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Could Our Shipyards Cope? If Not, Then What?

Paula J. Pettavino

Some may still believe that Franklin D. Roosevelt pulled the industrial mobilization switch when Pearl Harbor was attacked in December 1941. Anyone believing this is in error. Evidently, error abounds, especially concerning this country's shipbuilding and ship repair industry. Masquerading as truth, this error is often used to justify a policy of neglect toward that industry. With the possible exception of building commercial nuclear reactor plants, no construction or manufacturing has ever approximated the building and repair of large, complex ships.

Briefly stated, the shipyard capability and capacity needed by the Nation to defend itself is inadequate and has no prospect for bettering itself in the foreseeable future.

The cost of special tooling in automobile manufacturing can be dispersed over hundreds of thousands of cars. Specialized machinery for ship construction often must be apportioned over only three or four ships, resulting in a very high cost per ship. A ship requires years to design, years to build. Once completed, especially a fighting ship, she is expected to serve a useful life of 30 years or more, during which time the design must prove flexible enough to allow modifications unforeseen when the ship was new.¹

The myriad skills and facilities used to construct a ship—the plant knowledge of naval architecture, production skills, and managerial talents—are of small worth if not being used to build ships. Though there are some exceptions, on the whole, shipyards cannot be converted to produce an alternative commodity and have little value unless there is a demand for the product. When product demand slackens, the talents and plants fade away.²

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Let us examine the tasks to be performed by shipyards during a national emergency. Those yards would be required to:

- reactivate the reserve fleets;
- hasten the completion of ships under repair;
- carry out routine ships' maintenance;
- accelerate the completion of ships under construction;
- repair ships that are battle-damaged; and
- build new ships.

This is a formidable list of tasks, tasks that would have to be performed both rapidly and well. For example, during a mobilization period, just before or just after a war had begun, hundreds of idle ships would have to be made ready for service simultaneously. Though the ships most critically needed are already assigned to yards for activation, for most of the ships, unfortunately, there is no apparent plan that assigns them to yards for this purpose. Indeed, the materials and equipment needed to prepare ships for sea are scarce.

The three broad classes of shipyards are:

- privately owned shipbuilding yards that could perform part of each task listed above;
- privately owned ship repair yards that could modify much of the commercial fleet for military service and breakout, and ready for service the ships in the reserve fleets; and
- government-owned shipyards that would be fully engaged in the activation, maintenance, and repair of the Navy's ships.

Today there are 24 privately owned yards holding or actively seeking construction contracts for large oceangoing or Great Lakes commercial and naval vessels. In 1982 there were 27 such yards. Of the surviving 24, only 18 have shipbuilding contracts. In 1982 there were 83 privately owned repair yards. Currently there are 50.

There are nine public shipyards, eight belonging to the Navy and one to the Coast Guard. They cannot be expected to build, reactivate, or repair merchant ships.

It is clear that, as measured by physical assets, the size of the shipyard mobilization base is shrinking, as is the number of workers in those yards. In the last six years the shipyard work force has fallen by more than 28,000 employees, or 25 percent nationwide. The west coast has experienced a disaster, with a 51 percent loss in shipyard jobs.

Moreover, the character of the industry is undergoing rapid change. Nearly 60 percent of the workers in private building yards are employed by only three companies: Electric Boat, Newport News, and Ingalls. Another 25 percent are spread among twelve smaller yards. Few of these yards, which are engaged mainly in construction and repair for the Navy,

have reasonably secure work loads. The remaining 15 percent of the work force and their employers seek any jobs they can find.

Of the 74 privately owned shipyards, almost one-half are very small, with fewer than 300 employees each. Many have fewer than 150 production workers, and a significant number have no facilities under their direct control or ownership. Small yards with only one program continually face difficult decisions in the allocation of their labor force because demands for occupational specialities change as jobs progress. For example, in a robust economy, naval architects, after completing their portion of a job, would proceed to the firm's next project as the welders picked up the bulk of the work on the ship in progress. If there are no other programs in sight, must the yard then release its labor? This high concentration of the industry in a few large firms is an economic and military vulnerability requiring little comment.

Some Assumptions and Some Questions

For the moment, let us assume that there are enough shipyards for the nation's mobilization. Should we also assume that there are sufficient skilled production workers, engineers, and managers? Presumably, given a national emergency, designated reserve ships will be reactivated by the shipyards within 30 days of the order to begin. Most of the ships in the Ready Reserve Force would be towed to the shipyards during the first 10 days of mobilization. By the tenth day this would peak at well over 500 ships.

As the ships are made ready for service, it is expected that the number of vessels in the yards will fall rapidly, unless, of course, the naval and merchant fleets suffer severe battle damage in the early engagements. Should this be the case, then a substantial additional work load would be placed on the yards. In this regard it should be remembered that only 10 months after Pearl Harbor, the west coast yards were so overloaded that the Pacific Fleet had to send some of its most badly damaged ships to the east coast for repair.

There are some favorable, and possibly erroneous, assumptions we could make. First is the supposition that yard workers employed at the moment of mobilization would be available immediately for mobilization work. Should the jobs they are working on at that time be considered less urgent than the need to make ready some long-idle ships? Second, should we assume that worker skills are homogeneous; that an electrician and a welder are interchangeable, or that a worker skilled in the construction of a certain kind of structure or part of a ship would be equally skilled in the repair of battle damage spread indiscriminately across a ship's structure and systems? Third, can we assume that workers could be readily relocated? Does that correspond with current American family practices and values?

Where the Money Goes

The percentage of the Navy's shipbuilding budget actually being spent in the shipyards is declining. As the new ships become ever more complex, most of the money which once went into the ship is now spent on outfitting her with various advanced systems. Under the 1986 naval construction budget, only 36 percent was contracted with shipyards as compared with nearly 50 percent in 1981. Thus, the number of on-site shipyard workers required to meet the needs of the Navy in *peacetime* is declining, partly because of increased yard efficiency and partly because of the changing nature of ships under construction. (Merchant ships, of course, are very different from fighting ships.)

Most of the funds in the Navy's current five-year shipbuilding plan are scheduled for the purchase of nuclear-powered ships, other high-technology combatants, and some large (and not very simple) support ships. Many of the shipyards in need of work are incapable of building such ships and, in the absence of new work, survival prospects for about one-half of the yards are bleak. The consequence will be further loss of capability in the shipyard mobilization base.

Where the Manpower Goes

It seems unlikely that workers in the nuclear construction and repair element of the industry will be diverted to nonnuclear mobilization tasks, for, no doubt, submarines and aircraft carriers will have the highest priorities. At the close of 1986, the total number of shipyard production workers engaged in the construction and repair of nuclear vessels was 38,500, or nearly half of all those in the industry. That part of the force potentially usable for most mobilization work, the nonnuclear construction and repair staff, numbered 46,300. By the end of 1989, employment in nonnuclear construction and repair is projected to slip to about 42,000 employees.

As U.S. shipyards become more productive and efficient, ship construction continues to require ever fewer workers. Despite the appearance that shipbuilding has become, in part, an assembly-line process—where complete modules of ships are built and installed—it is no such thing. Not only do today's small building programs preclude duplicating the mass production of World War II, but the ships themselves are much larger and more complex than they were nearly a half century ago. In consequence, shipyard worker skills, as well as those of managers and engineers, have become highly specialized, with primary emphasis on new construction processes and techniques. Workers in steel fabrication, pipe shops, painting facilities, unit assembly shops, and the like rarely leave their facilities. Thus, it is unlikely that workers trained and experienced in new construction under

modern processes have ever been aboard a completed ship in the water, much less possess the skills needed to repair the kind of damage ships are likely to incur.

The shipbuilding and ship repair industry presently consists of a few large, sophisticated yards capable of building and repairing major naval vessels (at present the 10 largest shipyards employ 88,000 workers, or over 82 percent of the total employment), and a larger—but not large—number of small, specialized ship repair companies are able to carry out the currently needed level of naval ship repair. The number of people doing other work and available, motivated, and properly skilled for shipyard work may prove surprisingly small.

Here are some important differences between the industry we have now and that whose work of nearly half a century ago we admire so much.

The Old Days and the New Ones

The first important disparity between the two time periods is that the shipbuilding industry at the time of Pearl Harbor had been gearing up since 1933. Today's industry is clearly downshifting.

There is a simple building formula that is useful to weigh the effectiveness of shipyard capacity. A "generic freighter" requires about one million man-hours to build, or 500 production workers per ship per year. A "generic combatant (frigate)" requires 2.5 million man-hours or 1,250 production workers per ship per year. In an unprepared economy, with neither pre-engineering of ships nor stockpiling of weapon systems, the first deliveries of merchant ships would take about 18 to 27 months from the word go. For combatants, the delivery times would be on the order of 28 to 39 months. Of course, the throughput rate would improve over time as production geared up and skilled labor became available. However, if the contingency required new building immediately, as was necessary in World War II, it would be a long time before the new ships were available to any combat commander.

During the peak construction year of 1943, the number of ships produced in U.S. yards equalled the number built during the 25 years before the war. This was made possible, in part, because manpower was available and did not become scarce until the last two years of the war, 1944-45. At the time of the buildup, our country was still suffering from the Depression's high unemployment. (Funding for expansion of naval building before the war gained considerable political support because shipbuilding was a labor-intensive activity.) According to a survey of privately owned U.S. yards, the large pool of unused labor that was available then no longer exists. Tens of thousands of women left their kitchens and entered the work force during World War II. Today, their successors are already in the work force—and

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many of them are already working for the defense industry. Farms, formerly big consumers of labor, now employ only a miniscule number of workers. That source of manpower, which was so important 40-odd years ago, is likely to prove a dry well when tapped.

High wages drew labor to the shipbuilding industry during the Second World War. One should no longer rely on that attraction. In December 1986, weekly wages in the construction industry averaged \$468.63 for a 36.9-hour week (\$12.70 per hour) compared to \$481.15 for a 41.3-hour week (\$11.65 per hour) in the shipbuilding industry. (In the aircraft and parts industry, weekly wages for a 43.5-hour week are \$569.85 at \$13.10 per hour.)³ Further, the turnover rate in shipbuilding is aggravated by the absence of predictable, stable work loads.

The growing immobility of labor is an additional problem for shipyards. When facilities close, workers tend to seek employment in other industries in the immediate area, rather than relocate.⁴ A recent survey of privately owned shipyards in both metropolitan and isolated areas substantiates the difficulty in recruiting workers from outside the geographical area of a shipyard, even when they are offered an attractive wage and fringe-benefit package. In addition, workers with certain skills are plainly hard to come by. Regardless of the geographical area, welders seem to be plentiful, but electricians are always scarce. This lack of mobility and scarcity of skills would force the yards to hope for good results from semiskilled workers and accelerated training programs.

The average worker is 20 percent efficient after three months on the job, 40 percent after six months, 50 to 60 percent after twelve months, and 75 to 80 percent after two years. In practice, productivity growth often falls into the negative range during periods of training when the efficiency level of trained journeymen is lowered, while new members of the labor force are being trained. After several years of trade school it takes about three and one-half years to train a welder or machinist to the journeyman level, and four years to do the same for a shipfitter or an electrician.

Shift work and overtime would certainly help in mobilization, but there are costs to be paid here, too. Generally, prolonged overtime reduces an individual's efficiency. As measured in hours: 8 hours of overtime per week yields 90 percent efficiency; 16 hours—75 percent; 24 hours—50 percent; and 32 hours—25 percent. One reason for the high rate of shipyard absenteeism and turnover during World War II was the sheer exhaustion of the workers.⁵ Even so, it is probable that manpower shortages could be resolved with training programs because the delivery of those components requiring long lead times could take longer than the time to train new workers.

Bad Now. Worse to Come?

In 1985 Newport News estimated that it bought more than 250,000 separate items from approximately 3,500 suppliers.⁶ Because the commercial market for ships is essentially barren, the number of suppliers is far fewer than it was. This problem is worsened by the general competition of all heavy industries, not only shipbuilding, for the products of the same few suppliers. Therefore, although in peacetime two domestic suppliers of large forgings may appear to be sufficient, they could never support the demand that would arise with mobilization.

Some examples of where we are currently deficient in the capability to produce major equipment for ships are:

- reduction gear capacity which has severely diminished along with the commercial marine market;
- steam turbine capacity which is down nearly to zero;
- and—only since December 1987—we are no longer able to build large direct-drive (non-g geared) electric motors.⁷

True, there were shortages of components during World War II as well, however, with the more simply designed vessels of the time, suppliers could more readily adapt whatever was available. Thus, some destroyer escorts of that time were powered by steam engines, others with diesels, some were armed with 5-inch guns, and others with 3-inch guns.

The technologies available for ship propulsion during a mobilization would probably be limited to geared drives. The two prime mover technologies available in quantity would be diesels and gas turbines. But, the capacity to build large diesels in the United States is small and declining. The production of gas turbines is in direct competition with that of jet aircraft engines, since both are built on the same production lines. The current level of jet engine production uses the full resources of present suppliers.

Further, technological advances require the import of many materials or parts either unavailable or in very short supply in this country. (The situation is further complicated because less than one percent of these critical materials are shipped in U.S.-flag ships, thereby creating an additional dependence on foreign sources—but that is another story.)

A look at the industry supplying auxiliary equipment reveals the general decline in the ability of the United States to produce industrial gearing, electric motors, and generators. Materials, forgings, castings, and bearings are in short supply from U.S. producers. Each critical item sought by the Navy or a shipyard for use on a U.S. ship competes with the needs of other would-be purchasers for the same component, from the same supplier.

Perhaps the most significant difference between U.S. shipyards of the 1930s and those of today is the changed nature of the international

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environment. In 1940, about 200 merchant ships were on order in privately owned U.S. shipyards. Today there are none. Since 1970 the worldwide division of the commercial shipbuilding market has changed drastically, as the following table illustrates:

	1970	1986
Japan	45.0 percent	36.8 percent
Sweden	8.0	
West Germany	6.0	1.7
Spain	5.0	2.1
United Kingdom	5.0	1.2
United States	3.0	1.1
South Korea	0.3	15.9
Taiwan		4.4
China		2.7 ⁹
Others	27.7 ⁸	34.1
Total	100.0 percent	100.0 percent

For many reasons, the shipbuilding industry in this country has not been competitive on the international market since 1850 and is, therefore, unable to match the prices offered by South Korean and other overseas yards. What this has meant to us, especially since World War II, is that without naval and subsidized commercial building contracts, there can be no American shipbuilding capacity.¹⁰ The question then is, how does an industry that is facing certain decline continue long-term strategy for business development?

The problems of American shipbuilding are not easy to solve. If there were no national security need for ships, there would be no need for the shipbuilding industry, and there would be no lamenting its demise. However, ships and, therefore, an industry able to build them, are essential for the defense of the country. Yet, there is no consensus as to what we should do to sustain the industry or even, surprisingly, whether it should be sustained.

Even though we do not have agreement within either the Government or the academic and think-tank arenas in which defense issues are discussed and decided, there are things the Defense Department and, more specifically, the Navy, can do to help sustain the country's shipbuilding industry.

The first thing is to assume a mental attitude towards the need to be able to build new ships and repair old ones similar to the attitude the Navy assumes within its ships towards damage control. That is, it is wiser to mobilize as closely as possible to the *fear* of what might happen rather than hope that any potential conflict will require only the level of capacity that has been maintained. It is this very wisdom which impels the Nation to

maintain powerful armed forces in the first place. It is unwise to assume that the enemy will be unwilling to harm us in a situation for which we have chosen to be unprepared.

Two practical acts are available to the Navy and the Defense Department now. The first is to recognize as essential criteria (for contract awards), factors other than that of the lowest bid. This would help the remaining west coast yards (where the cost of living, hence wages, is higher than in some other places) to build enough ships so that they can stay in business and be available should an emergency befall us.

The other is to ease the burden on all yards anxious for naval work. For example, yards bidding for such work must justify every calculation of manhours and provide at least three quotations for all items of material and equipment. Every element of overhead cost also must be explained and justified.

As a result of such requirements, one private shipyard competing for the recent AOE program presented a proposal of approximately 4,000 pages delivered in eight large three-ring binders. All bidders produced similar proposals. Yet only one of them won the contract. Surely, the Navy can help its shipbuilders survive by cutting away such expensive (and usually unrewarded) practices.

The patient is badly injured and acts such as these are only first aid. But first aid may be enough to keep the patient alive until the defense and defense-interested communities can develop sufficient consensus to allow decisive action.

The decisive action needed is a step which balances the public consensus that it is proper for us to have a powerful navy with the fundamental contradiction that simultaneously we are content to be weak in the other elements of our maritime strength, commercial shipping and the shipbuilding industry.

The current American maritime structure is like a beautiful flower without a substantial root system. If we do not strengthen the roots, the flower is in danger of perishing.

If this means we must subsidize the industry, then let us develop a federal plan and get on with it. The matter is not one to be seen only as a matter of the marketplace in a capitalist society, of an industry which can be sacrificed for its lack of competitiveness. Rather, our need for the shipbuilding industry is as basic as our need for a powerful standing Army, Navy, and Air Force.

By ensuring the existence of the shipbuilding industry, we may be paying for something we do not need. By permitting it to pass away we may avoid

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wastage, but in doing so, we may also do away with an industry essential to our country's survival. The choice is ours.

Notes

1. Henry L. Troger, "The Shipyard Wage Systems," in F. G. Fassett, ed., *The Shipbuilding Business in the United States of America* (New York: The Society of Naval Architects and Marine Engineers, 1948), v. 1, p. 295; Burnham Finney, *Arsenal of Democracy: How Industry Builds our Defense* (New York: McGraw Hill, 1941), pp. 212-213; Brady M. Cole, *Procurement of Naval Ships*, National Security Affairs Monograph Series 79-5 (Washington, D.C.: National Defense Univ. Press, September 1979), pp. 29-30.
2. Fassett, pp. 2, 3.
3. U.S. Dept. of Labor, Bureau of Labor Statistics, *Employment and Earnings* (Washington: March 1987), pp. 82, 83, 88, 89.
4. Jacques Gansler, *The Defense Industry* (Cambridge, Mass.: The MIT Press, 1982), p. 189.
5. Informal survey conducted by the Shipbuilders Council of America, April 1987.
6. U.S. Congress, House, Seapower Subcommittee, *Current Status of Shipyards*, Hearings (Washington: U.S. Govt. Print. Off., 1974), p. 855; Jim Hessman, "Anatomy of a Ship," *Seapower*, July 1986, p. 30.
7. Specific information on the status of the shipbuilding supplier industry is derived from discussions with allied industry members of the Shipbuilders Council of America.
8. Industrial College of the Armed Forces, *The United States Shipyard Mobilization Base: Is it Ready for War?* (Washington, D.C.: National Defense Univ. Press, 1984), Mobilization and Defense Management Technical Reports Series, Mobilization Studies Program Research Paper, p. 12.
9. *Lloyd's Register Shipbuilding Return for Quarter Ended June 1986*.
10. Cole, pp. 3, 4; John T. Hayward, "Shipbuilding: Problems Beset the Navy's Program," *Government Executive*, June 1974, pp. 81-83.



"But in its relation to strategy, logistics assumes the character of a dynamic force, without which the strategic conception is simply a paper plan."

Commander C. Theo Vogelgesang, U.S. Navy
"Logistics—Its Bearing Upon the Art of War"
Lecture, Naval War College, Newport, R.I.
Published in the U.S. Naval Institute *Proceedings*,
v. 30, no. 1, 1913