The collapse of the U.S. shipping industry

Thoula Frangos, an engineer with the Fusion Energy Foundation, documents the growing national security threat.

At the end of World War II, the United States had the largest fleet of ships in the world. Today its merchant marine (of 1,000 tons and over) ranks 14 in the world in number while the Soviets rank second. (see **Table 1**). The Navy ships have also dropped from 979 in 1970 to 550 today in the face of a growing Soviet Navy of three times that size. The general collapse of the shipbuilding industry in the United States poses a national security threat. If the present deterioration is allowed to continue much longer, it will be very difficult to recover the lost infrastructure base required for mobilization in the event of a national emergency.

During World War II, the United States showed how quickly it could mobilize its shipbuilding industry. Within five years it doubled the number of shipyards and increased the number of shipyard workers by a factor of 10. The United States has proven, with the advances in submarine developments, that it can quickly implement new advances in technologies when it has perceived a need to. It is through the development of submarines that the industry has realized recently new, more efficient construction methods and nuclear propulsion systems with potential use in other type of vessels for the Navy and merchant marine. Today it must mobilize, before it is too late, to modernize and integrate its infrastructure, as the Japanese and South Koreans have done, and to finally implement a nuclear merchant marine.

In the postwar years the Soviets have rapidly implemented new technologies into their ships and have increased their merchant marine from an insignificant, mainly coastal enterprise to numerically the world's largest fleet. Due to the strict centralized organization of its merchant fleet, it has a unified, quickly mobilizable apparatus at its disposal.

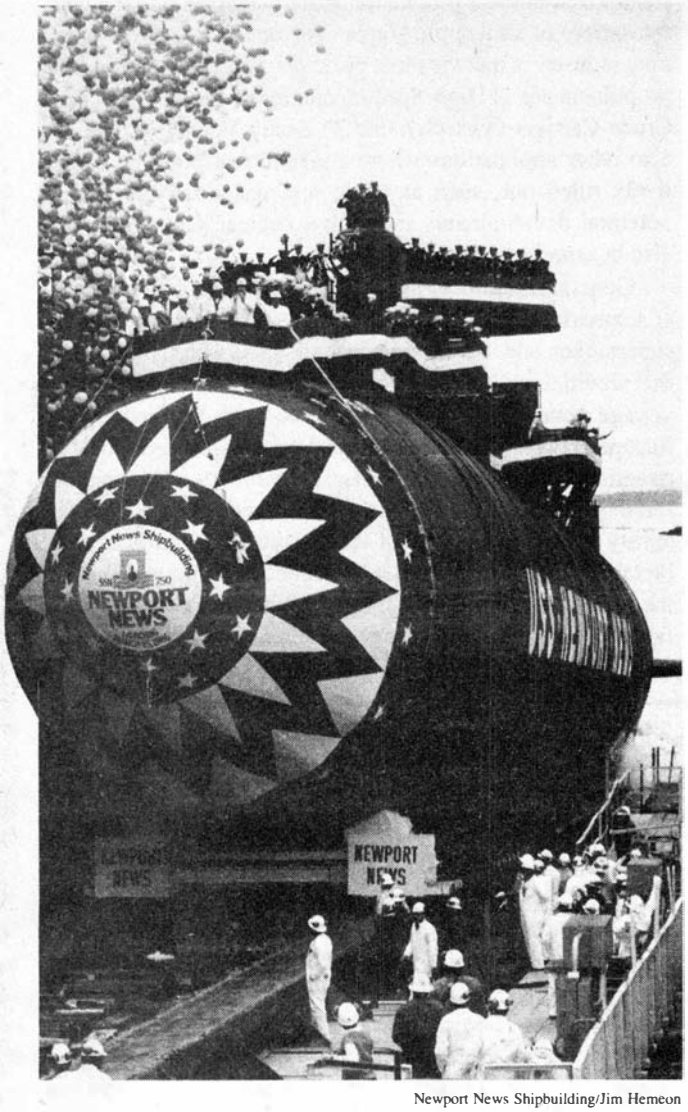
"The submarine plays an important part in our maritime strategy in that a submarine, because it operates undetected, is uniquely capable of deploying to forward areas, can do so on short notice and remain for long periods of time," said Captain T. J. Camilleri, acting chief of staff for the submarine force Atlantic in March of this year at Newport News.

The Soviets also see the importance of the submarine and its development. Last year, the then-Admiral of the Fleet of the U.S.S.R., Sergei G. Gorshkov, said that submarines are "most affected by successes in shipbuilding and nuclear power." He also attested to their primacy, saying that in nuclear submarines are concentrated all the main ingredients of modern naval power.

On March 15, 1986 *USS Newport News,* a nuclear-powered attack submarine of the Los Angeles class, was launched at the nation's largest private shipyard, Newport News Shipping. This 360-foot submarine is equipped with the most advanced anti-submarine warfare capabilities, and is considered by Navy officials as a deterrent against both enemy submarines and surface ships.

During the 20 years prior to the mid-1970s, the Navy built a series of larger, but slower nuclear-powered attack submarines. This fulfilled the Navy's need for more space for special equipment designed to reduce the noise of the reactor plant and other machinery in the subs. Speed was sacrificed in favor of a quieter vessel, one that was harder to detect.

By the late 1960s, Navy officials saw the need for a speedier attack submarine. Admiral Hyman Rickover pro-



Newport News Shipbuilding/Jim Hemeon

On March 15, 1986 *USS Newport News, a nuclear-powered attack submarine of the Los Angeles class was launched at Newport News Shipping. This 360 foot Los Angeles class submarine is equipped with the most advanced anti-submarine warfare capabilities.*

posed two types: a slow, but quiet version, and a speedier, deeper-diving version. Budgetary constraints restricted the options and the Navy opted for speed, thus the Los Angeles class. This is the fast attack submarine first built in 1972 at Newport News. Since then the design has changed to meet new challenges from the Soviet fleet. "The fast attack role has not changed significantly with the introduction of the 688 [Los Angeles] class. However, as the Soviet navy has grown in size and capabilities, acheivement of the fast attack sub mission has become more difficult," said Captain T. J. Camilleri. "The improvements realized in the 688 class sub have allowed us to continue successfully to operate our submarines in an increasingly demanding environment."

This class represents many new developments. Besides being anti-submarine and anti-surface ship vessels like the early versions, it is equipped with intelligence equipment for surveillance and mine-warfare capabilities. It carries a large sonar dome in the bow to track enemy submarines by picking up their sounds. There have been weapons improvement: The sub carries the MK-48 anti-submarine, anti-ship torpedo, which is guided by a trailing wire. It can also carry the Harpoon cruise missile, a longer range anti-ship weapon. The most significant design has been the development of the vertical launch system for the Tomahawk cruise missile, a long-range missile with a nuclear warhead that can be directed at land targets.

The Navy is trying to integrate all of the improvements in the Los Angeles-class sub into one major system known as Subacs, submarine advanced combat system. The Navy has nine Subacs-equipped attack subs under construction at Newport News amd General Dynamics Electric Boat Division in Groton, Connecticut.

The Navy's new attack class, Seawolf, takes over in the 1990s. It will be larger, quieter, deeper-diving, faster and carry twice as many weapons as the current class.

U.S. advances in construction

The construction of the *USS Newport News* represents a new generation of submarine construction techniques in which fewer, bigger sections or modules will be built prior to being joined. The method will be in full swing in about two years when the shipyard completes a $300 million modernization of its submarine facilities. The largest section ever built, a 540 ton bow section, was hauled from the assembly shop and raised on skids to the shipway. The bow section, the third of its kind to be built there, carries the sub's large sonar dome, and tubes for launching long-range missiles. It was, though, the first to be fitted to the rest of the sub hull through photogrammetry, the use of photographs to make very precise measurements. This resulted in increased precision from previous assemblies.

The Navy has embarked on a major program to integrate robotics into the fleet of the future. The Naval Surface Weapons Center has a new Robotics Research and Development Laboratory in White Oak, Maryland. It is intended initially to investigate the potential use of robotics to cut manufacturing and maintenance costs.

The application of lasers in shipping is also expanding. A portable 100-kW electron beam welding system for pressure vessel fabrication is being investigated at United Technologies which would reduce the time by a factor of 46.

Nuclear merchant marine

Nuclear-powered ships are more economical, less polluting, and more powerful than oil-fueled ships. But, most importantly, they can contain enough fuel to operate several

years without refueling. Three successful programs—*NS Savannah*, the MH-IA floating Nuclear Power Plant (christened *Sturgis*) and the West German *Otto Hahn*, each constructed without a preliminary prototype—provided confidence that nuclear powered ships could be constructed with little delay.

The world's first nuclear merchant ship, *NS Savannah*, was designed in the period 1956-58 and sailed in 1962. In the late 1950s, the Maritime Administration-Atomic Energy Commission joint project office, which directed the activity of *NS Savannah*, turned to a more advanced, second generation of nuclear merchant ships. This effort produced the Nuclear Steam Generator invented by Babcock and Wilcox Company and exported to West Germany for use in the *Otto Hahn*, which entered service in 1968. By early 1970, the Maritime Administration decided to expand its efforts toward more advanced nuclear-powered ships. "Our studies indicated that for certain applications, nuclear powered ships could be economically superior to the alternative fossil fueled ships," reported Dr. Zelvin Levine, former chief of the Office of Maritime Technology, in 1972.

The accomplishments have been the acheivement of a standarized nuclear propulsion system adaptable to the widest variety of ship applications. The consensus of the maritime industry is that the three principal candidates for nuclear propulsion are 1) High-Speed Containerships 2) Very Large Crude Carriers (VLCCs), and 3) Arctic Vessels. There are also other applications where conventional power is effectively ruled out, such as arctic icebreaker tankers. These potential developments show how nuclear submarines can also be commercial freight carriers.

General Dynamics, the nation's leading builder of nuclear submarines, was working on the concept of a commercial supertanker and building a fleet of underwater behemoths that would ferry liquefied natural gas (LNG) on a 3,200 mile voyage beneath the Arctic icecap to ports in Canada and Europe. This is finally the solution to transporting gas in large quantities to the world markets. The primary advantage offered by a submarine system over a surface ship system is the ability to deliver a constant cargo volume at uniform, predictable schedule intervals year-round, regardless of surface ice and weather conditions. Prevailing water depths of 200 fathoms or more would permit a submarine tanker to maintain

TABLE 1
Merchant fleets of the world
(Tonnage in thousands)

	January 1, 1984		January 1, 1974		January 1, 1964	
Country	No.	dwt	No.	dwt	No.	dwt
Liberia	2,019	131,545	2,211	95,315	967	20,705
Greece	2,454	68,612	1,724	32,315	828	9,988
Japan	1,712	61,191	2,145	57,286	1,267	12,893
Panama	3,290	57,781	1,111	15,246	521	6,054
Norway	529	32,470	1,102	40,781	1,401	20,014
United Kingdom	685	27,251	1,596	47,783	2,206	26,510
U.S.S.R.	2,497	23,157	2,262	16,507	1,124	7,032
United States	538	21,569	596	13,717	974	14,579
France	314	16,532	413	13,482	604	6,297
Italy	601	14,964	635	12,832	609	6,830
China (PRC)	861	12,628	293	2,368	165	793
Singapore	556	11,634	274	3,285	NA	NA
Spain	511	10,765	432	6,545	338	2,089
South Korea	499	10,585	122	1,647	30	167
India	375	9,847	264	4,669	191	1,842
Brazil	344	8,988	251	2,983	233	1,572
West Germany	437	8,869	702	11,417	883	6,834
Saudi Arabia	230	8,370	13	66	11	46
Cyprus	480	8,110	532	4,547	NA	NA
Denmark	261	7,444	299	6,553	346	3,132
World totals	25,579	666,404	21,600	446,370	18,033	194,274

Source: Shipbuilders Council of America, Statistical Summary, January 1985

cruising depth and speed over practically the entire length of any proposed shipping route. It is also considerably lower in cost than any of the proposed natural gas pipelines. General Dynamics proposed 17 nonnuclear subs and 14 nuclear subs with a combined capacity of 2 billion cubic feet per day every day. It would result in a floating pipeline, allowing subs to load and unload LNG at underwater terminals in an estimated economical 24-hour turn-around time.

Work on this project was, unfortunately, discontinued in 1982, as were many projects of this sort due to the world economic recession that collapsed world trade.

The application of nuclear propulsion for icebreakers enables the icebreaker to operate successfully in the hostile environment of the arctic by providing for extended times on station, increase range of operation, and a large power supply. Working with the Canadian Coast Guard and CECO Consultants Ltd., powerful icebreaking cutters have been studied. Russia's penetration to the North Pole with one of its nuclear icebreakers, the *Lenin*, demonstrated the potential for such vessels.

Unlike a conventional icebreaker, the nuclear-powered version would be able to remain on station for periods limited only by the requirment for hull maintenance. Advantages are immediately evident. The nuclear ship could deal with situations in heavy ice that the conventional ship could not handle because of the necessity for frequently returning to base for refueling; and, with virtually no restrictions on the rate of consumption of nuclear fuel, the nuclear icebreaker would be able to use full power whenever required, without the need to conserve fuel oil for the return trip to refuel. Missions would therefore be carried out more quickly and efficiently.

To date, the preliminary ship design and feasibility studies have been carried out on a 90,000 and 150,000 shaft-horsepower hybrid nuclear icebreaker. Such a vessel will have year-round arctic capability and will be able to extend commercial activities into hitherto inaccessible areas. The need for higher powered vessels for arctic operation will reinforce the already demonstrated advantages of nuclear propulsion.

It was the hope of Robert Young, former chairman of the American Bureau of Shipping, that nuclear-powered ships would sail the seas by 1990. In 1977 he recognized the potential that lay ahead with the proven technology and economic viability and the kind of bureaucratic issues that would be used to kill such a project. "The operating record of the nuclear merchant ships *Savannah* and *Otto Hahn*, together with the more than 200 nuclear naval vessels, clearly indicates that the technology exists today to provide sound and reliable nuclear-powered commercial vessels. These vessels have enabled the shipbuilding industry to gain considerable technical knowledge and experience. This expertise could be readily applied to building a nuclear-powered merchant fleet."

"Three major problems have hindered the advent of such ships: questions concerning economic justification, indemnification and liability in case of damages, and port entry and international clearance." An overriding factor in this picture is, of course, the collapse in world trade that has discouraged many companies from making any large investments. For example, the goods loaded in international seaborn shipping in 1979 was 3.8 billion tons and dropped to 3.2 billion tons by 1983.

The national security issue

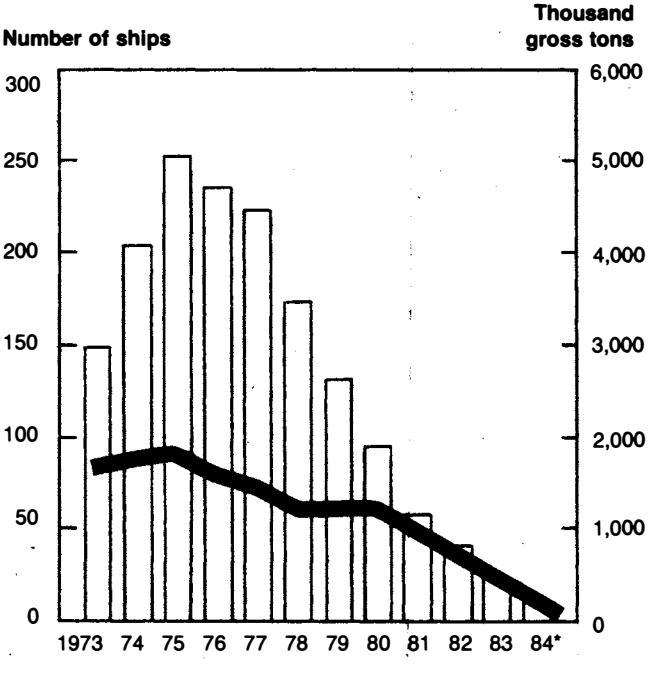
In 1984 Secretary of Defense Caspar Weinberger warned that U.S. national security is endangered by the decline in the U.S. merchant marine. He wrote to the transportation secretary: "The decline in U.S.-flag commercial shipping capable of carrying military unit equipment is of particular concern to the Department of Defense."

In a memorandum submitted to Weinberger in June 1983, the Navy said that the "shipyard mobilization base" as it then existed (27 major private shipyards, over 80 smaller private yards, 8 Navy yards, and 1 Coast Guard yard, collectively employing 165,000 skilled workers), is the minimum needed

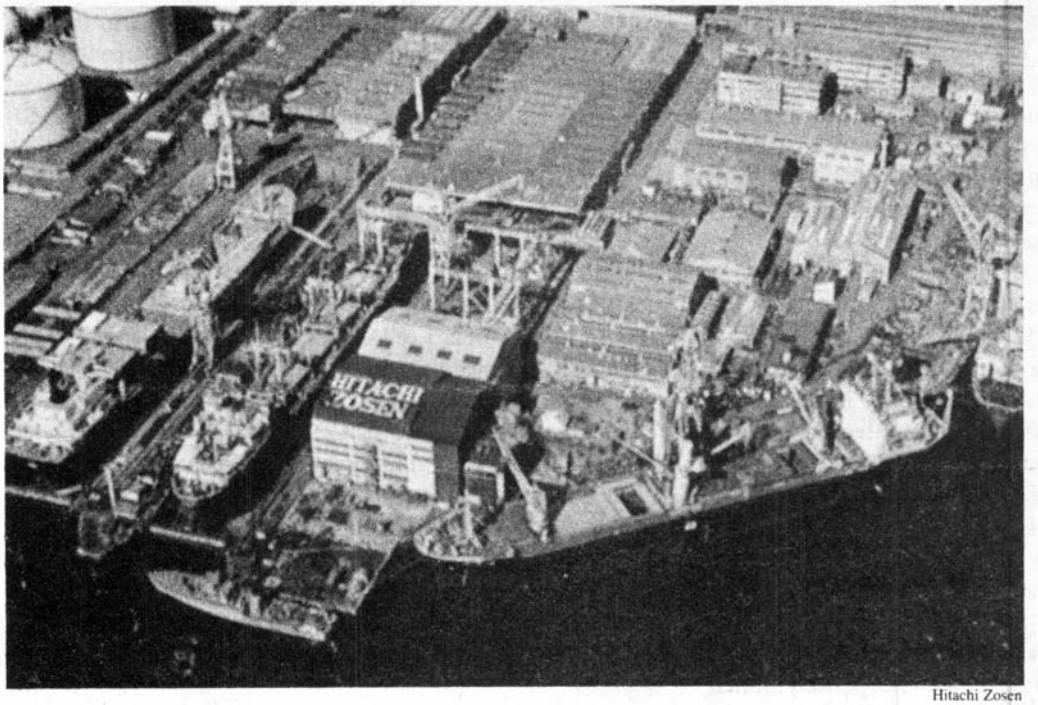
FIGURE 1

Merchant vessels building or on order (as of January 1)

(Ships of 1,000 gross tons and larger)



*Forecast
Source: Maritime Administration



Hitachi Zosen

Kanagawa Works: Japanese yard for shipbuilding, ship repair and conversion, with plants and machinery. Japanese shipbuilders, who have long dominated the world market, have been able to decrease costs and increase productivity considerably through series production of identical or near identical design. The shipyards are vertically integrated such that major builders are integral units of large companies which also produce steel, propulsion equipment, and other ship components.

to meet mobilization demands through the first six months of a war. In the next 12 months, the Navy said, another 60,000 workers would be neeed to meet the demands of the Navy and the merchant marine.

According to a Pentagon document, "Recent developments in the commercial fleet indicate that the U.S. commercial fleet of the 1980s/early 1990s may not be able to support adequately the military dry cargo requirments in the event of a war or national emergency."

Again, the House Arm Services Commitee highlighted the problem in its report on the Defense Authorization Act for 1985: "The committee is concerned that the precipitous decline in the domestic shipbuilding and ship repair industry, if not reversed, will force the closure of additional private shipyards, leaving inadequate capacity to support mobilization in time of war or national emergency."

"America soon will be unable to supply and reinforce its naval, air, and ground forces overseas in a sustained conflict of any magnitude," commented Jed L. Babbin, general counsel of the Shipbuilders Council of America. (*Seapower*, December 1984).

America's commercial shipbuilding and ship repair industry continues to decline. Since 1981, 20 of the shipyards which could have responded to a general or at least major mobilization have passed out of existence, taking with them the jobs of about 40,000 skilled workers. Many are likely to go in the next three to five years. There have been only five contracts for major commercial ships awarded to American shipyards in the last three and a half years. (see **Figure 1**)

At the end of World War II, America had the largest merchant fleet in the world as well as the largest shipbuilding industry. Since then, the U.S. merchant fleet has shrunk from over 5,000 vessels to fewer than 500—out of a current world fleet of 35,000 vessels. In the same time frame, U.S. commercial shipbuilding has shrunk from almost 100% of world orders to zero.

Since 1973, commercial shipbuilding worldwide has taken a nosedive. Ships on order around the world peaked in 1974 at 3,007, totaling over 235 million dwt (deadweight tons), and hit bottom in 1979 at 1,315, with a total deadweight tonnage at about 30 million. The collapse in world trade is the main reason accounting for the shrinking volume of merchant ship construction. Other combined factors are the oil embargo of 1973 and subsequent oil glut; global economic stagnation; a shipping recession; foreign exchange fluctuations; and a "wait and see" attitude on the part of ship owners. As a consequence, some old vessels, and some new ones as well, have been consigned to indefinite layup. In many cases, decisions to order fleet replacement ships have been purposely postponed.

Throughout 1984, Navy and Coast Guard contracts accounted for nearly 90% of ship construction employment within the yards in the Active Shipbuilding Base. The workload from the military orderbook has not offset the continuing decline in employment within the Active Shipbuilding Base, resulting mostly from the downtrend in commercial shipbuilding.

Projections for 1985, adjusted for inflation, show a decrease of 4% below the value of work completed by the industry in 1984.

"There is little prospect that significant opportunity will develop in the next several years for building commercial seagoing vessels. Regrettably this also is the prospect for both the offshore construction industry and for shipbuilders and ship repairers who support the river transportation system," commented Lee Rice, president of the Shipbuilders Council of America. (*Seapower* Almanac, 1985).

"Budgeteers may scream and free marketeers turn pale," Rice continued, "but the truth is that there is no free market in the world of international shipping and shipbuilding. Any solution to the problems created by a policy requiring defense needs to be met with commercial resources will have to take that fact into account. Because the issue is one involving national security, it should be defined in national security terms, and policies developed spelling out whatever government action is needed in the shipping and shipbuilding fields for national security. American political independence requires it. The United States cannot rely on foreign shippers or shipbuilders to meet its needs in time of mobilization or war. The President must act, and soon, to reduce what has become a very large, and growing, threat to the nation's security."

Alexander Hamilton stated in *The Federalist Papers* that, for the United States to be politically independent, there must be a large and flourishing U.S. merchant marine fleet to carry the nation's trade. If that fleet does not exist, he said, it will be in the power of those nations which do carry U.S. cargoes to control the nation's economy and thus limit its political freedom.

Many U.S. military observers and maritime experts have serious doubts about the reliability of foreign-flag, foreign crewed ships, even though owned by American citizens or corporations. The uncertainty about EUSC ships and crews is but one of many reasons why sealift, or the lack thereof, is so often called the "Achilles' heel" of the U.S. defense program. The United States is virtually the only major seatrading nation which provides neither assistance to its commercial shipyards nor protection to its ship operators. The "free enterprise" economics of the Reagan administration has been ideologically opposed to any form of subsidies. For this reason, one of the first acts of the Reagan adminstration was to terminate the subsidy programs started in the Roosevelt era to maintain the U.S. sealift and shipyard mobilization base. The Department of Transportation immediately terminated ship construction differential subsidies, and began phasing out ship operating differential subsidies which allow U.S.
foreign shippers.

It is believed by experts within and outside of the maritime industry that to build the U.S. flag merchant fleet must necessarily include a revitalization of the U. S. shipbuilding industry as well. Due to the initial monetary investment needed at a time when the federal budget is being cut, the administration has rejected this approach. Its alternative maritime strategy is to resort to foreign building and repair of U.S.-flag merchant ships. That course can only lead to extinction of domestic assets—facilities, skills, suppliers, and workers—vital to national security. The cost of restoring these assets in a future time of national emergency could be tremendous, not only in dollars, but also in time.

Foreign building and repair of U.S. ships will deny work to domestic shipyards as jobs that could be performed by trained U.S. craftsmen will be "exported" to other countries. Without a sufficient workload, U.S. ships will miss—and perhaps lose permanently—opportunities for greater efficiency and greater productivity. "Without a countervailing mechanism to offset the economic and industrial advantages enjoyed by builders in other nations, there is no hope that American shipbuilders can again become competitive on the world market," emphasized Edwin M. Hood, president emeritus of the Shipbuilders Council of America. (*Seapower*, September 1983).

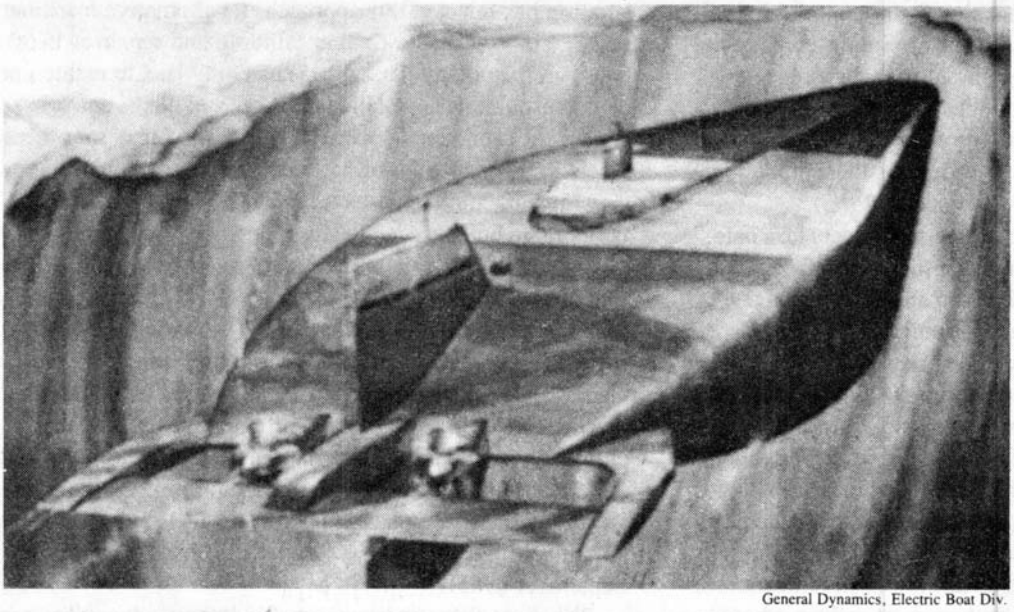
What are these economic and industrial advantages enjoyed by some other nations, particulary Japan and South Korea?

The Southeast Asian model

Japanese shipbuilders, who have long dominated the world market and, more recently, shipbuilders in South Korea, have been able to decrease costs and increase productivity considerably through series production or "runs" of ships of identical or near-identical design. This approach allows the shipyard to fit design details to its specialized capabilities and to control design, industrial engineering, and material procurement in a manner that will contribute to more efficient construction; such efficiency, of course, translates directly into cost reductions. Through series construction, moreover, economies of scale are possible for both shipbuilders and suppliers.

This situation is not the case in the United States, where production runs have been the exception rather than the rule. Due to unstable market opportunities, most U.S. shipbuilders of merchant vessels have rarely been able to enhance cost reductions and production efficiencies. Contracts have been awarded in units of two and three on average, and quite often more than one type of vessel has been under construction in a yard at the same time. Another factor in the United States is the decentralization of the shipbuilding process, which causes a lengthening of the construction cycle. At least 50% of the cost of merchant shipbuilding in the United States is represented by products, materials, and services which come from suppliers in virtually every state of the union. Any disruption in the flow of these items to the yard can delay assembly and final delivery of the ship.

An integrated infrastructure is of utmost importance for efficient shipbuilding. In South Korea and Japan, delays



General Dynamics, Electric Boat Div.

Artist's conception of General Dynamic's submarine liquified natural gas (LNG) tanker. This nuclear propelled tanker would act as a pipeline for natural gas, delivering a constant cargo volume at uniform, predictable schedule intervals year-round, regardless of surface ice or weather conditions.

caused by slow delivery of components are minimal because of the infrastructure of those nations' shipbuilding industries. Major builders are integral units of large companies which also produce steel, propulsion equipment, and other ship components. Since all these components are produced within the same corporate structure, their production and delivery schedules can be more easily coordinated with the production milestones projected in the shipbuilding cycle. This interface not only enhances quality control, delivery commitments, and profit potentials; it also eliminates a substantial portion of the marketing costs associated with ordinary commercial selling. In the United States such vertical integration of shipyards within larger corporate entities simply does not exist.

Workload continuity along with series production of ships has proven in the past to be the key to progress. A shipyard building a series—or a run—of ships of the same design or type can organize its planning, engineering, facilities, work force, and requisitioning of supplies and materials in a manner that will assure productivity gains. This has been demonstrated in connection with the Oliver Hazard Perry (FFG-7)-class guided frigates and other U.S. Navy programs; it is a fundamental precept of Japanese and South Korean shipbuilding.

The cost/price gap between European and Far East merchant shipbuilders is now about 35%, noted Sir Robert Atkinson, chairman of British Shipbuilders. Political pricing in the Far East and Europe, though, will not end till there is stability in world shipbuilding through expanded world trade.

The Soviet Navy and merchant marine

"An important integral part of sea power is the equipment and personnel which make possible the practical utilization of the oceans and seas as transport routes connecting continents, countries, and peoples. For this it is essential to have a merchant marine, a network of ports and services supporting its operation, and a developed shipbuilding and ship repair industry. . . . The Soviet merchant fleet, like the fleet of any state, is a constituent part of sea power of the U.S.S.R. . . . The flag of the Soviet Navy flies over the oceans of the world. Sooner or later the United States will have to understand it no longer has mastery of the seas."—Admiral of the Fleet of the Soviet Union, S. G. Gorshkov.

According to an insider in the shipping industry what caused the Soviet takeover of much of the world's freight transport can be explained politically by the role of Henry Kissinger as secretary of state in 1972 in concluding the Russian grain deal. Prior to 1972, the Russian merchant fleet, while it was an active fleet in world trade, had no presence in the U.S. market. This was due to the fact that Russian ships were not permitted entry into U.S. ports on national security grounds, and because U.S. labor unions, such as the International Longshoremen's Association, refused to unload their ships. The grain deal overturned all that with a protocol that specified that U.S. grain going to the Soviet Union was to be carried 50-50 in U.S. and Russian ships. However, under and unprecedent port-access agreement, Russian vessels were given U.S. port-entry rights unrestricted to grain.

Immediately, as a result of this deal, Soviet military vessels, carrying military cargo to Cuba, then proceeded to U.S. ports for general freight destined for U.S. trading partners, instead of returning home to Russia empty as on their previous routes. The Soviets started a price war with Western shipping companies as they charged dumping-level freight rates. Western shipping companies weakened as the Soviets charged 40% less than reasonable levels. Within a month in, 1972, Russian sailings went from 0 to 200 sailings between

U.S. ports and non-Russian ports. The Russians captured the cargo between the United States and trading partners and assumed a strategic position. At one point, the Russian lines, particularly the Baltatlantic, took over 25% of the cargo between the United States and West Germany, and captured 13% of the general cargo between the United States and Western Europe.

"In the past 10-15 years Western shipping lines have been faced by growing competition from the Soviet merchant fleet, which has used cutthroat rate policy that has shaken the structure of commercial shipping worldwide, and in some places subjected it to severe pressure," commented Jurg Dedial, a Swiss journalist of the *Neue Zürcher Zeitung* in a report by the National Strategy Information Center Inc. entitled "The Challenge of Soviet Shipping."

Unlike the United States, the Soviets have launched a nuclear merchant shipbuilding program which, by the close of the 1980s, is considered certain to make the Soviet merchant marine the only one in the world to possess both nuclear-powered icebreakers and cargo vessels. They already have oceangoing nuclear icebreakers with an "unlimited sailing range, and an endurance of between 500-700 days," according to their reports. This compares with an endurance of Western icebreakers such as the Canadian *Diberville* and American *Glacier* and *Gletcher* of no more than 50 days. The Russains have already built another giant icebreaker, the *Rossiya,* the fourth in the Soviet fleet. The others are the *Lenin,* the *Arktika,* and the *Sibir.*

According to the U.S.S.R. merchant marine ministry, "The growth of Arctic shipments demanded by growth of the national economy, has called for a new effort to create a new dependable transportation system . . . the operation of oceangoing nuclear vessels has proven the efficiency of their reactors and the feasibility of such plants in other super icebreakers and transport ships."

Dedial emphasized: "In the shadow of this breathtaking build-up of Soviet naval forces, a no less startling expansion is the Soviet merchant marine, fishing and research fleets has taken place and, like that of the navy, appears to be continuing unabated. During the postwar years the Soviet merchant marine grew to numerically the world's largest fleet (7,500). . . . Its equipment is extremely modern, with 90% of its ships less than 20 years old (compared to only about 60% for the U.S.).
freighters in Western shipping lanes also has a military aspect.

"The history of the Soviet merchant fleet is a true success story. Never before has any nation built up so mighty, modern and efficient a merchant marine in so short a time. . . . The result is not only a rate war in which Western shipping lines are steadily losing ground, but also an alarming overall weakening of the U.S. Merchant Marine. American ships now handle only about 6% of the country's foreign trade. Moreover . . . they bring in less than 5% of that import volume of critical raw materials regarded as essential for national security."

The history of submarines and nuclear propulsion

The submarine was introduced to America during the Revolutionary War with David Bushnell's *Turtle*. Incorporating ballast tanks, a conning tower, and a screw propellor, his attack on the British man-of-war *HMS Eagle* earned him the title "Father of Submarine Warfare."

By the late 1800s, the American Navy recognized the potential value of a ship that could operate both on and below the surface. So, in 1898 the Navy sponsored a competition open to the public for the design of such a vessel.

John Holland's vessel won the first competition, and his *USS Holland* officially joined the U.S. Navy on April 11, 1900. Powered by a 50-horsepower gasoline engine, the submarine was 53 feet long, almost 11 feet in diameter, and had a displacement of 74 tons.

As submarines evolved, diesel-powered engines replaced the old, dangerous gasoline engines. New designs produced boats that operated efficiently on the surface, but were limited by their battery-powered propulsion systems while underwater. The submariners knew that a new source of power was needed to make their boats more effective weapons.

As early as 1939 a Navy report had noted that an atomic power plant would not require oxygen, and therefore would become "a tremendous military advantage that would enormously increase the range and military effectiveness of a submarine." Early that year the Navy appropriated $1,500 to begin a study on nuclear power for its ships—the first government money set aside for nuclear research. In 1946, Admiral Harold Bowen, head of the Office of Naval Research argued: "The Navy is not only the greatest single user of power, it is also the largest technical organization in the world. . . . The use of atomic energy as a source of power for war vessels is now justified."

Finally on Jan. 21, 1954, the world's first nuclear-powered submarine, *Nautilus,* slid into the water. It was the first man-made conveyance of any kind to be propelled by nuclear power, which enabled it to endure months underwater rather than just hours.