Section III

Models of Other R&D Institutions

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FOREIGN APPROACHES

A variety of foreign approaches to encouraging R&D possibly could serve as models for considering support of U.S. maritime research:

In Germany, the Wagnisfinanzierungs Gesellschaft program under the Ministry of Research and Technology is an independent corporation formed by seven banks. The consortium purchases equity shares in new companies undertaking innovative projects. The government underwrites up to 75 percent of any losses incurred by this corporation for the first 12 years of its existence, thus considerably reducing investment risk. In return, the government retains a seat on the corporation's board of directors. Another program, the "First Innovations" program of the Ministry of Economic Affairs, advances interest-free loans of up to 50 percent of the cost for commercial development of a new technology. If the effort fails, the loan is canceled. The Japanese Ministry of Trade and Industry provides similar R&D support in the form of long-term notes or low-interest loans. The loans are repayable only if the program is successful.

In France, a Letter of Agreement program insures a company against loss for large projects involving high initial production costs and serves as a method for obtaining low-interest capital. An Aid to Development program pays 50 percent of the total cost of prototype development and provides for reimbursement in the case of success.[16]

In Norway, an industry government research institute, The Ship Research Institute of Norway, was chartered by Norwegian ship owners, the Royal Norwegian Council for Scientific and Industrial Research, and Det norske Veritas.[17] Most of the Institute's projects are started with grants from the Royal Norwegian Council for Scientific and Industrial Research or through a commission from a government directorate or a business company. Government funding of the Institute, however, has declined and is now approximately 8 percent of the total funding. Projects are normally conducted by Institute researchers but almost always in close contact with a customer or steering committee. The steering committee can be established for a single project, but is typically organized around programs composed of a number of similar projects. It will typically have resources of more than $250,000.

The Ship Research Institute of Norway sponsors a number of associated facilities. The Marine Technology Center (MTC) is one of the world's most comprehensive and well-equipped research facilities. Some of its laboratories are unique, and the center represents a considerable potential for Norwegian companies in their development of new products and services. A computer-aided design/computer-aided manufacturing (CAD/CAM) center, for instance, was recently established at the MTC. Its aim is to build up competence and to accumulate a library of CAD/CAM programs. In addition to laboratories and model testing facilities, The Ship Research Institute provides information and training services. Management seminars are organized to teach modern managerial concepts, skills, and techniques for managers in the shipping industry. The Institute has standard library services and access to domestic and foreign data bases. It participates in a European cooperative on-line information service called Ship Abstracts, which abstracts information on ship technology, ship operation and ocean engineering from approximately 450 periodicals, reports series and papers from all over the world.

The Institute experienced a high rate of activity in 1983 despite a sharp drop in Norwegian shipbuilding, a set-back for traditional shipping, and limited research grants in the public sector. The

[16] Testimony of Daniel DeSimone, Office of Technology Assessment to the Subcommittee on Transportation, Aviation and Communications of the Subcommittee on Transportation, Aviation and Communications of the Committee on Science and Technology, U.S. House of Representatives, May 1979.

[17] Personal communication with Mr. Egil Wulff, Research Coordinator, The Ship Research Institute of Norway and the 1983 annual report of The Ship Research Institute of Norway.

1983 turnover was $15.9 million compared with $14.2 million in 1982 (calculated in 1984 dollars). The shipowners' share of the Institute's revenues increased from 14.3 percent in 1982 to 21.4 percent in 1983. In 1983, the Institute had a total staff of over 300 people.

In the Far East, the Shipbuilding Research Association of Japan was established over 20 years ago by eight major Japanese shipbuilding companies, suppliers, and shipping industries. It is authorized by the Japanese Government as a nonprofit organization. A planning committee, composed of representatives of member organizations and scholars, selects priority "R&D themes, " which are then approved by a Board of Directors. Committees composed of the member organizations with relevant expertise are then organized to implement these "R&D themes. " The Association receives financial support from its membership and through grants from private financial bodies. The average appropriation over the past five years has been about $4 million a year.[18]

[18] Personal communication with the Shipbuilding Research Association of Japan, Mr. H. Haga, Managing Director, August 22, 1984; and with Mr. Katayama of the Japanese consulate in New York, June 5, 1984.

U.S. APPROACHES

A variety of models of proposed or existing R&D institutions can be found in other U.S. industries. In fact—especially in basic industries—recent reports have urged new attention to R&D as a means of improving world competitiveness. The January 1985 report of the President's Commission on Industrial Competitiveness concluded that technological innovation is fueled by R&D which is vital to America's future, being the key to productivity advances. That report recommended initiatives in the areas of R&D partnerships and cooperation between industry, government, and academic institutions .19

In one important U.S. industrial sector, OTA has recently published an assessment of Information Technology R&D. Among other topics, that report discusses Federal patent policies, technology transfer, tax credits, R&D limited partnerships, and antitrust policy. It also provides information about industry R&D in areas of industry-university links and jointly funded research. It concludes that cooperative industry research could have long-run policy implications for the level and focus of Federal R&D programs.[20]

"Report of the President's Commission on Industrial Competitiveness, "Global Competition–The New Reality, " Washington, DC, January *1985.*

[20] "Off ice of Technology Assessment, U.S. Congress, *Information Technolog, and R&D: Critical Trends and issues, OTA-CIT-268* (Washington, DC: U.S. Government Printing Office, February 1985).

The following discusses two joint industry R&D approaches that may have relevance to the maritime industry, one Federal program from another agency (NASA) and some existing maritime institutions that have potential for modification.

Research Joint Venture

R&D joint ventures and R&D limited partnerships have both been suggested by a few of OTA's respondents as a model for certain maritime R&D. Both approaches probably have limited applications (as other advisors to OTA have commented) but their characteristics are of interest because other industries have found useful applications.

For the joint venture approach, antitrust immunity is often a concern. In a new project, the applicability of the 1984 R&D Joint Venture Act would need to be examined, Further antitrust immunity might be sought for a specific industry sector, area of research, or qualifying institution.

Actually, at least two major research joint ventures have already been established—the Microelectronics and Computer Technology Corporation (MCC) and the Semiconductor Research Cooperative (SRC). MCC is a research and development venture owned by a number of major U.S. corporations in the computer, electronic, and semiconductor industries. Participating so far are Advanced Micro Devices, Allied Corporation,

Control Data, Digital Equipment Corporation, Harris, Honeywell, Martin Marietta, Mostek, Motorola, National Semiconductor, NCR, RCA, and Sperry. [21]

Projects to be undertaken by MCC are aimed beyond the state-of-the-art. Initially, four projects have been identified, lasting from 5 to 10 years. All shareholders are not required to participate in each project, but each is required to participate in at least one. MCC projects will be staffed to a considerable extent by personnel from shareholder companies. At the completion of a project, these borrowed experts will return to their respective companies. This flow of talent to and from shareholder companies is a key to the success of MCC projects. In addition, such a process greatly facilitates the transfer of technologies to participating companies. For convenience, MCC will hold title to all know-how and patents. Although participating companies will have initial rights to the resulting technology and to receive preferential treatment, technology will be licensed to other companies on reasonable terms.[22]

In 1980, the association that represents the semiconductor industry, the SIA, focused on self-help action by the industry to counter increasing competition from abroad by forming the Semiconductor Research Cooperative (SRC). The objectives of SRC are: to plan and to promote, conduct and sponsor research; to improve the understanding of semiconductor material, devices, and phenomena; and to develop new design and manufacturing technologies. The program operates on a contract basis, primarily with universities. About 50 projects have been funded so far.[23] Three university research centers have been established under the aegis of the SRC—computer-aided design centers at Carnegie-Mellon and Berkeley, and a microstructure center at Cornell. SRC is negotiating with MIT on a materials contract, with North Carolina on manufacturing research, and with Rensselaer Polytechnic Institute on beam technology. Thirty-eight other contracts of a smaller nature have been negotiated with other universities.

Z] Edward M. Kaitz & Associates, Inc., "The Profitability of the U.S. Shipbuilding Industry (1947-1976)," 1978, p. 7, statement of Admiral B. R. Inman.

*'U.S. Department of Commerce, 1983. The New Climate for Joint Research, Conference Proceedings held May 13, 1983, pp. 17-18.

[23]Kaitz & Associates, op. cit., note 10, pp. **45-46,** statement of Erich Bloch.

R&D Limited Partnerships

In some very special cases of high risk product development R&D limited partnerships may be useful to consider. Several basic concepts are common to all forms of R&D partnerships. Generally, limited partner investors receive a tax deduction for a substantial part of their initial investments. In addition, if the deal is properly structured, investors receive favorable capital gain treatment on their royalty or equity payback. A sponsoring corporation performs research on a particular project on behalf of the partnership, which owns the developed technology. The corporation controls the commercial exploitation of the product that results from the research and has an option to buy the technology from the partnership. If the corporation exercises its option, its payment to the partnership may take the form of royalties, stock, or a combination of royalties and equity, depending on the structure of the particular deal .24

The R&D limited partnership is an alternative to the joint research venture. It is based on a 1954 law that was not used until it was tested and validated by the Supreme Court in 1974. The Economic Recovery Tax Act of 1981 and a reduction of capital gains tax to a maximum of 20 percent have combined with this law to stimulate the creation of new venture capital businesses in recent years.

R&D partnerships have been evolving as a financial alternative since 1974. The early partnerships were formed to provide seed money to start-up ventures. These partnerships raised money to carry very early-stage companies through often protracted development periods before venture capital could be raised from more traditional sources. Later, early-stage operating companies began to consider R&D partnerships as a means to finance new or second generation products that faced either a high technical risk, a long development period, or both.

Finally, mature companies are now using R&D partnerships to raise substantial amounts of money. To these companies, the R&D partnerships offer a way to shift the development risk to outside investors—to avoid betting the company on

[24]Kaitz & Associates, op. cit., p. 57.

a speculative new technology. To the private investors, a joint investment like this with a well-established company may be less risky than one with an early-stage company. A number of regional and national investment banking firms are now involved in funding offerings such as these.

In spite of the numerous advantages of R&D partnerships, they are not right for all companies. First, the use of the funds raised will be strictly limited to research and development activities, except to the extent that the company generates profit on the contract. Second, only high margin products are appropriate for royalty partnerships, since generous royalties directly reduce profit margins. Depending on the particular structure, the company's cost of capital may be relatively high. Third, the company must be prepared to give up potential tax loss carry forwards and R&D tax credits, since the investors, rather than the company, would take the deductions for research expenses. Finally, the formation and structuring of R&D partnerships could have high transaction costs, and may dilute the use of management's time.

Investors in R&D limited partnerships face particular uncertainty with respect to long-term capital gains treatment. Recent changes in the tax law, under the Tax Equity and Fiscal Responsibility Act of *1982,* have been designed to discourage individual investments in R&D. It is too early to assess the impact of the recent change to include research and development expense deductions as a tax preference item for the minimum tax, but it is likely to reduce the attractiveness of R&D partnerships to a great number of potential investors .[25]

NASA Industrial Applications Center

The U.S. Navy conducts a great deal of research and development that has significant applicability to the commercial maritime industry. While the results of unclassified R&D are generally available to the commercial sector, the institutional aspects and quantity of completed **and ongoing work preclude easy access to** these **products.**

An effort to facilitate the flow of information from the U.S. Navy to the private sector might be modeled on the industrial application centers set up by NASA. As one shipyard responded to the OTA survey: "1 would suggest the establishment of a maritime industry (applications center) equivalent to NASA with responsibility for collection and industry-wide dissemination of maritime related basic research, design, and construction technology. " Eight nonprofit industrial application centers were organized under an original grant from NASA to transfer NASA technology to commercial industrial applications. These centers enter into agreements with individual firms or groups of companies to develop solutions to industry technical problems. The fees from private firms help to support these activities.

The first Aerospace Research Applications Center (ARAC) was created by NASA in 1963 as a private not-for-profit technical information and assistance center operated by the Indianapolis Center for Advanced Research. ARAC maintains a staff of scientists and engineers and a system of computerized data bases of world-wide scientific and technical literature to aid industry, business, and government. It was first designed to help NASA find industrial uses for space research. However, ARAC's literature and data resources have now extended into the full range of modern, industrial science and technology chemistry, materials, reliability and quality control, and computer science.

ARAC provides two primary services to industrial clients. One is through engineering background studies, essentially extensive literature searches. The other is a current awareness search, which provides access to the new literature that is continuously added to the ARAC data bases. The current awareness search contains abstracts of new literature on a monthly basis in an attempt to keep clients abreast of new research and developments taking place in industrial science and technology.

[25]Kaitz & Associates, op. cit., p. *59.*

EXISTING MARITIME INSTITUTIONS

The David Taylor Naval Ship Research and Development Center

The David Taylor Naval Ship Research and Development Center is the U.S. Navy's principal research, development, test, and evaluation center for naval vehicles.[26] It was established March 31, 1967, with the merger of the David Taylor Model Basin at Carderock, Maryland, and the Marine Engineering Laboratory at Annapolis, Maryland. The Carderock laboratory is the largest facility of its kind in the Western World with about 1,000 people employed in its seven major research departments. The Annapolis facility employs another *500* people. Research areas addressed at these two facilities include hull-form structures, propulsion, silencing, maneuvering and control, auxiliary machinery, environmental effects, pollution abatement, logistics, computer techniques, and software for analysis and design.

The enabling legislation for a model experiment tank at the Washington Navy Yard, the precursor to the Carderock facility, specified that upon the authorization of the Secretary of the Navy, experiments could be conducted for private shipbuilders provided that they defray the costs of material and of labor for such experiments. This authority continues to prevail today but is seldom used.

The Kings Point, New York, Facility

At present, a national maritime research center exists at the U.S. Merchant Marine Academy at Kings Point, New York, but it provides few services and lacks the focus for R&D projects that this option might envision. The National Maritime Research Center was created in response to conclusions drawn at a maritime R&D conference held at Wood's Hole, Massachusetts, in 1969 to attempt to identify a long-range maritime research program. One final recommendation called for establishing field centers to conduct maritime research. In response, centers were set up in Galveston, Texas, and at Kings Point, New York. Originally, the intent was to establish laboratory and model testing facilities at both centers, but neither materialized. The Computer-aided Operations Research Facility was the only facility actually established; it now dominates the budget and agenda of the Kings Point operation. The Galveston center was closed a few years ago.

In January 1982, MarAd completed a study that assessed the level of industry interest in supporting a shipping management center designed to disseminate management techniques to individual companies. As a result of this effort, an exchange center, which would rely on industry for most of its support, was proposed. At least on paper, it was established and a few symposia were sponsored under its auspices. However, progress towards full realization of its stated objectives has stalled. Through congressional oversight activities, full-scale realization of such a center might be encouraged.

The Maritime Research Information Service

The Transportation Research Information Service (TRIS) is a computer-based research information storage and retrieval system maintained and operated by the Transportation Research Board of the National Research Council. TRIS consists of more than 185,000 abstracts of published works and summaries of research in progress. This data base is made up of four principal subfiles on highway, urban mass transportation, highway safety, and railroad research.

The Railroad Research Information Service (RRIS), for example, which receives its financial support from the Federal Railroad Administration, began abstracting technical papers, journal articles, research reports, statistical sources, computer programs, and data sets in 1973. The service collects information from a number of U.S. Government and industry sources and has a formal exchange agreement with the International Union of Railways, which allows it to obtain foreign railroad research information. In addition, RRIS provides dissemination services such as the semiannual Railroad Research Bulletin which lists

[26] Brochure of the David Taylor Naval Ship R&D Center and legislation establishing the Washington Navy Yard's model experiment tank, 54th Cong., 1st sess., June 10, 1896.

all new references placed on its magnetic tape files during the preceding six months. File searches are also conducted on request.

A maritime research data base, similar to the RRIS, was formerly available as part of the Transportation Research Information Service. The Maritime Research Information Service (MRIS) had information exchange agreements with Norwegian and British maritime research institutes. The data base was financially supported by MarAd until 1981. Abstracts from this data base, however, are still filed on the TRIS computers and operations could be resumed if funding were reinstated. Alternatively, MRIS could be integrated with the information services already available at the Merchant Marine Academy. This alternative was, in fact, proposed after MRIS was discontinued, but it was never acted on.