
Section I
Introduction

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CONGRESSIONAL INTEREST IN MARITIME R&D

In 1982, in response to their concerns about the viability of U.S. maritime industries as well as the future U.S. position in world trade, the House Committees on Merchant Marine and Fisheries and on Ways and Means jointly requested the Office of Technology Assessment (OTA) to undertake an analysis of maritime trade and technology issues. In particular, the committees asked OTA to evaluate long-term trends in global seaborne trade and maritime technology in relation to the U.S. maritime industry. This study was completed in the course of the following year and the final report, "An Assessment of Maritime Trade and Technology," was presented to Congress in October of 1983.

In conducting this study for the Committees, OTA reviewed the status of American maritime technology and surveyed the members of the Society of Naval Architects and Marine Engineers (SNAME) Ship Technical Operations Committee for their views on U.S. maritime technology. As a result of this work, OTA found that the U.S. generally has lagged behind foreign competitors in applying technological advances to much of the U.S.-flag fleet and to the technology of constructing ships. OTA concluded that to achieve a competitive position in world shipping and shipbuilding, it is important for the United States to regain technological preeminence in these areas.

Following these conclusions, OTA examined the role of R&D in stimulating technological in-

novation in the shipping and shipbuilding industries. OTA's analysis suggested that there is a need for a more effective R&D program, and that Congress could help establish a more specific Federal role in maritime research. The elements of a congressionally defined Federal role, as outlined in the OTA report, might include:

1. identifying R&D objectives as a subset of an overall maritime policy;
2. determining what U.S. industry can do better itself and formulating indirect incentives for industry R&D;
3. stimulating coordination and transfer of technology within the industry and from military, foreign, and other sources;
4. focusing on high-risk areas and long-range problems that are not adequately addressed by industry or elsewhere, the solution of which could contribute to national goals; and
5. establishing new or modified institutional arrangements to encourage, coordinate, and foster R&D with either *or* both private and Federal support.

In response to these findings, both the Senate and House Subcommittees on the Merchant Marine asked OTA to take a more in-depth look at maritime R&D, addressing those issues raised in the original OTA report. The findings of that analysis are described in this supplement.

DEFINITIONS OF R&D

For this study, OTA ascribes to a definition of R&D used by the National Science Foundation (NSF).¹ The NSF defines "research" as: ". . . sys-

¹National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 1979, 1980, and 1981*, Vol. XXIX. Surveys of Science Resources Series. NSF 81-306 (Washington, DC: U.S. Government Printing Office, 1981).

tematic study directed toward fuller scientific knowledge or understanding of the subject studied." Development is defined as: ". . . the activity (that is) directed toward the creative application to practical affairs of that knowledge gained from research and that frequently in itself involves the discovery of new knowledge."

In relation to the shipping and shipbuilding industries, these inclusive definitions would encompass all activities related to designing new or improved products, technologies, techniques or procedures to improve the operation or construction of ships. While this supplement mainly uses

the term “R&D” to refer to most of the activities under discussion, it should be noted that the greatest portion of these activities in the U.S. maritime industries fall under “development” rather than “research.”

SCOPE AND DESIGN OF THIS SUPPLEMENTAL STUDY

This OTA supplemental study does not attempt to examine in detail any programs of ongoing research or to evaluate gaps or needs in current Federal maritime R&D. Instead, its primary objective is to investigate those institutional or policy issues that broadly influence the quantity and quality of R&D in the United States. For example, the study focuses on issues such as the effect of the tax, patent, and antitrust laws on research activities by the industry. It also examines the ability of the current Federal organizational structure to provide a focus for maritime R&D and to stimulate industry participation in this program.

In addition to a review of the existing literature, conversations with U.S. Navy and Maritime Administration personnel, and discussions with representatives of shipyards and ship operating companies, much of the information in this study comes from a survey sent to 80 U.S. ship operating firms and 50 U.S. shipyards, of which 66 operators and 48 builders met the survey criteria (see below). The survey queried both operators and shipyards on the percentage of their operating budgets spent on R&D in the past five years and in the current year. Information was also requested on what share of the total amount spent by these firms on R&D was contributed by the Federal Government. Finally, the respondents were asked to evaluate the effect of specific Federal policies on their decisions to commit resources to R&D and to register their support for various policy options for promoting R&D. The survey also solicited suggestions for other potential policy options.

The OTA ship operating survey was sent to U.S. ship operating firms selected because of their affiliation with major industry associations—the American Institute of Merchant Shipping, the

Council of American-Flag Ship Operators, and the Federation of American-Controlled Shipping. A number of unaffiliated operators were also selected from published sources.

OTA’s shipbuilding survey was sent to the members of the Active Shipbuilding Industrial Base (ASIB), most of whom are also members of the Shipbuilders Council of America. The ASIB designates those firms that are currently building or seeking to build ships for the U.S. Navy and includes all of the larger U.S. shipyards and a number of yards that specialize in medium-sized and smaller military vessels, such as patrol boats. In addition, OTA sent questionnaires to smaller (so-called “second-tier”) shipyards that are members of the American Waterways Shipyard Conference. These yards build a variety of vessels including fishing boats, barges, drilling rigs, and tug boats.

Table 1 shows the make-up of the survey sample. Out of the original group who were solicited, a number of operators or builders were disqualified because they were either not in the business OTA had assumed, they had just gone out of busi-

**Table 1.—R&D in the Maritime Industry:
U.S. Ship/Barge Operators and Builders
OTA Survey and Response Data**

	Operators		Builders	
	Number	Percent	Number	Percent
Original sample . . .	80		50	
Firms disqualified (not in business, etc.)	14		2	
Net qualified firms in survey	66	100	48	100
No response	18	27	12	25
Total respondents .	48	73	36	75

NOTE: Percentages are rounded, and may not add up to 100 in some tables.

ness, or they were foreign-owned companies. For example, some major petroleum companies recently disposed of their operating fleets and now only charter ships for their needs; two shipbuilders went out of business while OTA was conducting the survey; two companies thought to be operators turned out to be only brokers.

Thus, the net size of the sample (i.e., the number of qualified firms included) in the OTA survey was 66 operators and 48 builders. Of that group, 73 percent of the operators (48 firms) and 75 percent of the builders (36 firms) responded to the survey. Those firms who responded are listed in appendix D. Most of the firms who did not engage in any R&D did not complete the entire survey form; however, the others reported almost all the information that was requested.

The survey sample therefore represents a sizable portion of the U.S. maritime industry. For example, the 23 operator firms that had some R&D activities and reported on the survey forms represent 50 percent of the total U.S. flag fleet tonnage plus about 3 million gross tons of the U.S. owned, foreign flag fleet. These 23 firms include seven liner companies, one roll on/roll off (Ro/Ro) operator, 14 bulk and barge operators, and one cruise operator.

The U.S. shipyards responding to the survey represent 75 percent of the major yards (considered the Active Shipbuilding Industrial Base) plus 22 of the so-called "second tier" yards. The 36 yards responding represent about 50 percent of the total U.S. shipyard employment base. Of these, 22 (61 percent) completed the survey forms in their entirety.

OTA also asked each respondent to identify his or her position in the organization. The replies were in three general categories—about one-third were presidents or chief executive officers of the firms, one-third were vice presidents, and one-third were division managers responsible for

R&D, engineering, transportation, or planning functions. It appears from these data and other responses, that most firms gave serious attention to our survey and tried to provide comprehensive and accurate information.

Changes in Federal policies supporting the U.S. shipping and shipbuilding industries, combined with a worldwide slump in commercial shipping and shipbuilding, have caused severe problems in a number of sectors of the U.S. maritime industries. These problems, leading to a decline in traditional markets and a concentration of some of the major firms in a few growing market segments (e. g., liner shipping and military ship construction), were analyzed in the 1983 OTA study. Most of that analysis is still very timely and many of the problems facing the industry are still very evident.

Thus, the survey of R&D activities may have met with some skepticism. Many responses were qualified to reflect a view that R&D is far down the list of priorities in an industry which is fighting for day-to-day survival. Some respondents insisted that the Federal Government must change its policy towards supporting the industry and its markets before it would make sense to develop new technology to either build or operate ships. On the other hand, there is also a segment of the industry, reflected in the survey, which does not want Federal Government involvement in anything but support of basic research and educational facilities. This segment believes that the present Federal policy trends are beneficial.

Given this wide divergence of views within the U.S. maritime industries, it is not clear that a cohesive national policy towards R&D, or an institutional framework for R&D, can gain adequate support. In any case, it would be important to integrate approaches to Federal involvement in R&D with the major elements of an overall national maritime policy.

SUMMARY OF FINDINGS

OTA's approach to this analysis has been twofold: first, to understand the existing impediments to R&D investment in the maritime industry; and

second, to examine ways in which the Federal Government might encourage or facilitate maritime R&D, either directly or indirectly. In the case

of the former, OTA's survey has provided an unambiguous answer: the marketplace is the final arbiter. The low and unsteady demand for U. S.-built ships, for instance, either at present or anticipated in the near future, has forced the shipbuilding industry to be extremely conservative in devoting funds to R&D. In comparison with the effects of the marketplace, interest rates and the availability of capital were found to be only slightly influential factors. This is presumably because many firms are extremely hesitant to borrow money for R&D unless the future of the industry looks relatively promising.

On the other hand, some believe that R&D itself can be a driving force for improvement in both the marketplace and the productive capability. On the whole, Government policies were considered by the survey respondents to have only a moderate effect on R&D decisions. When respondents were asked about specific Government policies, their responses did not indicate a clear pattern of the effects of these policies.

In the shipbuilding industry, the phase-out of subsidies was most clearly regarded as a factor discouraging R&D investment; but a significant number of respondents also felt the phase-out of subsidies had a negligible effect on R&D. The ocean-going ship operators, on the other hand, reported that the phase-out of subsidies had little effect on their R&D investment. * The shipbuilding respondents were almost equally divided as to whether the U.S. tax code had negative, positive, or negligible effects on investment. The ship operators were equally divided about the impact of Coast Guard regulations. Otherwise, the respondents indicated that other policies had little or no effect on their R&D investment. Policies that OTA suspected might affect investment—such as anti-trust statutes, patent law, OSHA safety regulations, rail and truck deregulation—apparently were not significant, although some respondents were in favor of modifying antitrust laws.

*It should be noted that while construction subsidies for the ocean-going fleet have virtually been eliminated for the past 2 years, existing operational subsidies, in fact, have not.

In response to the survey findings and other available information, OTA formulated a number of policy options. These options fall into four categories: 1) increasing direct Federal support, 2) encouraging the industry to invest more in R&D, 3) encouraging cooperative industry R&D, and 4) facilitating inter- and intra-industry technology transfer. The OTA analysis also produced a number of indications about the potential efficacy of these options to the maritime industry. For instance, most of the firms responding to the relevant portion of the survey (hereafter called "respondents") believed that increasing direct Federal funding for maritime R&D would act as an incentive for further private investment. Respondents were also favorably disposed toward a revision of the antitrust laws to permit joint ventures and toward measures to provide them with loan guarantees and tax deferrals on funds committed to R&D (despite their ambivalence when asked whether antitrust laws and the limited availability of capital were impediments to investment). With respect to coordinating maritime R&D, respondents endorsed the concept of a central government/industry sponsored maritime R&D institution. However, most of the survey respondents were hesitant about their own participation in such a scheme; therefore, it is likely that the Federal Government would not only have to spearhead such a concept, but that the industry might be financially unwilling or unable to provide consistent support for it. On the subject of technology transfer, the respondents indicated that for many firms, access to U.S. Navy and foreign R&D results is a problem. A number of positive suggestions to facilitate technology transfer were made, such as publication of an annual catalog of completed and ongoing research activities.

While a wide diversity of opinion exists concerning the need for and the nature of a new maritime R&D institution, OTA's industry survey and subsequent workshop discussions led to the following principal findings regarding the features of a new institution should it be supported:

1. Some existing Federal efforts and programs (e.g., the National Shipbuilding Research Program) are valuable and effective. Any new institution should incorporate successful existing elements and gradually phase-in new initiatives.

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2. Any new institution should have adequate contracting flexibility.
 3. Any new institution should have the capability of initiating joint government/industry cooperative ventures in specific areas.
 4. Methods should be developed for any new institution to encourage participation of a broad industry group and to utilize industry guidance in developing program goals and selecting R&D projects.
 5. Any new institution should include programs for adequate technical information retrieval and for wide dissemination of R&D results.
 6. Any new institution should maintain and enhance the most productive existing programs providing direct support of basic research, research at educational facilities, and unique national laboratories.
 7. Any new institutions should seek to incorporate methods that facilitate innovations in the private sector and encourage adoption of advanced technologies within the U.S. maritime industries.