & Land Systems, have used this strategy successfully.

Another explanation for the lack of capital investment in big U.S. yards is the manner in which they charge for government work. Their contracts are "cost-driven," and the major determinant is personnel hours. In that structure, there is little incentive to automate, and productivity declines. Like overseas yards, second-tier U.S. yards are "price-driven," so they have every reason to take full advantage of opportunities to automate.

GOVERNMENT GOALS AND ROLE

Two government agencies have leading roles in ensuring that the shipbuilding industry supports national security objectives. The U.S. Navy, as the primary customer of the industry, has a stake in ensuring the health of the industry. The agency specifically charged with assessing and managing the vitality of the U.S. shipbuilding industry, however, is the Maritime Administration (MARAD). The mission of MARAD is:

> . . . to promote the development and maintenance of an adequate, well-balanced U.S. merchant marine, sufficient to carry the Nation's domestic waterborne

> commerce and a substantial portion of its waterborne foreign commerce…and also ensure that the United States enjoys adequate shipbuilding and repair service…and reserve shipping capacity for times of national emergency.[xvi]

The Clinton White House maintains that "revitalization of the nation's shipbuilding program continues to be an Administration priority."[xvii] MARAD support of the shipbuilding industry during the 1990s came primarily through two budget line programs and the administrative support of MARAD professionals. The two key programs were the Maritime Administration's Title XI program and the government-sponsored shipyard research and development (R&D) program known as Maritime Systems Technology (MARITECH).

Title XI loan guarantees enable ship owners and operators to borrow private sector funds on more favorable terms than would otherwise be available. This is accomplished through the use of government funds to cover guarantee and administrative costs. Since the inception of MARAD Title XI assistance in 1993, $6 billion in construction and modernization costs have been secured through the program.[xviii] Government investment to achieve this level of growth amounts to about $300 million, based on a 5 percent loan subsidy rate. This is an excellent return on investment.

The Administration proposal for fiscal year 2001 funding of the Title XI program is only $2 million. Such an investment would free up only $40 million for shipbuilding industry-wide, a figure that falls far below what some advocates say would be needed to help U.S. shipbuilders improve competitiveness and take advantage of the few remaining phase-in years of the Oil Pollution Act of 1990.[xix]

The MARITECH program, in place over fiscal years 1993–1995, was conceived to help the U.S. shipbuilding industry improve its competitiveness as it "re-entered" the international commercial market. MARITECH sought to achieve this objective through (1) a comprehensive audit of the world ship needs and (2) a specific audit of domestic shipyard requirements for upgrade, with an emphasis on emerging processes for automation and the use of information technology. There were, however, two problems with the implementation of the program. First, the users of the program submitted proposals aimed more at current technology than at emerging or experimental technologies. Second, the proposals in information management predominantly addressed cost accounting within the DOD acquisition system.[xx] This is not surprising, considering the fact that government orders represent 90 percent of the current work at U.S. shipyards.

The MARITECH program was terminated after a brief run, and MARAD has not had an R&D budget in the 5 years since.[xxi] But the program did achieve some useful products. Sixty-five projects were funded on a cost share basis with industry. "These projects yielded 30 new ship designs, improvements in construction strategies, and improved marketing and ship sales. Shipyards invested $500 million

as a direct result of lessons learned in the MARITECH Program."[xxii] In April 1998, there were 21 commercial ships on U.S. order books, attributable in some part to the MARITECH program. The total contract value of these 21 ships exceeded $1 billion. The program's innovation also led to reduced expenses for Navy ships purchased or serviced on cost-plus contracts.

Currently, MARAD personnel are working on technology issues related to power plant efficiency, fuel economy, and emission control—all in an effort to help ship owners reduce operating costs for U.S.-built ships.[xxiii]

This analysis of MARAD performance highlights three factors worthy of note by the domestic shipbuilding industry:

1. MARAD programs have been effective in retaining some level of vitality within the shipbuilding industry.

2. Government investment in MARAD programs, despite their apparent success, has fallen precipitously. Because of the remaining oversight and reporting requirements, MARAD is in danger of becoming more a hindrance than a help to shipbuilders.

3. MARAD should seek to partner with MARITECH–ASE and provide that group with administrative assistance and federal funding.

CONCLUSION

Shipbuilding is a growing market with sharply decreasing prices. The world shipbuilding market is moving east: Japan and South Korea have nearly equal shares of 70 percent of that market, and the most rapid growth in market share—observed and planned—is in China. The European shipbuilding industry is particularly strained, owing to the sharp fall in prices attributable mainly to Asian yards.

The U.S. shipbuilding industry is not an effective competitor in the world market, a condition attributable largely to the more favorable national industrial policies, labor rates, and government investment in shipbuilding observed in many foreign countries. It does, however, meet the nation's basic national security requirements—no foreign navy can match the technology and the industry of the U.S. Navy—yet at a premium and ever-increasing price. The present mix of company business practices and government procurement policies combines to create products that are rapidly becoming unaffordable. The negative effects of those policies are spilling over into the commercial shipbuilding sector. While the U.S. shortcomings in world market competition can be corrected, the resources required to do so—i.e., to bring the U.S. industry up to world-class status—cannot be justified as long as the required assets can be purchased from foreign sources.

ESSAYS ON MAJOR ISSUES

ECONOMIC HEALTH OF THE U.S. SHIPBUILDING INDUSTRY

Naval vessels, particularly combatants, must be designed and constructed to perform at maximum capability across a wide range of environments. Only a handful of builders throughout the world engage in this demanding and highly specialized task. Therefore, naval vessels command premium prices compared with commercial vessels, even at the most complex end of the commercial market. But is the price paid for a General Dynamics, Litton, or Newport News vessel justified when compared with that of an Australian or French naval vessel? What makes U.S. naval shipyards unique and worth premium payments? More specifically, is the magnitude of these payments justified, and are the private U.S. naval shipyards maximizing the use of their resources to provide the best possible vessel at the lowest cost?

Since 1980, the value added by U.S. shipyards to the construction process has remained between 58 and 62 percent, and the total delivery value has fluctuated over a rather small band—$9.3 billion to $11.0 billion. This indicates that U.S. shipbuilders are neither demonstrating the characteristics of a learning organization (i.e., observing and making use of competitors' best practices as benchmarks or benefiting from feedback in their own company) nor improving their production processes. The size of the naval construction budget versus commercial purchases ($24 billion versus $3 billion as of April 2000) also indicates that any improvements by yards doing commercial work could be masked by the three biggest firms, which do the vast majority of the Navy's construction.

The share prices of the three major (i.e., "Big Three") U.S. naval shipbuilders (Litton, General Dynamics and Newport News) fell in 1999, mirroring the performance of the Standard and Poor's 500 industrial group. This raises the question of whether this reduction in market value is a rational reaction by the civilian investment sector. Answering this question, and determining its significance, requires consideration of three key economic factors: book value per share, total equity, and asset replacement costs. Book value per share, the amount of money each shareholder would receive if the company were liquidated, is determined from published balance sheet information. Between 1996 and 1998, the average book value for the Big Three increased 19.3 percent. The 30 percent increase experienced by General Dynamics and Litton was offset by a Newport News decrease. Likewise, total equity values for General Dynamics and Litton increased by 29 percent over the period 1996–1998, whereas Newport News values did not change.

The most recent MARAD annual report shows that capital investment for the entire U.S. shipbuilding and repair industry amounted to more than $2.6 billion between 1985 and 1997, averaging $205 million per year.[xxiv] Actual investment exceeded planned investment by almost 62 percent, but the accumulating depreciation of plant, property, and equipment (PP&E) accounts of the primary U.S. Navy vessel builders tempers this good news. The combined PP&E market value reported for the Big Three for 1998 was $8.7 billion. It would cost almost $12 billion to replace Big Three facilities in current dollars, assuming the reported depreciation, a 20-year schedule, and 4.5 percent inflation. Their combined depreciation amounts to $591 million dollars per year, for an annual recapitalization shortfall across the industry of almost $300 million per year. Thus, the annual depreciation accumulated by the Big Three yards more than offsets the entire industry's investment budget.

Further analysis, in two parts, has shown that the major U.S. shipbuilders are not maximizing employment of their existing assets. The first part employed Nobel laureate James Tobin's "Q" method, an assessment of management performance involving calculation of the ratio of current equity market value to PP&E replacement costs. In Tobin's system, values of less than 1 indicate substandard performance; values greater than 1, employment of equipment and personnel that should generate equity purchase interest prices. Of the three major shipbuilders, only General Dynamics shows above-average performance (1.48). The ratios for both Newport News and Litton are less the 0.5 for a 20-year depreciation schedule.

The second part of the analysis entailed the use of Stewart's "calculated intangible value" (CIV) method to determine how much the intellectual capital within these three companies contributes to profits.[xxv] Through CIV, it is possible to estimate the productive value of a company's organization and the efficiency with which the company employs not only its physical assets, but also the knowledge and talent of its workforce. The market value of Merck, the pharmaceutical company, for example, is substantially more than the sum of its physical and financial assets. Almost 65 percent of Merck's average pre-tax earnings can be attributed to its employment of intellectual assets. The same cannot be said of the Big Three U.S. shipbuilders; published financial data from all three companies shows that while their pre-tax earnings slightly exceed the Standard and Poor's 500 return on asset rates (3.5 percent versus 3.0 percent), only 22 percent of it can be attributed to resident intellectual capital. In other words, despite specialization in the naval construction sector, these firms do not show unique profits from their specialized knowledge and years of experience in a niche market. Neither do the data indicate that they are extracting unique value from their aging plant and equipment.

Consequently, the lack of interest that the commercial market shows in U.S. shipbuilders is thoroughly rational. Uncertainty about future work, an aging workforce, and substandard use of existing plant and equipment support the commercial sector's decision not to invest in these firms. The result is increasing vulnerability of strategic U.S. Navy programs, as the primary U.S. naval shipbuilders will continue to be restricted in their ability to fund manufacturing process upgrades. General Dynamics and Newport News are the only certified nuclear and submarine construction yards. Failure of these companies to invest in production facilities, particularly as an aging workforce begins to leave the industry, will leave the Navy without the domestic capacity to insert affordable new platforms with enhanced technology into the fleet.

EMERGING NICHES WITHIN THE SHIPBUILDING INDUSTRY

Technological advancements in ship design may provide the U.S. shipbuilding industry with an opportunity to assert itself in new niche markets. Significant

advances have been made in the area of high-speed ships. Among these are the fast ferries produced by International Catamarans (Incat) of Australia. Incat has built a wave-piercing trimaran that has a payload of 375 tons, a range of 350 nautical miles and a speed of 42 knots. One of its ferries, HMAS *Jervis Bay,* is currently under lease to the Australian Armed Forces and is providing logistical support to peacekeeping forces in East Timor. Additionally, Sweden's Stena Line is employing a very large catamaran ferry capable of carrying 1,000 tons at more than 40 knots. However, while there is undeniably a market for these ships, design and material limitations preclude the carrying capacity and range required for transoceanic applications or for any but the most limited military situations.

Perhaps a more promising design for general commercial application is Fast Ship Atlantic's semi-planing monohull. This design uses a deep "V" bow that eventually becomes flat and almost concave at the stern. It allows the ship's stern to ride on top of the water rather than squatting as it does with conventional ships. This planing effect reduces drag and gives the ship higher speed for the same horsepower. Fast Ship believes that its ship, which would be about 860 feet long and displace about 40,000 tons, could carry 1,434 twenty-foot equivalent units (about 10,000 tons) at 37 knots over a distance of 4,000 nautical miles. While a significant improvement over most other designs, this one still falls short of the carrying capacity of a conventional hull at equivalent displacement. Additionally, fuel usage for the six gas turbines that propel the ship would be about 15 times that of a conventional ship. However, Fast Ship believes that it can capture a segment of the transatlantic cargo market that would benefit from higher surface transit speeds and, thus, make its idea profitable.

Another aspect of the Fast Ship concept holds real promise for both commercial and military cargo. The company's design for a horizontal loading system uses pallets that ride on a cushion of air, much like hovercraft. In the offloading process, as many as 18 of these pallets are linked together and towed off the ship by means of a small tractor. This concept could reduce offload time by as much as two-thirds over the conventional crane process.

Ingalls Shipyard has produced a design for a large Surface Effect Ship they call the Surface Effect Vehicle (SEV). The SEV design would be capable of delivering cargo at a significantly increased range over even the Fast Ship concept—8,700 nautical miles as opposed to 4,000. Its speed and payload options would range from 55 knots with 1,800 tons of cargo to 37 knots with 10,500 tons.

The key to getting high-capacity, high-speed sealift off the drawing boards and into production is a teaming effort between the commercial and government sectors. While the military requirement for this type of capability is well defined, the commercial application is not. Historically, both the military and the commercial community have been risk-adverse when it comes to the introduction of new and radically different modes of sea transportation.

Partially funded by the federal government, the Center for the Commercial Deployment of Transportation Technologies (CCDoTT) is chartered to facilitate the

development of high-speed ships in the commercial market. It does so by exploring those technologies that streamline and enhance logistics capabilities. Among these are high-speed sealift, state-of-the-art cargo-handling systems, and agile port facilities. The shipbuilding industry should also work to accelerate the introduction of more fuel-efficient marine engines. For instance, the WR–21 gas turbine, a cooperative effort between the United States, France, and Canada, is projected to be 25–27 percent more fuel-efficient than current models. Research into the market for high-speed sealift could produce data that would allow industry to optimize its design for the target market, as well as focus marketing efforts. The CCDoTT could assist the commercial sector in its market assessment efforts. It could also assist Fast Ship Atlantic in determining whether its plan to target a very narrow segment of the shipping market is economically viable.

Another method through which the government could assist the commercial sector is the Voluntary Intermodal Sealift Agreement (VISA). Under VISA, the government pays a stipend to shipping companies that own ships with a potential for military use, with the understanding that in times of crisis these ships can be pressed into service to carry military cargo. VISA ships are also eligible for benefits under the Defense Features Act. This program pays owners to acquire militarily useful systems for their ships, such as 100-ton–capable ramps that could support the M1A1 tank and more powerful engines that can support higher speeds. Since most of these features have direct commercial utility, this program can help defray the cost of construction.

If the United States, through a cooperative effort between industry, the government, and the military, could develop the technology necessary to produce and support high-speed sealift ships, as well as the supporting infrastructure, it could potentially gain a significant advantage in the global market. As mentioned earlier, there is currently little competition for building large, very fast cargo vessels. If the United States could develop a market and production capacity for maritime cargo ships capable of speeds of more than 40 knots, it would find, at least for a time, a niche that would take its commercial shipbuilding industry out of head-to-head competition with the Asian yards. Early entry into fast sealift could provide the United States a significant advantage in the construction of large cargo-carrying vessels.

RECOMMENDATIONS FOR ENHANCING NATIONAL SECURITY THROUGH REVITALIZATION OF SHIPBUILDING

The U.S. national security posture and the U.S. Navy will benefit from a shipbuilding industry that is more competitive in the world market. Myriad government and Navy policies have worked against the industry's competitiveness. By changing the way that the government buys ships and supporting initiatives that level the global playing field, this industry can reduce costs for all customers, public and private.

Military Shipbuilding

The U.S. military ship procurement policies promote inefficient processes. Government policy maintains dual sources for each ship type where possible. Each bidding yard is guaranteed a share of the work. There is no strong incentive to improve competitiveness and cost efficiency, because survival is guaranteed whether the yard "wins" or "loses" the bidding competition. Also, because a shipyard's profit is based on the number of personnel hours expended on a task, its incentive is to increase rather than decrease the hours, thus lowering productivity.

To move toward cost reduction, the government must re-engineer the contracting process so that more of the risks and rewards go to the shipbuilder. For example, a revised contract fee structure and a steeper share line would allow a shipbuilder who saves money to keep more of those savings. On the other hand, money lost because of inefficiency would come to a greater degree out of the shipbuilder's profits. This will move the Big Six yards from a cost-driven philosophy to a price-driven one.

Once the government moves toward price-driven contracts, it must make "winning" the contract a more lucrative victory than the current 50–50 or 51–49 propositions. Efficiency should be rewarded with more stable, multiyear contracts. The Navy shipbuilding plan is subject to change every year, either within the DOD, the Administration, or Congress. It would be desirable to have closer collaboration among the stakeholders to create a stable shipbuilding schedule. This would allow shipbuilders to plan personnel and material requirements more effectively, leading to a reduction in program cost to the government.

Another government policy that inhibits efficiency in private yards is the work and funding quotas for public yards. Currently, 50 percent of the repair expenditures must go to the four public Naval shipyards. This takes a lucrative price-based opportunity away from the commercial sector. Every dollar spent in a government yard is a dollar taken out of the commercial industrial base.

A continuous review of functions must be initiated to ensure that the government engages only in those activities that the commercial sector cannot provide. The current practice of arbitrarily apportioning work in the interests of "competitiveness" creates inefficiencies. Given the present environment, a determination as to which sector is truly more efficient and effective is impossible. However, the public yards do provide vital services in terms of nuclear propulsion and submarine work that presently private yards cannot provide in a timely fashion. These critical competencies must be maintained.

Commercial Shipbuilding

There are various arguments in support of regulatory reforms to support the shipbuilding industry. It can be argued, for example, that the U.S. Congress should ratify a global trade accord that would end—or at least regulate—shipbuilding subsidies. Also, the U.S. shipbuilding industry and the U.S. economy would benefit from an increase in funding for the guaranteed loan program (Title XI). Implementing these recommendations would improve the international

competitiveness of U.S. shipyards.

In June 1989, the Shipbuilders Council of America filed a petition under Section 301 of the Trade Act of 1974 alleging that foreign government subsidies to the shipbuilding industry constituted an unjustifiable, unreasonable, or discriminatory trade practice that burdened or restricted U.S. commerce. The petition was aimed at Japan, South Korea, West Germany, and Norway. Virtually all shipbuilding nations, with the exception of Canada, have provided direct subsidies to shipbuilders. In the Asia–Pacific region and India, the subsidy can exceed 30 percent. European subsidies have ranged from 4.5 to 9 percent.

The petition was withdrawn in July 1989 after a commitment by the U.S. government to initiate negotiations aimed at controlling state aid to shipbuilding. In October 1989, the United States notified the Organization for Economic Cooperation and Development (OECD) of its intention to seek an agreement. The OECD completed negotiations in December 1994 when the Commission of the European Communities and the governments of Finland, Japan, South Korea, Norway, Sweden, and the United States signed the final act. This agreement sought to eliminate many subsidies to the international shipbuilding industry and also to prohibit dumping underpriced ships on the market.

Specifically, the agreement would prohibit export subsidies and grants; loans, loan guarantees, and capital on better terms than the commercial market; writing-off of debts; the provision of subsidized goods or services; discriminatory tax advantages; and discriminatory regulatory practices that favor the shipbuilding and repair industry, except in regard to provisions of the Jones Act.

The agreement does permit other forms of state aid, such as loan and loan guarantees to domestic purchasers of new ships (although the guarantee amount would be reduced from 87 to 80 percent); support for R&D at specified rates; and assistance to cover costs for displaced workers, yard closures, bankruptcy, or conversion to alternative productive activity. All of the affected governments, except the United States, ratified the agreement by June 1996. Many started voluntary compliance with the agreement in anticipation of U.S. ratification.

With the failure of the United States to ratify the OECD agreement, the Council of European Industry Ministers approved extension of European Union ship subsidies and financial aid packages to yards in Germany, Spain, and Greece. Sweden has reintroduced a 9 percent subsidy, and Australia has extended its 5 percent subsidy. In addition to direct construction subsidies, most shipbuilding nations have other programs to help its industries keep competitive. They include restructuring assistance; financing programs; scrap and build assistance; export assistance; tax benefits; customs duties, levies, and restrictions; government ownership; and R&D. European nations use innovative tax credits. In Germany, for example, individuals or corporations who invest in ship shares receive tax reductions equivalent to 100 percent of their investment.

Issues for Consideration

The following two issues—essentially, alternative strategies—are considered controversial, but they bear inclusion in a comprehensive academic report on shipbuilding.

International Competition for Naval Requirements. Lower labor rates in some countries make them extremely attractive locations for commercial shipbuilding. Shipyards in the United States simply cannot compete with countries paying minimal wages unless they make up the difference in higher efficiency, lower production costs, or subsidies. Since U.S. shipyards import a significant amount of equipment and material required for shipbuilding, and are not heavily automated, subsidized, or efficient, they are unable to compete on the world market. Gains in foreign shipbuilding automation and efficiency that outpace the U.S. shipbuilding industry will likely exacerbate this problem.

Efforts to sustain or improve U.S. shipyards pale in comparison to those of foreign shipbuilding nations. There is comparatively little money being invested in the United States to improve shipbuilding infrastructure and commercial competitiveness—primarily because the six primary yards recognize their inability to compete on the international market and have chosen to exist by producing ships for the essentially noncompetitive U.S. Navy "market."

Maintenance of a highly inefficient and costly military shipbuilding capability reflects its perceived importance to the national defense and survival. In view of this dynamic, the United States could substantially reduce its warship procurement costs by competing future warship-building requirements on the world market. As long as no country or block of nations possesses monopolistic pricing control over the worldwide shipbuilding market, millions of dollars could be saved. Even under the worst of circumstances, monopolistic pricing would be unlikely, for shipbuilding is a very competitive industry, and Japan and Korea, two very strong U.S. allies, control more than70 percent of the market.

Nationalization of Shipyards. A controversial alternative to buying military ships from the private sector is nationalizing some or all of the existing private yards. Major U.S. shipbuilders understand that they are not competitive on the international shipbuilding market and have chosen to rely on U.S. warship construction for their survival. Consequently, since U.S. government policy dictates the limitation of warship construction to a small group of domestic suppliers, the government will bear virtually any cost to meet its minimum requirements. This entails paying for rampant inefficiency and duplication of effort, and paying labor and material costs much higher than those of countries such as South Korea and China—all in the context of a government-allowed profit margin of approximately 20 percent.

Nationalizing shipyards that construct U.S. warships would have many positive effects: avoidance of unnecessary duplication in terms of personnel and equipment, including those personnel currently retained for commercial applications; standardization of policies and procedures; sharing of technology and efficiencies, thereby eliminating competition; and establishment of rigid price and production controls. Additionally, the government could realize reduced material costs through bulk purchasing. Greater efficiencies could be achieved through uniform accounting, personnel, production, and inventory management systems. The main drawback to nationalization is that it installs government control over, and operation in, a previously private industry—a contradiction in the U.S. free market system.

An increased vitality of shipbuilding and its related industries will enhance national security. Improved efficiency is achievable through the adoption of some combination of these varied recommendations as a revitalization strategy. Such a strategy will give the government more steel for its dollar and, thus, buy national security at a more reasonable price. The increased vitality of the overall industry will help individual shipbuilders to better afford the excess capacity and surge

capability desired to support U.S. national security objectives.

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