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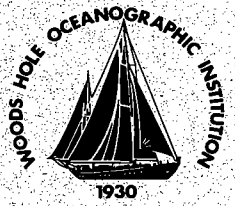


# Developing a National Marine Electronics Agenda: Proceedings of the Marine Instrumentation Panel Meeting September 12 - 14, 1989.

edited by

Arthur G. Gaines and Kristina L. C. Lindborg

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Funding was provided by the National Oceanic and Atmospheric Administration through a grant to the Massachusetts Centers of Excellence Corporation, grant No. NA87-AA-D-M00037.

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**Technical Report**

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**Approved for Distribution:**

**James M. Broadus III, Director**
Marine Policy Center

# PREFACE

This volume contains collected papers from the 1989 meeting of the Marine Instrumentation Panel (MIP) covering aspects of competitiveness in the marine electronics instrumentation industry. Topics addressed at the meeting had been identified largely at the previous year's MIP meeting; presentations were by invitation. The 1989 meeting was convened at Woods Hole, Massachusetts, from September 12-14. A complete agenda as well as the attendance list are given in appendices I and II. As evidenced by their absence from this volume, a few papers were regarded as inappropriate for publication by their authors.

Deliberations of the Panel are an integral part of our program, *Developing a National Marine Electronics Agenda*, which aims to develop a prescriptive set of recommendations to help invigorate and strengthen the marine electronics industry. Our interest in this industry stems from the fact that it supplies products to the oceanographic (aquatic) research and monitoring community; acts as a conduit through which instruments developed by ocean scientists and engineers are commercialized; and constitutes a significant economic factor in parts of the United States and other nations.

Our program is funded through the Office of NOAA Corps Operations and organized through the Massachusetts Centers of Excellence Corporation (MCEC). MCEC is a partnership program linking government, academia, and the private sector in joint programs whose vitality springs from the collaboration. Our program has included participation by three academic/research institutions: The Oceanic Institute (Hawaii); Florida State University; and the Woods Hole Oceanographic Institution. Participation by industry and government comes through the Marine Instrumentation Panel at events such as this conference, and through review of written program products.

Papers in these proceedings were compiled and edited by Ms. Kristina Lindborg, who was enlisted specifically for this task. Ms. Theresa McKee, a Research Assistant at the WHOI Marine Policy Center provided crucial help in organizing the conference and finalizing the camera ready draft, including editorial work and graphics.

Arthur Gaines
Program Manager
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# ABSTRACT

Thirteen short papers address aspects of competitiveness in the marine electronics instrumentation industry. Topics include activity and status of government initiatives in Japan and Europe to promote this industry; and the possible role of federal-state collaboration in the U.S. Papers address technology transfer between research institutions and the commercial sector; the role of "strategic alliances" in this process; and the "dual-use" concept in effective technology development and commercialization. Other papers address electronic technology applications in specific marine areas, such as the use and implications of the COMSAT mobile satellite communication infrastructure; electronic charts and safety of tanker operations; and instrumentation applications in aquaculture and environmental monitoring.

## Table of Contents

**Appendices**

**Developing a National Marine Electronics Agenda**

Gary Glenn
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Background

The proposal to the National Oceanic and Atmospheric Administration (NOAA) to create this project, entitled, *Developing a National Marine Electronics Agenda*, was submitted in final form just over two years ago. The final proposal was the fifth draft we had submitted. The problem was apparently a conceptual gap between the questions we wanted to ask and NOAA's need for some operational specificity. We, as the proposers, had what amounted to a sequence of questions marks and unknowns. We knew that our central questions all revolved around issues of competitiveness.

For instance, why could some sectors of the U.S. economy compete successfully with foreign commercial interests while others could not? Why did technologies originally developed with strong U.S. government financial involvement so often end up benefitting non U.S. companies? And, what was the proper balance to be struck between governmental, private, international security, and other interests?

NOAA, on the other hand, wanted more than just open questions. It also wanted an indication of what direction would be taken, what data would be collected, and where the whole enterprise was headed. We finally managed to compromise on a project description that had a good deal of specificity in terms of method but also allowed the various investigators wide latitude to follow the logical outcomes of their research.

The core of the proposal to NOAA can be summarized as follows:

*The project described in this proposal is designed to assess the competitive position of the U.S. marine instrumentation industry in order to obtain empirical baseline data required for preparation of policy guidelines relevant to increasing the competitiveness of the United States in the worldwide marine instrumentation market.*

Our concern on the specific level was to identify factors and circumstances in the marine electronics industry which related to the competitive status of the U.S. industry. On a broader level, we also hoped to determine the extent that this industry could be used as a real world case study to trace the affects of the many factors influencing U.S. industrial competitiveness in the world economy -- especially toward the close of the 20th century.

During the two years we have been at this task, other relevant activities, some parallel and some tangential, have also been underway. I would like to mention three activities that directly relate to the current study.

First, one of the most significant recent actions by the federal government has been the passage of the Omnibus Trade and Competitiveness Act of 1988. This legislation contains over 400 sections, divided into ten major titles. It fills 149 pages in the Congressional Record and another 156 pages of Explanatory Comments. A quick review of these titles will demonstrate the scope of the legislation and its relevance to our current task.

Title I deals with "Trade, Customs and Tariff Laws," and contains several subsections of interest to our deliberations in this project. Subtitle C contains legislation relating to "unfair international trade practices," and Sections 1303, 1305, and 1306 all target Japan as a potential violator of good trade relations. Subtitle C also contains legislation concerning the protection of intellectual property rights. Title II focuses on "Export Enhancement" and contains 71 sections which deal with everything from support for the Overseas Private Investment Corporation and negotiations with COCOM to sanctions against Toshiba and Kongsberg. Title III deals with "International Financial Policy" and includes a number of sections of importance to current and perspective exporters.

Section IV covers "Agricultural Trade" and includes some legislation of interest to U.S. aquaculture interests, especially in terms of establishing precedents for certain policy formulations. Title V deals with both foreign corrupt practices and what is generically called "investment and technology." Under this rubric, the Act broadens and redefines the National Institute for Standards and Technology (out of the old National Bureau of Standards) and establishes a number of technology related programs and policies. Subtitle C of Title V is the "Competitiveness Policy Council Act," and Subtitle D is the "Federal Budget Competitiveness Impact Statement," which in turn has two parts -- the National Trade Data Bank (Part I) and the requirement for competitiveness impact statements (Part II).

Each of the other titles contains at least some legislation of interest to us: Title VI is "Education and Training for American Competitiveness." Title VII is the "Buy American Act of 1988." Title VIII is "Small Business." Title IX is "Patents." Title X is "Ocean and Air Transportation".

Needless to say, given the objectives of our project to "develop a national marine electronics agenda," our deliberation will be enhanced by a thorough understanding of the Omnibus Trade and Competitiveness Act.

Second, in the past year there has been a major outpouring of books, articles, essays, and miscellaneous writings on various aspects of competitiveness. One of the most influential has been, "Made in America: Regaining the Competitive Edge," prepared by the Massachusetts Institute of Technology Commission on Industrial Productivity. In testimony before Congress in May of 1989, four authors of the book told the Senate Committee on Labor and Human

Resources that their study indicated six principal across-the-board weaknesses in major U.S. industries -- most of which appear to afflict the marine electronics industry as well.

As a result, the Commission recommended five "imperatives" to restore U.S. competitiveness. These include cultivating a new, economic citizenship through more extensive worker training and participation in firms, and learning to live more effectively in a world economy. The Commission also recommended a series of specific policy steps, such as rebuilding the nation's technological infrastructure and making a major commitment to improve education at all levels, with special emphasis on grades Kindergarten through 12.

It is clear from a review of "Made in America" and many other writings on the subject that certain themes are universal. The problem then is how to make the importance of this issue more apparent next to the many other priority issues competing for attention at the state and national levels.

Third, there is a sentiment in Congress and in the home districts of many Congressmen that favors increased government involvement in trade issues and support for 'Buy American' policies. The House of Representatives bill authorizing $310 million for the Maritime Administration requires purchase of U.S. manufactured goods if the cost differential is no greater than 6 percent. There is a mood for action in Congress -- regardless of what that action might be. There are currently five major bills pending in Congress that deal with the various aspects of competitive positioning. The "National Cooperative Innovation and Commercialization Act" would facilitate joint production, distribution, and marketing activities of U.S. firms by relaxing antitrust laws. It would also establish a procedure by which the Department of Justice and the Federal Trade Commission, in consultation with the Department of Commerce, could review proposed joint ventures. If the agencies were to approve a venture, the participating firms would be relieved of all potential civil and criminal penalties for activities performed within the scope of the agreement.

Similarly, "The Cooperative Productivity and Competitiveness Act" would amend the National Cooperative Research Act of 1989 by allowing joint production of products, processes, and or services.

Overall, U.S. business practices are being examined much more closely. It has been widely reported that in the early 1980's, U.S. chip manufacturers such as Intel, Motorola, National, and Zilog licensed their microprocessor technology to Japanese companies in order to secure short term financing, without negotiating any reciprocal exchange of technology. This short-sighted action boomeranged when the intellectual property was used by the Japanese companies to capture market share.

More recently, NeXT Computer accepted $100 million from Canon for 16.7% equity, and virtually every major U.S. computer manufacturer (the list includes Hewlett Packard, TI, Cray, Tandy, Sun and Maxtor) either has entered into joint deals, or is now negotiating such a deal.

There is currently a major debate raging over so-called strategic alliances, which allow individual companies to make their own deals, versus "industrial base protection" (supported by techno-hawks.) The effort by Fujitsu to buy Fairchild was thought to be too great a threat, but many other such deals are pending. One very controversial deal involved the sale by Atlantic Richfield of its photovoltaics (PV) subsidiary, Arco Solar, to Siemens AG of West Germany. Arco Solar has received millions of federal dollars for PV research and is the leading U.S. PV company. Major breakthroughs have occurred in PV technology in the past year and many applications are opening up for PV devices. However, the U.S. funded technology is now German owned.

There are many parallels between the PV situation and marine electronics and instrumentation companies that may be purchased by foreign companies after receiving major amounts of federal funding, or where technology finds its way into foreign hands in other ways.

The point is that significant parts of the competitiveness problem are receiving close attention in Washington, and legislation is being drafted, written, debated -- and in some cases passed -- which is designed to deal with various parts of the whole dilemma. What we might hope for is a coordinated, cohesive, and continuing set of policies rather than short-term, ad hoc solutions that address only a fraction of the problem.

Summary

In summary, it seems to me there are some basic questions we need to keep asking. In policy terms, there will be some kind of answer eventually, because even inaction has its consequences.

The first basic question has to do with defining the relationship between the military and the private sector. As "Determining the Structure of the United States Marine Instrumentation Industry and its Position in the World Industry," (produced by this project) points out, the military plays a major role in marine electronics -- from funding research to identifying products to procuring products and services. That amounts to about three quarters of the $3 billion U.S. market for marine instruments. Given the military's primary role as the protector of national security and its secondary but growing role as the promoter of U.S. economic strength, the question then is, what affect does this have on the development and purchase of marine instrumentation? Can any level of security be sacrificed for economic and commercial gains? If so, who decides, and on what basis?

The second question repeats the first, excepting that it applies specifically to the scientific community. According to the "Chronicle of Higher Education," the United States will pay 50 percent of the $450 million cost of the World Ocean Circulation Experiment (WOCE). The same article states that "thousands of scientific instruments will be deployed in WOCE." We can also add to that list the Tropical Ocean and Global Atmosphere and the United States Global Change Research experiments.

Do U.S. companies get 50 percent of the market? Should they? Are U.S. scientists willing to give up any level of accuracy in order to 'Buy American'? Do U.S. scientists have any

obligation to work with U.S. companies to develop new instrumentation?

Do U.S. government funding sources that support scientific research have any such obligations? Merely raising these questions is heresy in some quarters, but many foreign countries demand exactly these sorts of relationships between government and the scientific community.

Finally, you may ask, what does all this have to do with *Developing a National Marine Electronics Agenda*? I would reply that the agenda we are seeking must be developed within a context of the economic and political realities we live in. There is currently great flux in the relations within the U.S. economic structure and the various institutions of government. For those of us interested in marine electronics, there is a great challenge and a real opportunity to make a difference. A chance to inform policy with facts and reasoned approaches, rather than just slogans. We have already made an outstanding beginning.

**The Influence of Japanese Industrial Targeting and Trade Policy on the Markets for Marine Electronic Instruments**

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Background

In Broadus et al. (1988), we presented a broad overview of the organization of firms and industrial networks through which products in the field of marine electronic instrumentation (MEI) are marketed. The research that went into the preparation of that report has been continued with, among other things, an emphasis on technological histories. These histories (or "case studies") have been directed at determining the origins of research and development (R&D) activities, identifying the sources of research sponsorship, and understanding the means by which funding for technological development has crossed the boundaries of end user sectors.

In addition to the technology histories, we have begun to analyze technology transfer among private, nonprofit, and public sectors in this field (Kite-Powell and Hoagland, in this volume) and the role of foreign governments in the promotion of their own MEI industries. Elsewhere in this volume, Hoagland and Kite-Powell report on the preliminary results of their fact-finding mission to six European countries and the Commission of the European Communities. We were unable to conduct a similar mission to Japan this summer. However, we are able to outline some of the technological developments that currently are taking place in the MEI field in Japan and to identify some of the major issues facing U.S. industry there.

Japanese government involvement in the MEI field, as in other advanced technology fields, can be divided into two elements (ACTPN, 1989; Heaton, 1988). The first is government involvement in the research endeavor, especially through its "intertwined", but coordinated relationship with the industrial establishment, the "targeting" of broad-scale research opportunities, and the direct sponsorship of R&D, product development, and marketing. The second element is trade policy.

Japanese Government Research and MEI R&D Targets

In the MEI field, the high-volume, low-margin consumer electronics markets have been most subject to Japanese competition. Consumer electronics is the kind of market in which the Japanese excel -- it's the paradigm of Japanese international competitiveness. (U.S.

manufacturers look for very specific high volume niches for their survival in that industry.)

We have not identified any initiatives in Japan that portend increased efforts by its government in the marine consumer electronics industry. However, there is some reason to believe that the Japanese government has begun to target the oceanographic and environmental monitoring instrumentation sector through government-sponsored R&D efforts. This may be particularly troubling for U.S. manufacturers of these technologies, because this is not the typical mass market toward which most Japanese government support has been targeted in the past.

In the defense and military systems sector, there is mixed news. We expect to see increased competition from the Japanese in terms of components included in western defense systems. It is conceivable that there may be some market opportunities for U.S. vendors as Japan expands its participation in the western alliance antisubmarine warfare (ASW) efforts (although this is a sensitive area not usually talked about openly).

The principal sponsor of marine technology development efforts in Japan is the Science and Technology Agency (STA), particularly through its subsidiary body, the Japan Marine Science and Technology Center (JAMSTEC) (Okamura, 1987; Saeki, 1984). Table 2 in Hoagland and Kite-Powell's paper gives a general impression of the size of funding for oceanographic research in Japan (and compares it to the levels of other countries). STA is the primary sponsor of a number of MEI-relevant projects that include the participation and partial sponsorship of Japanese industrial corporations (STA, 1987). These projects are worth describing:

1. The Japanese are at the cutting-edge of marine submergence technology. JAMSTEC has operating experience with its own 2000m capable deep diving manned submersible and has just taken delivery of its "world class" 6500m deep diving submersible, the Shinkai 6500. This submersible will be equipped with the capability for sending television signals acoustically.

2. JAMSTEC has constructed and successfully operated a 300m remotely operated vehicle (ROV), the Dolphin 3-K. Beginning in 1992, R&D efforts are planned for a 10,000m capable ROV. The development and manufacturing budget for this ROV has been estimated at $20 million.

3. JAMSTEC is involved in several instrumentation projects as components in the design of a much larger "marine environmental control system." These include marine remote sensing technologies, related particularly to earthquake prediction, and geologic and seismic sensors.

4. There are several interagency projects, including one directed at the development of new oceanographic instrumentation for exploitation of the Japanese EEZ (Chijiya and Odamaki, 1988). These include fast collection and processing systems for ocean data and ocean "condition" observational instruments. Among the specific instrument types are composite optical sensors for seawater analysis, a ship-mounted acoustic doppler current

profiler, an ocean acoustic tomography system, and an "intelligent" sonar system for the measurement of oceanic fish and plankton populations. This line of research has been postponed but may resume in the future.

In addition to JAMSTEC, MEI technologies are under development or are being sponsored by several other government research institutions (Westwood, 1989). Detailed descriptions of these institutions can be found in STA (1988). Among these, the Ministry of International Trade and Industry (MITI) has a number of projects involving deep sea minerals and offshore oil and gas development. However, the Japanese industry has suffered the same kind of downturn in the oceans sector as the U.S. industry. MITI's deep seabed mining project, one of its targeted national large-scale R&D efforts, was initially planned as a nine year, $100 million large-scale project to start in 1981. Funding dropped to roughly one third of the initial level after the third or fourth year and has never been increased. The project is now approaching its terminus.

The Maritime Safety Agency (MSA) (located in the Ministry of Transportation) will become a major player in ocean instrumentation. MSA's Ocean Surveys Division and Coastal Surveys and Photography Division are responsible for integrated marine survey and research for bathymetric charting and marine surveys. MSA is heavily involved in the development of instrumentation to serve its missions. These technologies include GPS and interactive editing systems for nautical charts. Other government agencies include the Japan Weather Association (drift buoys for wave observation); the National Research Institute of Fisheries Engineering (echo sounders and sonar for fisheries resource surveys; physical oceanographic sensors); the Geological Survey of Japan (ocean thermal energy conversion research); the National Research Institute for Pollution and Resources (manganese nodule recovery system research); the Ship Research Institute (integrated navigation systems; artificial intelligence); the Port and Harbor Research Institute (a "walking robot" for undersea observation); the Geographical Survey Institute (hydrology and coastal sea mapping). The major marine trade association, the Japan Ocean Industries Association, is not involved in ocean instrumentation development, although it does sponsor research in offshore oil and gas production and pollution control technologies (JOIA, 1987).

Japanese Trade Policies

There are two primary strategies that can be employed by the Japanese to shift the competitive advantage in their favor (ACTPN, 1989). One strategy involves the imposition of tariffs and quotas that can act to shut down home markets. The other strategy involves so-called "invisible" barriers to trade, and these may be the most important to U.S. manufacturers in the MEI field.

In Table 1, relative average tariff levels in the United States are compared with those in the European Community countries and Japan for raw materials, semi-manufactures, and finished manufactured goods (Balassa and Michalopoulos, 1986). Notably, Japanese tariffs really are not out-of-line with those in the United States. In fact, these data do not reflect reforms that have been instituted in Japan during the past year that actually have the effect of lowering tariff barriers in Japan.

Table 1: Relative Average Tariff Levels
(% Ad Valorem)

| | USA | EC | JAPAN |
|---|---|---|---|
| RAW MATERIALS | 0.2 | 0.2 | **0.5** |
| SEMI-MANUFACTURES | 3.0 | 4.2 | **4.6** |
| FINISHED MANUFACTURES | 5.7 | 6.9 | **6.0** |

Source: Balassa and Michalopoulos (1986)

However, as shown in Table 2, the degree of specialization in Japanese industry is not nearly as high as in other countries. Lawrence (1987) measures the degree of specialization using an "intra-industry manufacturing trade index." Using 1980 data from 94 industries, the index is a weighted measure of the balance between exports and imports across those industries. In effect, the index measures the extent to which there is an export-import balance within a country's industries. For Canada, Finland, France, West Germany, Italy, Norway, the United Kingdom, and the United States, the index is between roughly 0.5 to 0.8. This indicates a higher export-import balance within industries in these countries in comparison to Japan with an index of 0.25. What this means is that, within Japanese industries, there is a lot of exporting, but this is not accompanied by importing from abroad. These industries are supplied with components or other supplies manufactured in Japan. The primary implication of this kind of analysis is that trade barriers may exist.

Table 2: Intra-Industry Manufacturing Trade
Indices, 1980
(94 Industries)

| | |
|---|---|
| CANADA | 0.68 |
| FINLAND | 0.49 |
| FRANCE | 0.82 |
| FRG | 0.66 |
| ITALY | 0.61 |
| **JAPAN** | **0.25** |
| NORWAY | 0.51 |
| UK | 0.78 |
| USA | 0.60 |

Source: Lawrence (1987)

In Japan, there is a distinct preference for Japanese goods and services. Balassa and Noland (forthcoming) have found that, based upon national attributes, a model of import penetration in

manufacturing would predict between 25 to 40 percent more imports than what is currently observed in Japan. Much of this effect may be attributed to the fact that the Japanese have been tremendous savers. Until the last few years, Japanese tax laws have systematically encouraged personal savings (earnings on these accounts were tax exempt). But these laws have changed recently, and we can begin to see a more consumer-oriented economy in Japan, with a narrowing difference between the relatively high savings rate in Japan and the much lower rate in the United States.

What about the invisible barriers? The most significant one probably is "administrative." It emerges from the intimate relationship between the governmental agencies and the industrial organizations in Japan. It implies that the government officials tell (perhaps informally) Japanese companies whether or not to import and from which Japanese companies to purchase supplies. This is just another manifestation of governmental economic coordination.

Standards testing and certification is another area in which there have been complaints about Japanese practice. The standards required by the Japanese for imported products are not always clearly articulated, and frequently they are written in such a way as to appear to favor Japanese products and to "lock-out" U.S. products. Invisible barriers tend to crop up in public procurement as well. Such barriers involve the use of single tenders, short bid times, complex qualifying procedures, and a general lack of transparency in the procurement process. Furthermore, in Japan there is a systematic "defense" of depressed industries. Among these is included the shipbuilding industry, and electronics instrumentation for ships may be favored through support for this industry.

Two more invisible barriers are important to mention. One concerns the lag between invention disclosure and patent issuance. In Japan this period averages about six years (compared with two in the United States). Thus there is concern that the longer lag period leads to imitation and quasi-infringement of technologies developed outside Japan.

Finally, the complexity of distribution channels may have a significant effect on the extent to which U.S. products can compete in Japanese markets. Balassa and Noland (forthcoming) have explained that:

*Commercial practices, many unique only to Japan, had severely inhibited the ability of companies wishing to enlarge their share of the market. For example, it is virtually impossible to sell to Japan without having an affiliated company doing the marketing and distribution...the structure of Japan's distribution network is a major impediment to our exporters gaining a fair share of the market. The distribution network is so complex that the imported product becomes very expensive by the time it reaches the consumer.*

Conclusion

It is important to point out a trend in Japan concerning the decline in the strength and depth of the market faced by marine technologies. In order to fill a gap in the market, the Japanese have