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Problems and Prospects of the United States Shipbuilding Industry

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The U.S. shipbuilding industry is in for a decade of dramatic change and strange anomalies: it will be a period when the contract definition of procurement will come under fire even before its fruits have been fully realized; it will be a period when U.S. ship contracts will be the highest since World War II, yet shipyards will go out of business; it will be a period when the advance of military technology will create a major problem in configuration for management; and it will be a period when we will see a cost parity among United States, European, and Japanese yards that will allow U.S. shipbuilders—who survive the decade—to compete effectively in the world market of the 1980's.

PROBLEMS AND PROSPECTS OF THE UNITED STATES SHIPBUILDING INDUSTRY

A lecture delivered at the Naval War College

by

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Any overview of American shipbuilding must include a discussion of our industry's ability, or lack of it, to compete today in world markets with shipbuilders of other nations.

Presently, we cannot compete effectively in world markets but not, as some have said, because of inherent deficiencies or inefficiencies in American shipyards. We cannot compete effectively today outside the United States largely because of the rising price required for maintaining a high American standard of living. The industry is paying the highest prices in the world for both shipyard labor and U.S.-made components and other materials used in American ships.

Today, U.S.-made components and other materials account for more than 50 percent of the cost of an American ship. Where foreign shipbuilders can purchase similar products made elsewhere in the world at prices from 10 percent to 70 percent lower than those charged in the United States, we cannot use these products because, in most instances, U.S. law requires that the overwhelming percentage of construction materials needed on U.S. Navy ships must be of U.S. origin and manufacture. For Maritime Administration-subsidized ships, insofar as practical, 100 percent must be "Bought American."

Consequently, at least for the time being, American shipbuilders must content themselves with the domestic market until cost parity in world shipbuilding is achieved. There are indica-

tions that cost parity for United States, European, and Japanese shipbuilders will occur sometime in this decade, certainly by 1980. A major indication is the trend in wage rates, as we observe that wages now being paid in non-U.S. shipyards are rising faster than in the United States. At the same time, American shipbuilders must concentrate on upgrading existing facilities, turning more and more to specialization, and adopting more sophisticated methods of construction in order to effectively meet the near-term challenge and opportunity posed by the renaissance we now see taking place in American shipbuilding.

In the next 10 years we can expect to see the U.S. Navy's requirements call for a variety of ships costing an average of $3 billion a year. At the same time, President Nixon's plan to rejuvenate the American merchant fleet with 300 new ships will generate another $500 million a year in business. In both cases, Congress has determined that such ships will be built in the United States by American shipbuilders. Those who effectively meet this challenge will also be in a very good position to meet the future and even more imposing challenge of the world market. Those who do not, and there will be some, will not be around to care.

Let us now turn to specifics about the industry. First, shipbuilding is one of the few industries which can lay claim to being both people intensive and capital intensive. As to the people-intensive characteristic, most shipyards in the world provide employment to thousands of people in one location. Frequently the shipyard is the largest employer in its immediate area, sometimes in its state, and occasionally in its entire region, providing not only thousands of shipyard jobs but also creating hundreds of additional service jobs in the community: grocers, barbers, home maintenance, et cetera.

Thus, the shipyard is a natural center of gravity for a tremendous amount of attention on the part of local, State, and Federal officials and regulatory agencies. Under such circumstances, the typical shipyard has daily involvement with labor relations, safety, pollution, and equal employment opportunity matters. So much so that the people-intensive nature of shipbuilding creates a management constraint of a size and proportion seldom seen in other industries. This produces the situation where considerable management and money resources are directed from production efficiency into caring for the people doing a lot of different jobs needed to build ships.

As for shipbuilding's capital intensity, allow me to describe it this way: it takes years to build a ship manufacturing facility, principally because it is literally set in concrete. Once built, that facility is most difficult to reorient or reorganize. Sixty to 70 percent comprises pilings, foundations, concrete ramps, rail lines, fences, piers, graving docks, buildings, and craneways, with metalworking and metal forming equipment representing only a small percentage of the total investment.

The reduced flexibility of a shipyard is constrained even more by the simple fact that it must be contiguous to deep water, requiring considerable investment in bulwarks and dredgework immediately offshore. Even if it could be moved easily, it can be moved only to another shoreside site, and little of its original investment can be moved or changed.

What about the product of the shipbuilding industry? In recent years, ships of all types have been growing more sophisticated at an exponential rate, from the use of new high-tensile steels in the hull to the complexity of the electronics, automation, environmental, and weapons systems.

In addition, new U.S. ship designs cover a widening range of sizes, types, and missions. From this diversity of

requirements we have learned that, for example, the facility specifically adapted to the efficient construction or overhaul of nuclear submarines cannot efficiently manufacture barges. We have learned also that management of any shipyard can be spread extremely thin if it must concentrate on numerous programs of one and two ships each, with each type widely different from the others. Orderly planning of the infinite variety of disciplines, both engineering and hand-skilled, represents a sizable undertaking as the workload shifts from ship type to ship type. Furthermore, uniform quality control standards cannot be maintained from program to program. Out of all this grew the realization that specialization must occur in the shipbuilding business.

As one might suspect, these conditions have had some effect on U.S. Navy procurement policies. During the years preceding 1965, the U.S. Navy procurement policy was to contract for one, two, three, or four ships at a time, in order better to spread the workload among all the major shipyards of the United States. This more or less kept each of some 15 yards alive through the pre-1965 procurement era.

These procurements, generally, were competitively bid on a fixed-price basis. The Navy utilized its own in-house design capability—plus some four or five leading naval architectural firms—for the contract design and specifications, usually without considering the integration of design with the particular production facilities which might win the award. These contract design and specifications were less than adequate for precise estimating, and the bidding time was quite short, 60 to 90 days, considering the size and complexity of the product. The result of this process is predictable. With insufficient ships to go around and with a procurement bait of ship lots of one, two, three, or four, most situations found six to seven shipyards bidding.

Given these circumstances, it is inevitable that the contract would go to a yard desperately needing the work or one which failed to allow sufficient costs in its estimates for engineering design inadequacy. As working drawings were prepared and during ship construction, the shipbuilder found many discrepancies in the naval architect's two-dimensional plans and specifications. These discrepancies usually became apparent and were corrected at great cost in the field by skilled craftsmen.

Few shipyards could afford to maintain any "feedback" to their engineering departments for amendments and corrections to drawings. This resulted in further confusion in instances where a second shipyard bid on a subsequent lot of ships after the original or lead yard had produced the working drawings. In this instance the follow yard, utilizing the lead yard's working drawings, again found the same interferences and deficiencies which the craftsmen in the lead yard had corrected, but such corrections had not been documented to or by engineering.

During the same period, most shipyards, particularly those contiguous to large population centers, suffered serious attrition as their skilled work forces moved to greener fields. This left fewer people on the waterfront capable of efficiently coping with engineering errors and omissions. This generally deteriorating situation was the cause for most major companies to report losses on shipbuilding operations to their stockholders during the midsixties. It also generated claims holding the customer responsible for the problem. Change orders and claims generated during that period of time are a prospect with which DOD budget makers must contend in the next few years.

Beginning in 1965, a new approach to solve many of those costly and time-consuming problems was created. After the concept formulations on the Fast Deployment Logistics program, the

LHA amphibious assault ship program, and the DD-963 destroyer program, the Navy requested design proposals for these type ships. From these proposals it selected three or four competent shipyards for a contract definition competition. Each contracted yard was expected to design a ship that would accomplish the operational concept as formulated by the Navy, to make the necessary considerations in the design for producing the ships in their production facilities and to use total systems analysis, providing for life cycle cost analyses (techniques which had not been employed by the naval architects).

In comparison with previous procedures, contractors had achieved a ship design in greater detail, with more conformity to the manufacturing operation to take place later, and with optimization of all subsystems consistent with the ship system as a whole and consistent with the mission of the ship. Needless to say, the contractor had a much better idea than ever before of what he was bidding on and what it would cost.

During the course of these design competitions, Litton Industries recognized the need for a new facility in this country, not merely to increase capacity, but to upgrade American capability with respect both to cost and the ability to manufacture ships of all sizes in series production. In 1967 we began construction on a large new ship-manufacturing facility that included many new ideas in materials handling and ship integration, hitherto unseen in the Western World. The leadtime between making that decision and having a producing facility was 3 to 4 years, and we were anxious to be in production by 1970 to serve our customers.

One cannot look at the problems and prospects of the shipbuilding industry in the decade ahead without considering the impact of Litton's new and highly automated ship manufacturing facility. Among other things, the existence of this new facility, plus a capability which we had been assembling under our Litton corporate roof for systems analyses, marine electronics, and naval design work, enabled us to win the FDL program, the LHA program, and the DD-963 program. Suddenly, instead of the piecemeal, helter-skelter division of work among 15 major shipyards, a big backlog was accumulated for one large, new manufacturing facility. Quite naturally, this created deep concerns throughout the rest of the industry.

These concerns were heightened recently by a report of the Institute for Defense Analysis under a contract to the Department of Defense. This report analyzed the major shipyards of the United States under two assumptions: one called for a relatively small shipbuilding program during the next 12 years; the other assumed a relatively larger one. The report concluded that the available military and commercial business, under the small program, would generate sufficient business to keep busy only the new Litton facility plus one existing yard on the Gulf Coast and one existing yard on the East Coast during the 12-year period. With the larger program, the study concluded that six existing yards could be kept busy during the period. These six include the new Litton facility plus two others on the Gulf Coast, two on the East Coast, and one on the West Coast.*

The study assumed that no additional new yards would be constructed, but should the large program be realized, there would be room for one more yard of the capacity and size of the present new facility operated by Litton. Should such a second new yard come into existence, the study was not opti-

*Because of the urgency of nuclear submarine construction and overhaul during the next decade, three private shipyards currently devoted to this work must be considered separately.

mistic about survival prospects of all of the five older yards.

While several companies have talked about opening a new shipyard, none have announced any firm constructive programs. With the 3 to 4 years lead-time needed to bring such a yard on stream and with the prices of facilities, construction, and equipment continually going up, it is my opinion that it is highly unlikely anyone will build such a shipyard in the near future. It seems to me doubtful that any company will commit, without sizable ship contracts *in hand*, the $150 million to $180 million needed to duplicate the new Litton ship manufacturing facility. Given these circumstances it is quite understandable that many shipbuilding companies would naturally prefer the older way of parceling out ships a few at a time to all of the shipyards -despite the time delays and associated costs to the Government and the other problems discussed earlier.

In addition, the professional naval architectural firms have a strong parochial interest to discourage contract definition procurements, since under this new procurement approach the ship manufacturer and not the naval architect creates the design. Nonetheless, with few exceptions, these professionals—having a high sense of ethics—have adjusted themselves with dignity to the Navy's major procurement policies of the past few years. One firm designed and sold the new LASH ship concept, and others have profitably teamed with contract definition shipbuilding companies and will probably do so again in the future.

Those who advocate a return to the older method of bidding ships in limited quantities usually argue for "dispersion" to avoid vulnerability to enemy attack or to a single contractor's shortcomings. However, even with dispersion of a multiple-ship program, the *real* vulnerability has not been removed as many major critical components are produced only at one location. Management errors, facility destruction, or labor difficulty would be just as tragic if they occurred at the site of these single sources as they would if they occurred at the ship assembly line, and late delivery of such components would slow down the follow yard as badly as they would the prime contractor.

Should a real emergency occur, it would be more feasible to transfer ship production to an undestroyed shipyard than it would be to replace the sole source producer of, say, critical electronics equipment, sonar, or propulsion units. Nor will dispersion get ships produced faster; a follow assembly plant is not going to deliver the last 15 ships sooner or at lower cost than the plant which has already hit its momentum and stride with the first 15 ships. As a matter of fact, the only major criticism the General Accounting Office could levy against the DD-963 procurement was the advantageous position, costwise and delivery-wise, the original contractor would have in subsequent procurements.

In any event, the contract definition method of procuring ships has only been utilized on two important programs, and its full advantages will be unfolding and proven during these next few years. The last published major weapons systems cost report furnished to the Senate Armed Services Committee revealed some interesting information on cost growth. The first ship procurement under the contract definition process, the LHA, had a cost "growth" of less than 4 percent, a figure far less than any other program of comparable size on the list.

This report was issued just before the decision was made to reduce the LHA program from nine to five ships, and, therefore, reflected the nine-ship buy. With a five-ship program, the unit cost obviously will be greater, and we and the Navy have been negotiating a revised schedule for optimum economic pro-

duction of the smaller quantity.

In any event, one prospect which I believe we can expect—a seeming paradox in this discussion—is an increasing reutilization of the procurement techniques popular in the early 1960's in the early seventies. In my opinion, return to these procednres, or variations of them, was prohably inevitable even without detractors of the contract definition process, simply because those in charge of our naval procurement recognize that the procurement form must be tailored to the size, type, and quantity of ships in each procurement. From the standpoint of the professional naval architect, this change will be a beneficial one, and as in the past, he probably will not be held responsible for the inevitable shipbuilding problems encountered during the construction cycle.

When faced with the choice of a parceling ont of work on a bidding basis on the one hand and possible bankruptcy on the other hand, it is obvious that some shipbuilders would relish the prospect of returning to the problems of the early sixties. Their problems and prospects during the early 1970's will probably be very similar to those they encountered 10 years ago.

Now I would like to discuss types of ships which, in all probability, will be produced in the comiug years by American shipbuilders.

One does not have to be a politician to judge the temperament of the American public and Congress as far as defense spending is concerned. I refer here more to the qualitative aspects of defense spending rather than size of appropriations. There will certainly be an emphasis on defensive weapons as opposed to forces of projection or strategic weapons.

In this environment, Navy programs will receive proportionately larger shares of the DOD budget. But the Navy programs will be geared principally to antisubmarine warfare and defense of the sealanes of supply, with decreased emphasis on amphibious assault and offensive striking power. Thus, it was no surprise that the LHA amphibious assault ship program was reduced from nine to five vessels.

As Admiral Moorer pointed out in testimony before the House Appropriations Committee, a Navy annual building and conversion expenditure of $3.1 billion during the next 7 years would still find over 20 percent of a 750-ship fleet over 25 years old in 1978. A 750-ship fleet is much smaller than we have had in the recent past, and it would appear prudent to expect that the Navy will receive about $3 billion per year. These funds will most likely be directed to SSN attack submarines (an antisubmarine warfare weapon) and destroyers, whose mission is ASW and sealane protection. There will continue to be some replacement programs for auxiliaries.

In addition to the *Spruance* class DD-963 30-ship program, a contract has been awarded to a naval architectural firm to assist with studies in support of the preliminary design of a "small" destroyer. Several attack submarine designs are also under development. Such contracts might follow the procurement practices of the early 1960's, with the shipyards bidding to the contract design and specifications.

Incidentally, design and production of "small" ships is reminiscent of the U.S. automotive industry's experience with compact cars. By the time the manufacturer has added into the "compact" all the comfort and gadgetry that the public wants, the "compact" is as large as the old "standard" and a new "smaller compact" is being designed. There is a prospect and a problem that crew morale, speed, damage control, multiple mission capability, and the current available array of tactical and sensing devices, all included in the design of a single vessel, will always result in increased size.

If the procurement method in vogue

in the early 1960's were to be utilized for the "small" destroyers, one should bear in mind that this practice generally failed to disclose the schedule and cost impact of poor engineering until very late in the construction cycle, requiring those problems to be corrected on the waterfront. Also bear in mind that almost every Navy surface ship contracted from 1955 until 1966 was delivered later than contracted delivery date.

To avoid this prospect, it is to be hoped that the engineering for Navy ships procured in the 1970's by early 1960 methods will be subjected to the engineering quality and configuration discipline currently being applied on DD-963.

As to the Nation's sealanes of supply, the American merchant marine is looking forward to the President's 10-year, 300-ship program. The prospect can be good, provided the infinitely varied requirements of the operators can be met with the standard designs under consideration. It appears to me that bulk carriers, dry and liquid, will continue in large demand and comprise most of this market. Bulk carriers, however, are large ships, and most of the shipways and graving docks in this country are not large enough to accommodate building them. Those who have specialized for such ships should find a ready, continuing market.

Some shipbuilding companies in this country—I can think of two in particular—have already geared themselves to becoming specialists. One specializes in the production of tankers, and another apparently intends to specialize in the LASH-type ship. Since both the LASH-type ship and tankers seem to have a ready market during the next few years, these two companies certainly will have a minimum of problems and maximum of prospects.

Our own company has very carefully attempted to gear itself for particular types of ships. Our older shipyard, like two other private yards, is specialized for construction and overhaul of nuclear-powered vessels. Although Litton's new facility was designed to accommodate, in a flexible manner, ships of the large size represented by bulk carriers, we have chosen to specialize on complex Navy work—such as the LHA's and DD-963's—where series production can be utilized, but we have the option to go to the very large and simpler bulk carrier.

There will always be one continuing problem regardless of what form Navy ship procurement takes or what contractor performs the work. Because so much time elapses between concept formulation and hardware delivery, it is difficult to ensure that the ship, when delivered, contains latest technological advances.

During design and production, Navy operations continually asks, and rightly so, that the ship be fully updated to accomplish its missions, bearing in mind latest developments in the state of the art and the latest developments in the fleet of our adversary. Even today, as we are about to cut metal on the LHA, recommendations continue to come in from the fleet.

In fact, it may well be that the greatest problem facing the industry today is one of configuration management. How do we produce a ship with absolutely up-to-date and proven weapon systems and yet avoid the cost-disruptive effects of what could amount to retrofitting during production? You rarely see an automobile company halting its assembly line in midstream to change the beam of the headlights, the stopping power of the brakes, or the hood configuration. Because of the relatively shorter leadtimes, automakers merely wait for the next model year. But with ships it means waiting perhaps 4 or 5 years or, the alternative, incorporating some changes before the ship is completed.

In this scenario it is even more

difficult to see how the so-called fly-before-you-buy concept can be applied to ship acquisitions. In the case of DD-963, the concept was fully formulated and the weapons systems parameters established over 2 years ago. Contract definition was completed in July 1970. Throughout contract definition the design was continually adjusted to reflect latest inputs from the fleet. With contract definition completed on DD-963 in July 1970, the first ship is scheduled for delivery in 1974. Should that first ship be a prototype to be floated, operated, tested, and configured before the purchase of the remainder of a series, then the second ship, regardless of what shipyard produces it, could not be put into the water prior to 1976. From a military effectiveness standpoint, 2 to 3 more years of technological advances would have occurred before the second ship of the series is delivered to the fleet.

From the cost standpoint, the second ship under the fly-before-you-buy concept, coming 2 or 3 years later than it would have under current series production concepts, would cost about 15 to 20 percent more, simply recognizing 2 to 3 years of inflation.

In summary, shipbuilding is in for a decade of dramatic change and strange anomalies.

- It will be a period during which the results of the contract definition form of procurement to improve cost and schedule control will not even be seen before detractors begin seeking a return to a procurement system which seemed unworkable in the past.
- It will be a period when U.S. ship contracts and appropriations will be higher than at any time since World War II; nonetheless, it will be a period when some shipyards may well go out of business.
- It will be a period of continued rapid advance in military weapons systems, which, by their very nature, will create a configuration management problem of immense proportions.
- It will be a period when foreign shipyards will be too full to accept orders; but the ships required, which might be ordered in the United States, will be so large that only a handful of U.S. yards will be able to handle them, and at least two of that handful will have too large a backlog to consider them.
- Additionally, it will be a period which will result in cost parity among United States, European, and Japanese yards, thus enabling those American shipbuilders who survive the decade to compete effectively in the world market in the 1980's.

BIOGRAPHIC SUMMARY

Mr. Ellis B. Gardner, Jr., did his undergraduate work at Columbia University and is a graduate of the University of Buffalo Graduate School of Business Administration. He served in the Army Air Force in World War II and subsequently as an executive with the General Electric Company and Hewitt-Robins Company. He joined Litton Industries in 1965 and currently occupies the position of Senior Vice President, Litton Industries; President, Ingalls Shipbuilding Division.