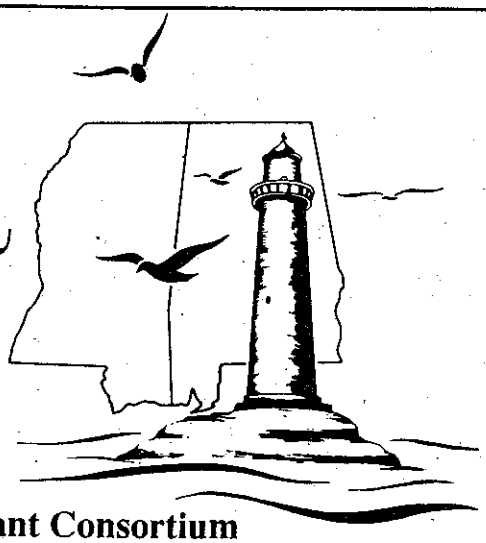
WATER LOG



A Legal Reporter of the
Mississippi-Alabama Sea Grant Consortium

Special Issue: Ocean Space Utilization

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WATER LOG

WATER LOG is a quarterly publication reporting on legal issues affecting the Mississippi-Alabama coastal area. Its purpose is to increase public awareness and understanding of coastal problems and issues.

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Preface

Coastal regions have come to be regarded as the most economically productive and ecologically valuable areas on earth. Much of the world's population and industry is now crowded within coastal zones, and this trend is expected to accelerate. New and innovative ocean technologies and uses such as floating commercial and residential structures, ocean-based waste treatment facilities, and artificial ocean habitats have been proposed as one method of meeting the growing demands placed on coastal areas. While many observers believe that these new technologies are compatible with sound environmental management practices, others are skeptical and want the oceans preserved in as natural a state as possible.

This edition of WATER LOG will examine ocean space utilization and new ocean technologies focusing especially on developments in the United States and Japan. The first article, by Dr. Takeo Kondo and Dr. Joseph R. Vadus, looks at trends in planning and developing offshore projects planned or constructed between 1961 and 1990 and selects fifty for detailed analysis. After a discussion of environmental considerations related to coastal development, the article classifies various structures based on future trends toward integrated multiple-user and multiple-function offshore complexes. The article concludes by asserting that coastal ocean space and development projects have evolved to a level in which technology is capable of addressing many multiple-user needs in harmony with the environment.

Richard J. McLaughlin's article compares policies in the United States and Japan relating to the development of new ocean technologies and uses. He summarizes the findings of a national ocean enterprise workshop sponsored by the National Science Foundation and suggests that most of its recommendations have little chance of being implemented in the United States. This is followed by an examination of Japan's interest in new ocean uses and technologies. The article then compares environmental regulatory systems and the role that each plays in encouraging or discouraging ocean development. It concludes with a call for the governments of the United States and Japan to establish a program to encourage collaborative research and cooperative commercial arrangements for the development of new ocean uses and technologies in Japan. The author asserts that increased U.S. access to the Japanese market for new ocean technologies will reduce trade tensions and provide benefits to both American and Japanese companies.

Ocean Space Utilizaton — Trends and Needs

by Takeo Kondo and Joseph R. Vadus

INTRODUCTION

Many of the world's coastal regions are developing rapidly in an unplanned manner and without serious concern for the environment. Since the industrial revolution, industrialized nations focused mainly on economic wealth, allowing the vastness of the land, ocean, and air environment to accept and spread many substances harmful to the environment. The people of industrialized nations have only recently begun to place greater value on the coastal environment and the quality of life of their citizens.

In Japan, the need for additional coastal real estate has resulted in developing artificial islands in estuaries and coastal areas for a variety of uses such as power stations; municipal airports; and integrated, high-quality living, working, educational, and recreational facilities. Major coastal development projects have been completed and others are planned or under way in major coastal areas including Tokyo, Yokohama, and the Kobe-Osaka region. In the U.S., several major port and harbor communities such as Los Angeles, Long Beach, Baltimore, and New York have also begun or are planning large-scale coastal ocean space revitalization projects.

In order to assess trends in planning and development of offshore facilities, over 400 projects were identified in the literature for the 30-year period between 1961 and 1990. Of these, 50 projects were selected for additional analysis as representative of ocean space utilization projects and not just traditional coastal land reclamation. After discussing the relationship between the coastal environment and ocean space utilization, this article will examine the evolution of ocean space development projects and future trends.

Trends in coastal development include port and harbor modernization and waterfront development; integrated living, working, and recreational facilities; seaward extension of land-based facilities, artificial islands, and floating facilities and cities; and hybrid combinations of fixed and floating structures or partially buoyant structures.

ENVIRONMENTAL CONSIDERATIONS

The coastal environment is affected by slow natural processes punctuated by occasional natural disasters and human-induced impacts that appear to cause faster change.

Slow geophysical natural processes and occasional natural disasters such as earthquakes, tornadoes, and hurricanes are major forces that greatly affect coastal living and have significant implications in urban planning and structural design. Besides natural disasters, man-induced disasters exist, such as global warming, ozone depletion, acid rain, and marine pollution.

Natural Disasters

Earthquakes have had a major impact around the world. The Pacific Rim countries and many major coastal cities are located on rift zones. Earthquake engineering has advanced structural designs to provide a high degree of shock mitigation for building on land. Construction of artificial islands on rift zones presents a number of significant dangers that should obviously be avoided. The effect of tremors would depend on the degree of direct coupling and how much would be isolated by layers of sediment and the magnitude of shearing lateral forces. Unlike structures on reclaimed land, floating facilities would have the advantage of using the water as a buffer. However, construction of artificial islands and floating facilities near shore require design considerations for tsunami waves caused by earthquakes or coastal avalanches. Historic environmental data on earthquakes and tsunamis would normally be consulted in making site selections and estimating the environmental forces involved. Similarly, historic data on typhoons, hurricane tracks, and tornado paths are needed in the site selection process to consider those forces in structural design and protection of property.

Global Warming

Over the past 50 years, global sea levels have been rising at about 3.0 millimeters a year (three times the rate of the previous 50 years). If this trend continues or possibly escalates, sea levels could rise as much as 30 to 60 cm by the middle of the 21st century, flooding some coastal cities and villages. This will create concern in designing and building homes, buildings, ports, and harbors for future coastal communities. Technology plays a vital role in providing a wide variety of atmospheric and ocean measurement systems and large-scale networks to monitor the effects of global warming; conservation measures to reduce consumption of fossil fuels; a means to reduce CO_2 emissions; alternate fuels for transportation; alternate energy sources to supply electrical power; a means to redeem CO_2; and new water supplies to offset scarcity due to warming.

Marine Pollution

Marine pollution is severe in many coastal areas, as reflected by beach closings, prohibitions on shellfishing, habitat losses, and health warnings to seafood consumers. Many coastal regions around the world, especially near major population centers, have reached critical stages of marine pollution due to sewer outfalls, ocean dumping, land runoff, shipping discharges, and plastic debris from marine recreational activities and marine vessels. In addition, industrial waste and effluents are being discharged in coastal waters, and in rivers and streams that terminate in coastal estuaries. Hazardous material spills, especially those that occur in coastal waters and within the Exclusive Economic Zone (EEZ), are a major concern.

Coastal Data and Information

Most of the developed nations have various data collection, processing, assessment, dissemination systems, and archival centers holding the kinds of environmental information needed for coastal planning development. The scope, extent, quality, and accessibility of this data differ in each nation. In the U.S., major efforts have been undertaken to access all available sources of data and information taken in the past and present, especially in the coastal ocean and EEZ. This information is electronically stored, processed, and analyzed using desk-top computer systems.

Environmental Impact of Structures

Marine structures can be divided into several types, most notably floating, fixed, gravity, and reclaimed-land types. The degree of their impact on the ocean environment (ecology, climate, and physical characteristics) varies from significant in the case of reclaimed-land structures to light in the case of semi-submersible platforms. The impact of a structure on the ocean environment is largely determined by the degree of free flow of seawater (including content of dissolved oxygen, nutrients, and any imparted temperature change); the degree of sunlight penetrability to stimulate photosynthesis and carbon dioxide assimilation; and the rate of evaporation (affected by atmospheric and water temperatures). In general, the impact is likely to increase with a larger ocean space coverage area of a structure. Regardless of its type and size, a structure's use objectives and assigned functions can have a severe impact on the ocean environment. If a structure is intended solely as living space, the impact is relatively small. In comparison, the potential impact is vary large in the case of a desalina-

tion plant, an ocean thermal energy conversion system (OTEC), or a nuclear, coal, or oil thermal power generation plant which directly uses very large volumes of seawater as a heat exchange medium. Furthermore, a petrochemical plant, chemical plant, or heavy machinery manufacturing plant which produces contaminant industrial waste may also cause significant damage.

In considering technical issues relating to ocean control, calm and safe ocean space must be secured to protect and promote the effective use of ocean space. Technologies to control high tides, tsunami, and swells are not well understood at present and require urgent development to stabilize and control extensive ocean space.

EVOLUTION OF OCEAN SPACE DEVELOPMENT PROJECTS

A total of 402 ocean space development projects were identified in the literature for the period between 1961 and 1990. These included completed development projects, those previously planned and proposed, and those currently under way or planned. In the case of planned projects, only those which have been determined to be technically feasible through engineering analysis (excluding financial factors) were selected. These projects are classified in Table 1 in terms of their functional characteristics (production, recreation, urban and residential space, transportation, communication, safety and disaster prevention, national land conservation, and others) and resource characteristics (biological, mineral, seawater, and ocean energy and space such as coastal or offshore development). The classification results show that production facilities are the top category in terms of function, followed by transportation-related facilities. In terms of resource development, mineral and seawater resources are first, followed by offshore space development projects.

Fifty projects were selected based on the criteria that they are ocean space utilization projects for the benefit of society and not just coastal land reclamation projects. These 50 projects were further divided into production facilities (industrial production base, oil and gas storage, and prodution base), urban amenity assistance facilities (power generation plant, airport, recreation facility), and urban residential facilities (marine city). Their structural types (reclaimed land type, gravity type, fixed type and floating type) and physical characteristics (in terms of distance from the nearest coast, sea depth, location and space coverage area) were compared, and the following observations can be made.

Structural Type

Reclaimed land type structures are the most common of both current and planned projects because of technical feasibility and relative economy. Floating-type structures are usually associated with deep sea, single-function small projects.

Relationship between Sea Depth and Distance from Coast

There is an obvious trend for production facilities to be located in deeper waters because of diminishing coastal resources. In comparison, urban amenity assistance facilities are mainly located in shallow seas near large cities for such obvious reasons as access cost, which depends on distance and available modes of transportation. Urban residential facilities are either located in shallow, near-coastal areas (less than 20 to 100 m deep and about 5 km distance from the coast). The former is associated with reclaimed-land type structures or floating-type structures. Most of the projects are less than 10 km offshore and less than 25 meters in depth. Project site selection is mainly based on geological considerations, bathymetry of the offshore area, and economic considerations.

Relationship between Area Size and Distance from Coast

The size of production facilities tends to diminish with increased distance from the coast and these are mainly associated with single-function facilities. Conversely, the size increases with multi-functional features when distance from the coast is less. Urban amenity assistance facilities tend to be very extensive, covering 100 to 10,000 hectares (one hectare equals 10,000 square meters) and are located near large cities. There is a tendency for these facilities to be associated with coastal, shallow sea, and large-size development. Urban residential facilities increase in size with provisions for urban amenity assistance facilities, but their locations have become bipolarized to shallow sea, coastal development, and deep offshore development. Area size and distance from the coast are very important factors in determining overall costs. Residential and urban assistance projects are relatively large in area and are closer to shore, mainly for linkage with coastal facilities for obvious reasons such as transportation of people and goods.

Development Concept

Changes in the types of development projects reflect the requirements of the time period. Before the 1973 oil crisis, many ocean development projects were aimed at national visibility and growth with companies competing with each other for the development of oil and gas resources. Since the oil crisis, however, projects associated with alternative energies such as solar and solar-derived energy became noticeable; the OTEC and wave energy conversion projects are examples. From the functional point of view, a single function plant construction has shifted to a multipurpose use of reclaimed land. With regard to urban amenity assistance facilities, international airport projects on reclaimed land serving large nearby cities in close cooperation with international ports have become popular, due in part to the globalization of the economy. In the case of urban residential facilities, the conventional newtown-type projects have been increasingly replaced by multipurpose projects. These projects provide commercial functions with a large service-industry sector, conference functions for information exchange, and residential functions including cultural and recreational amenities.

TRENDS AND FUTURE REQUIREMENTS

The changes in ocean space utilization reflect changing economic and social needs. If the period from the mid-60s to mid-70s (to the Middle East oil crisis) is considered to be the first ocean development period, it was a period of resource exploration and development in both territorial waters and high seas. In this period, secondary marine industries emerged from the exploitation of oil, minerals, and fish resources. Most projects using ocean space were associated with heavy industries or the concept of coastal industrial cities which would process and exploit marine resources.

In contrast, the second development period lasting from the mid-70s to the mid-80s can be regarded as an age of alternative energy development to respond to the oil crisis. This included an emphasis on nuclear power, and solar and solar-derived energy. For instance, an offshore nuclear power plant was designed for a site off the east coast of Florida. Examples of solar-derived energy include ocean thermal energy conversion (OTEC) and wave energy conversion projects. It was a period dominated by the problem-solving type ocean development concept which addressed not only the development of alternative energies, but also the creation of alternative space to deal with the overcrowding of cities and the preference for the amenities of coastal living. An ocean city project and a maritime airport project are the best examples of such projects. Efforts were made to solve problems on land by using ocean space.

The third ocean development period commenced in the mid-80s and continues today. It can be described as a period of integrated multiple use of coastal ocean space influenced by the globalization of ocean development and the tendency towards tripolarizing the international economy into megalopolis blocks such as the European Economic Community (EEC), North American Economic Community (NAEC), and the Asian Economic Community (AEC). The dominant status of tertiary industries which accounts for more than 70 percent of the GNP in the United States and Japan will transform industry-based ocean development into service-type and high-value-added industries.

Rapid consumption of fossil fuels since the industrial revolution, increasing urban development, and the gradual disappearance of the tropical rain forests may cause the global environment to become increasingly warmer. The conventional symptomatic treatment or problem-solving type ocean development approach is only partially capable of handling this new situation which requires the urgent adoption of a preventive and target-setting type ocean development approach.

At the same time, the infrastructures of such large cities as New York, London, and Paris (built at the beginning of the 20th century) are showing signs of urban deterioration. Construction of a modern infrastructure suited to the new information-oriented society and global marketplace of the 21st century is needed. The components of this infrastructure include international transportation complexes integrating sea, land, and air transportation and electronic media functions; international exchange facilities such as convention centers for the exchange of people, goods, money, and information; and intelligent business centers.

CONCLUSION

Coastal ocean space and associated development projects have evolved to a level in which technology is capable of addressing many multiple-user needs in harmony with the environment. A healthy economy can only survive with a healthy ecology. Seaward extension of many major coastal cities and regions can be used to develop a new, more integrated social, economic, and environmental infrastructure. This could include provisions for a centralized, more rapid multi-model transportation system integrating air, sea, and land transport of people and goods. It could also provide an integrated complex for comfortable living, recreation, and cultural activities, along with a co-located

working environment mainly concerned with information-oriented and high-technology products.

Seaward extension could be a direct extension of the shoreline; an artificial island linked by bridges or tunnels; an offshore floating facility or city which can be linked in the same way; or by high-speed surface craft. As floating cities are located further offshore, other supportive and complementary ocean facilities can be incorporated into future designs. These include ocean energy with by-products for freshwater, aquaculture, calm seas, and air cooling; artificial upwelling to enhance photosynthesis and fisheries production via open-ocean ranching and artificial habitats; production of hydrogen from electrolysis of seawater to provide clean fuel for power plants and transportation; environmentally compatible mineral extraction from seawater and the seabed; and a base for environmentally compatible ocean industry. Coastal ocean space can be developed in an integrated multi-user and multi-function plan to satisfy social, economic, and environmental needs.❑

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TABLE I. OCEAN SPACE DEVELOPMENT PROJECTS

PROJECT NAME	COUNTRY	PLAN (P) CONSTR(C)	AREA (ha)	DIST (km)	DEPTH (m)	STRUCTURE TYPE
INDUSTRIAL USE						
Nagoya-Port No.9	Japan	1961-C	218	2	3	Reclam
Yokohama Honmoku Port	Japan	1963-C	594	2.5	12	Reclam
Yokkaichi Hasumigaura	Japan	1967-C	387	0.1	12	Reclam
Oogishima Artificial Island	Japan	1971-C	515	0.4	15	Reclam
Osaka North Port	Japan	1972-C	615	0.5	10	Reclam
Industrial Island in the North Sea	NLD	1973-P	50	50	25	Reclam
Multipurpose Offshore Industrial-Port Island	USA	1975-P	728	13	18	Reclam/ Reclam
Akita-Wan Artificial Island	Japan	1982-P	780	1	30	Pile/Jacket
Shimonoseki Kiaura	Japan	1984-P	750	1	30	Reclam
OIL-GAS DEVELOPMENT						
Thums Island	USA	1965-C	16	2	12	Reclam
Ubarana Concrete Platform	Brazil	1967-C	0.2	12	15	Gravity
Roberts Bank Development	Canada	1968-P	90	4.8	21	Reclam
Porto de Areia Blanca	Brazil	1973-C	1.8	1.4	7	Reclam
Namorado Platform	Brazil	1973-C	0.3	90	146	Pile/Jacket
Fisherman Island	Australia	1977-C	600	0.7	0	Reclam
Statford Platform	Norway	1980-C	1.3	150	145	Gravity
Tarsiut Island	Canada	1981-C	1	40	22	Reclam
Shirashima Floating Oil Storage	Japan	1986-C	60	8	4	Float
POWER PLANTS						
Bolsa Island Project	USA	1970-P	15	1	20	Reclam
Atlantic Generating Sta.	USA	1970-P	75	4.8	17	Float
Offshore Coal Power Plant	Japan	1980-P	120	7	25	Reclam
Floating Island - Coal Power Plant	Japan	1980-P	2.25	30	100	Float
Nuclear Power Plant	Japan	1980-P	2.96	5	100	Float
Gobou Power Plan	Japan	1980-C	35	0.2	18	Reclam

AIRPORTS						
Oita Airport	Japan	1970-C	103	0.1	4	Reclam
Nagasaki Airport	Japan	1971-C	163	1.5	18	Reclam
Boston New Airport	USA	1971-P	735	16	15	Reclam
Honolulu Airport	USA	1973-C	400	0.4	9	Reclam
Lake Erie Int'l Airport	USA	1973-P	6734	13	14	Reclam
Chicago Lake Airport	USA	1975-P	4450	9	17	Reclam
L.A. Offshore Airport	USA	1975-P	4047	8	23	Reclam
Takamatsu Airport	Japan	1978-P	141	1	20	Float
Kansai Int'l Airport	Japan	1988-C	1159	5	20	Reclam
San Diego Airport	USA	1989-P	800	6	600	Float
RECREATION USE						
Nagoya Port Kinjyou Futou	Japan	1963-C	141	1.4	5	Reclam
Tampa Harbor Project	USA	1967-C	240	3.5	5	Reclam
Yokohama Daikoku Futou	Japan	1971-C	321	0.5	12	Reclam
Hart Miller Island	USA	1976-C	40	1.2	5	Reclam
Karita Artificial Island	Japan	1681-CC	153	3.5	8	Reclam
CITY & RESIDENTIAL USE						
Port Island - Kobe	Japan	1966-C	436	0.4	13	Reclam
Monaco Offshore Island	France	1968-P	6	4.8	300	Float
Hawaii Floating City	USA	1670-P	45.4	5	1000	Float
Rokko Island - Kobe	Japan	1971-C	583	0.2	14	Reclam
Kawasaki Higashi Oogishima	Japan	1972-C	434	0.7	10	Reclam
Okinawa Aqua-Polis	Japan	1974-C	1	0.3	50	Float
Man-made Island Complex	Japan	1985-P	3000	2	25	Reclam
Offshore Island Project	Japan	1985-P	3400	5	30	Reclam
City Complex Island	Japan	1985-P	5000	5	30	Reclam
Shimizu Artificial Island	Japan	1986-P	230	0.5	10	Reclam
Oomura-Wan ManmadeIsland	Japan	1988-P	1000	2.4	22	Reclam

Abbreviations: Island - Is; Power - Pwr; and Station - Sta; Netherlands - NLD; Hectare - ha.

Comparison of New Ocean Technologies and Ocean Space Utilization in the United States and Japan

Richard McLaughlin

INTRODUCTION

The coastal regions of the United States and Japan share a number of geographic characteristics. Both nations possess long coastlines and large 200-mile exclusive economic zones. Much of each nation's population and industrial base is located within the coastal zone, resulting in serious environmental degradation. In fact, census projections indicate that by the year 2000, nearly 80 percent of the populations of both countries will be living within fifty miles of the coastline. Similarities also exist in the two countries' levels of economic development and their reliance on capitalist economic policies and pluralistic democratic institutions.

Although the coastal regions in the United States and Japan share many of the same characteristics and problems, their respective management philosophies are markedly different. Different historical perceptions concerning the role of the government, the use of legal institutions, and the proper utilization of natural areas have greatly influenced how the two nations seek to use and develop their coastal and ocean resources. Moreover, unlike the United States, which has a large continental land mass, Japan is a heavily populated island nation with rugged topography and few natural resources. Only about 20 percent of the nation's land area is considered habitable, thereby placing intense pressure on the coastal regions and adjacent ocean areas.

This article will compare the development of new ocean uses and technologies in the United States and Japan. It will examine government policies in the two countries and will discuss impediments to ocean development from a comparative point of view. Because the environmental consequences of many new ocean technologies are not known and are of great concern, special emphasis will be placed on a comparison of the environmental regulatory systems in each country and the role that each plays in encouraging or discouraging private-sector investment in new ocean technologies.

Use of the term "new ocean technologies" is intended to describe technologies outside of the well-established areas of shipping, fishing, oil and gas production, and the military. Examples of new ocean technologies include energy production from oceanic sources such as ocean thermal energy conversion (OTEC), waves, and tides; large multipurpose floating platforms; marine hard-mineral mining technologies; extraction of uranium and other elements from sea water; mariculture using OTEC and deep ocean nutrients; offshore waste disposal technology; ocean purification systems; and others.

In contrast with "ocean technologies," which are generic in function and may be generally applied in any oceanic environment that is physically suitable, the term "new ocean space" is meant to describe new uses of specific and discrete submerged ocean territory. The technology used in creating new ocean space may or may not be innovative. The defining characteristic is that ocean space is used in a non-traditional fashion. Examples include offshore man-made islands, calmed sea areas created by large floating or attached breakwaters, and new forms of marine fish farming and ranching.

The thesis of this article is that serious legal, political, and economic barriers in the United States make the domestic commercialization of most new ocean uses and technologies relatively unlikely in the near future. In contrast, the outlook for similar technologies in Japan is much brighter. Japan's government and private sector have exhibited significantly more interest than their U.S. counterparts in promoting new ocean technologies and uses. Moreover, many of the legal, political, and economic obstacles found in the United States are of less concern in Japan.

It is suggested that significant benefits could be accorded to both the United States and Japan if their governments establish a program to encourage collaborative research and cooperative commercial arrangements for the development and application of new ocean uses and technologies in Japan. Commercial partnerships of interest will benefit U.S. companies by providing capital and access to Japan's growing market for ocean-related technologies. Japanese companies will gain benefit from new American technologies and opportunities to enter U.S. markets in the future. Moreover, cooperative ventures will contribute to lowering the huge trade imbalance between the two countries and help to reduce tensions concerning U.S. access to Japanese markets.

Ocean Development in the United States

More than two decades ago, the Stratton Commission released a very influential report entitled *Our Nation and the Sea* that was intended to serve as a "blueprint" for ocean development in the United States. The Stratton Report recognized the great scientific and economic potential of the oceans and called on the federal government to assume a greater role in stimulating the development of marine technology and engineering. The Report recommended that this be accomplished through developmental contracts and grants to industry and universities and by government-supported multi-purpose projects in which private industry and universities would participate.

Regrettably, United States government priorities have changed since *Our Nation and the Sea* was published. Federal funding of basic and applied ocean science has actually declined during the past two decades relative to the rate of inflation. While some growth in funding for basic research has recently been provided, most funding for demonstration projects has been eliminated under the theory that if private industry cannot justify support for a particular demonstration project, it is not worth funding. Given the large budget deficits and severe spending constraints currently imposed on federal and state governments, significant growth of public-sector funding for ocean-related research and development seems unlikely in the near future.

Most observers have come to recognize that if innovative new ocean technologies are to be developed in the United States, any increased funding will have to come primarily from the private sector. It was within this conceptual framework that the National Science Foundation (NSF) sponsored an Ocean Enterprise Workshop in February, 1989. Findings of the workshop were published in *Report to the National Science Foundation on the Ocean Enterprise Workshop*, David A. Ross and James E. Daily, 20-24 February 1989, National Science Foundation Office of Engineering Infrastructure and Development, Washington D.C. 20550.

Findings of the Ocean Enterprise Workshop

The purpose of the NSF-sponsored workshop was to reinvigorate commercial development of new ocean technologies in the United States. Participants from government, academia, and industry set out to develop a national strategy for the responsible use and development of the nation's ocean resources through private and public sharing of funding to support development activities.

Workshop participants agreed that although the U.S. private sector retains its position among the world's technological leaders in the traditional maritime areas of offshore oil and gas, fishing, shipping, and the military, it is generally reluctant to invest in the commercialization of innovative new ocean technologies. Certain technologies, including OTEC associated with mariculture, ocean placer mining, offshore waste disposal technologies, and multi-purpose floating platforms, were found to be technically and economically feasible in the short term. However, the following considerations were cited as inhibiting commercial development of new ocean technologies and uses in the United States:

- industry perception that development of the ocean environment is too risky;
- lack of sufficient public and private funding to demonstrate the profitability of new ocean technologies; and
- uncertainties and risks associated with the U.S. regulatory framework, the public's protectionist perceptions about ocean use, and possible exposure to judicial challenges.

Research talent and resources from academia, government, offshore energy and related ocean industries, and the military provide a foundation for significant U.S. technological advances in the use of the oceans. The problem that the United States must overcome, according to workshop participants, is in moving from the research and development stage into the stage of demonstrating commercial feasibility. Emphasis in the allocation of private-sector investments is placed on those ventures that will yield reasonably well-defined, near-term economic returns. Since the value of new and untested ocean technologies is clearly in their long-term significance rather than in their short-term profit potential, it is difficult for industry to rationalize investing in such risky ventures.

Additional investment risk is brought about by the unique political and regulatory climate in the United States. Because the oceans are not susceptible to private ownership and are considered a public trust, many citizens are becoming increasingly insistent that their views be respected regarding how the oceans are managed and protected. As a consequence, opponents of particular ocean development projects are likely to use the full quiver of political and judicial weapons available to slow down or stop proposed ocean ventures.

To improve the investment climate for the development of new ocean uses and technologies, the Ocean Enterprise

Workshop Report recommended that the U.S. government pass legislation that would create a non-profit ocean enterprise corporation composed of academic, industrial, and private-sector institutions, venture capitalists, and federal agencies. The Ocean Enterprise Corporation would obtain seed money from government, participating industries, and private foundations, and would be housed and incubated within a federal agency for a set period of time to encourage and assist industry in developing new ocean opportunities. Upon attaining some success, the corporation would exist as a self-supporting entity through return on its investment obtained from successful new ocean ventures launched under its auspices.

To attract private-sector investment, it was suggested that the President issue a declaration of support for the program. In addition, it was proposed that federal legislation be enacted that provides for limitation of liability to the extent normally accorded governmental entities as well as some protection from intervenor legal challenges such as those accorded under the Trans-Alaskan Pipeline Act, 43 U.S.C.A. §§ 1651 *et seq.* (West 1986 and Supp. 1991).

Feasibility of the Ocean Enterprise Workshop Recommendations

It has been nearly three years since the Ocean Enterprise Workshop issued its findings. To date, the federal government has chosen not to act upon any of the workshop's recommendations. While most of the workshop's findings pertaining to the reasons behind the lack of new ocean development in the United States are thoughtful and appropriate, its recommended cure for the nation's malaise is unrealistic. The likelihood that the federal government will establish a federally chartered ocean development corporation with government immunities from judicial challenge is quite remote for several reasons.

First, the tight federal budget and statutory spending restraints will probably preclude additional funding for bold yet speculative projects like an ocean enterprise corporation. There has been some optimism that the nation will realize a "peace dividend" as a result of the collapse of the Soviet Union; however, most additional funding made available from reductions in military spending will be used to lower the huge budget deficit. Moreover, funding priorities in the environmental area will probably involve remedial and clean-up measures, rather than subsidies for ocean enterprises.

Second, any attempt to insulate ocean enterprise ventures by granting them statutory immunities or limitations of liability will be met by strong opposition from environmental groups and others. The executive branch and Congress will be understandably reluctant to support suitable enabling legislation given the likely political fallout.

Finally, it should be recognized that constraints on private-sector investment due to perceptions of high financial risk, threats of legal intervention by the public, and reduced government support are not entirely responsible for the lack of new U.S. ocean enterprises. Limited demand in the U.S. domestic market for many of these technologies has also restrained private-sector interest. As a consequence, the catalyst for federal action is not yet apparent. The need for new ocean technologies and uses in the United States is not sufficiently urgent to warrant active federal participation. For example, low energy costs from traditional sources has made the development of ocean-related energy sources such as OTEC, wave, and current less attractive. U.S. population densities are still not so high, even in the heavily developed coastal areas, as to create an immediate need for new technologies that would allow for increased human habitation of the ocean environment. Nor is physical space for the upland storage of solid and hazardous wastes sufficiently scarce to warrant a concerted effort to develop ocean waste incineration and storage technologies.

Although a strong argument can be made that the federal government should increase support for research and development of new ocean technologies to meet the long-term needs of the nation, the argument loses much of its validity if commercialization in the near-term is the intended goal. Clearly, the United States needs to look beyond the domestic market if it is to attract the level of political and financial support necessary to reinvigorate U.S. private-sector interest in commercializing new ocean technologies. One foreign market that may offer significant opportunities for U.S. companies is Japan.

OCEAN DEVELOPMENT IN JAPAN

Japan is currently engaged in the world's most active planning and promotional effort to develop new ocean uses and technologies. The nation's geographical setting has played a major role in motivating the government to investigate new uses of the ocean. Because most of Japan's interior is mountainous and for the most part uninhabitable, its coastal regions have some of the highest population densities in the world. For generations, Japanese policymakers

recognized that the nation would have to expand into the ocean to satisfy the advancement of urban development and the demands of its people for more social amenities and greater living space.

Limited coastal and ocean resources will come under additional pressure during the 1990's as a result of structural changes in the Japanese economy from export-based to domestically-based growth. Dramatically increased levels of government funding for public works and rapidly growing demand for housing in coastal areas and for ocean-related leisure activities will intensify the use of scarce coastal space.

More than 50 percent of Japan's total coastline and over 80 percent of Tokyo and Osaka Bays have been modified by dikes, groins, reclamation, or other construction methods. Over the next 20 years, it is expected that an additional 1.5 million hectares (one hectare equals 10,000 square meters) of property within the coastal zone will be required for recreation, fishing, and ports.

Traditional land use policies also encourage the government to look increasingly toward the development of publicly owned tidal areas. Much of Japan's coastal upland property is held by private owners in very small parcels. As a consequence, it is difficult to purchase the large tracts necessary for major development projects and associated infrastructure improvements. Coastal real estate, particularly in the major cities, is also extraordinarily expensive. For example, it has been estimated that in the Tokyo metropolitan area it costs an astounding one trillion yen to build a single kilometer of road. Of this one trillion, 99 percent goes toward land acquisition and compensation.

Waste disposal also places increasing pressure on Japanese policymakers to use intensively the nation's ocean and coastal areas. Each year, Japan produces approximately 300,000,000 tons of waste, including more than 100,000,000 tons of sludge generated from wastewater treatment plants. Strict recycling programs are in place, but have their practical limits. Upland disposal sites and incineration are also used, but have their own limitations due to cost and environmental concerns. Consequently about one-third of the wastes produced in Japan are disposed of as reclamation material in coastal waters.

Finally, Japan's heavy reliance on foreign sources of raw materials for food, manufacturing, and energy production has required extensive use of coastal and ocean space. Most of the nation's storage facilities, refineries, manufacturing plants, energy production facilities, and associated infrastructure are by necessity located on water-dependent coastal sites.

Interestingly, the current shift in Japan's economy away from a secondary industries such as iron and steel production and shipbuilding toward tertiary service and information-based industries will cause a significant amount of coastal reclaimed land to sit idle. Corporate owners of this land as well as local governments are seeking acceptable methods of converting former industrial sites into residential or commercial properties.

Given the large set of geographical constraints that Japan faces regarding the use of its limited coastal space, it is not surprising that the government has energetically supported the development of innovative new ocean uses and technologies. This support includes direct funding of research and development, and a complex set of subsidies, tax incentives, and cooperative arrangements between government and private interests. It can be argued that many of these policies have not been entirely successful. However, they do clearly illustrate Japan's unique commitment to the use and development of its coastal and ocean resources.

Ocean Development In Japan Since the 1960s

The Japanese government began seriously to examine ocean development in the mid-1960s when the Science and Technology Agency designated it one of three large-scale national projects along with nuclear energy and space development. Later in the decade several blue-ribbon councils and interagency committees were established to guide government ocean development activities.

Private-sector interest in ocean development also increased during this period. For example, *Keidanren* (the Federation of Economic Organizations, somewhat akin to, but much more powerful than, the U.S. Chamber of Commerce) set up a committee on ocean resources to discuss ocean development opportunities and to present the views of its members to the government. Other industry associations such as the steel industry's *Kozai* Club and the Japan Economic Research Institute published influential reports that predicted that ocean development would someday be as important to the Japanese economy as the automobile and shipbuilding industries.

Important strides in public and private-sector cooperation also took place during the late 1960s and early 1970s. One of the most important developments was the establishment of the Japan Marine Science and Technology Center (JAMSTEC). JAMSTEC is a special public corporation designed to conduct ocean-related research requested and

partially funded by private companies. A sponsor's group of 160 business organizations and private companies collaborates with JAMSTEC in pinpointing specific needs, participating in joint studies, and cooperating in funding.

The high level of enthusiasm for ocean development peaked during the early 1970s when several bank-led groups of companies including Mitsui, Mitsubishi, and Sumitomo established ocean development subsidiaries. However, the boom was short-lived, and private-sector interest tapered off considerably as a result of the so-called "oil shocks" of 1974 and 1978, which caused the price of imported oil to skyrocket. With the slowdown of the Japanese economy, expectations of long research and development periods and small immediate profits led the private sector to reduce its commitment to ocean development and shifted a larger share of the funding for ocean science and technology to the government.

During the period of slow economic growth in the late 1970s and early 1980s much of the industry stagnated due to the Japanese government's policy of restrained public investment. Several ocean development companies were forced to reduce the scope of their operations and their position within their parent groups of companies became uncertain.

Exports of offshore oil and gas-related technologies soon became the dominant part of Japan's ocean development business. In 1982, sales of all marine equipment (not including shipbuilding and dredging and reclamation equipment) amounted to approximately 76 billion yen, of which more than 80 percent was exports. A breakdown of sales by type of equipment shows that oil and gas development equipment, devices for desalinating seawater, and natural gas production equipment produced two thirds of the total sales.

Reclamation of submerged tidelands also slowed considerably during the decade beginning in 1975. In the early 1970s port-related reclamation projects had averaged about 4000 hectares annually. During the following decade the annual average had dropped to around 2000 hectares.

Future Demand For New Ocean Technologies

As Japan's economy improved during the mid-1980s, domestic demand for ocean-related technologies grew significantly. This trend of steady growth is expected to continue through the 1990s chiefly due to an ambitious government program of public works and cooperative public and private-sector development projects in coastal areas. The costs associated with major offshore construction projects have been projected at nearly 30 trillion yen over the next 15 years. It has been estimated that if these projects advance according to plan, offshore civil engineering companies will average 400 to 500 billion yen in annual work contracts up to fiscal 1997.

Government budgets for port and harbor projects have also increased dramatically over the past five years. In fiscal year 1986, the budget was 818 billion yen. By 1990, the budget had increased by over 45 percent to 1,260 billion yen.

In April 1990, the government formally reasserted its policy to push ahead with plans for the qualitative improvement of comprehensive port and harbor space, entitling its ambitious program "Toward an Enriched Waterfront." An important part of the government's program is an effort to encourage private-sector participation in coastal development projects by providing tax incentives, low-interest loans, and other forms of financial assistance. (See figure 1 for a map of private sector port and harbor related projects in Japan.)

The Ministry of Transportation has also adopted a plan to meet the growing demand for recreational boating opportunities by dramatically expanding the number of marinas in Japan. The plan calls for an increase in moorings from about 50,000 in 1987 to 280,000 by the year 2000.

Resort development in coastal areas is also expected to boom in coming years. In May 1987 the government enacted the Resort Promotion Act to reduce disincentives for domestic resort development. A survey in 1989 indicated that 200 companies are planning or already working on new resort developments in 322 locations in 43 different prefectures. Several of the proposed marina and coastal development projects will require new and innovative types of ocean technology.

Development of new types of environmental control equipment also offers opportunities. Demand for such equipment has been growing in Japan at an annual rate of seven percent, due to increased public interest in domestic infrastructure improvement. Many of Japan's garbage disposal facilities will soon need to be replaced after reaching the end of their useful lives, and construction of new sewage systems and other infrastructure improvement is moving rapidly forward. For example, the Tokyo Metropolitan Government recently unveiled a 720-billion yen project to build ten garbage incineration plants over the next 20 years. A floating incineration plant on Tokyo Bay has been proposed for completion by 1995. The city is planning to hold public hearings shortly with residents of neighboring districts and has begun work on an environmental impact assessment.

Floating structures of several varieties are being investigated by the public and private sectors in Japan. Over 20 major floating structures already exist in Japan, primarily as restaurants, exhibition halls, and museums. Floating breakwaters are being investigated intensively for use in conjunction with artificial calmed sea areas and for wave-activated power generation. A floating oil storage facility with a capacity of 4.4 million kiloliters is already in operation and others are being examined. There are also ambitious proposals for the future construction of floating residential, commercial, and recreational complexes.

In summary, the political and business climate for commercial development of new ocean uses and technologies is quite favorable in Japan relative to the United States. Expected steady increases in national and municipal government spending on public works in coastal areas, coupled with programs to increase private-sector investment in multi-purpose ports, recreational boat marinas, and resort complexes should provide significant opportunities to market new ocean technologies well into the next century.

COMPARISON OF U.S. AND JAPANESE LEGAL AND REGULATORY REGIMES

Japan's policies concerning the use and development of its coastal and ocean resources are obviously quite different than those in the United States. Even if U.S. domestic demand for ocean-related technologies dramatically increases in the future, it is quite unlikely that the U.S. government could implement the kinds of incentives for development that are currently in place in Japan. Most of the projects that have been proposed in Japan would probably face severe and perhaps insurmountable political and legal opposition in the United States. Undoubtedly, many of the ocean development projects proposed in Japan will also fail due to similar kinds of opposition. However, different perceptions regarding the environment and the appropriate role of the government make the chances of overcoming such obstacles decidedly greater in Japan than in the United States.

These differences are a manifestation of centuries of cultural, political, social, institutional, and legal traditions and practices. A full discussion of these issues must be left to others. However, a few general observations comparing the two nations' environmental regulatory systems are possible.

While risking oversimplification, the regulatory regime in the United States can generally be characterized as more adversarial, legislatively controlled, and legalistic than the regime in Japan. It relies on a broad array of federal, state, and local statutes and regulations coupled with strong judicial review. Federal and state legislatures have played a dominant role in developing and overseeing the nation's environmental policy. This reliance on statutory authority has, in turn, diminished the power of the executive branch in environmental matters by significantly limiting its discretionary prerogatives.

Environmental regulatory policy in the United States is also remarkably adversarial in outlook. Industry and the citizenry in general have historically been rather scornful of government intervention in their affairs. The defense of free and unfettered enterprise has remained a powerful principle in American society. Government regulators are seen by a significant number of Americans as the greatest single threat to this cherished tenet.

Conversely, as a result of pressure from environmentalists and other special interests, the government has come to believe that its primary function in the environmental arena is to serve as a watchdog over industry. The relationship between industry and government in the United States is thus quite often antagonistic, and any attempt to bring the two sides into greater harmony is usually met with deep suspicion.

In sharp contrast with the United States, the relationship between industry and the government in Japan is for the most part cooperative and friendly. While industry in the United States views most environmental protection measures as a prescriptive burden foisted upon them by government, in Japan they are viewed as a shared responsibility between government and the private sector. Through an eloborate system of joint institution and industry associations, private-sector interests are incorporated in to the policy-making process. In turn, industry organizations help the government by disseminating information and encouraging members to comply with regulatory standards. This has led to a regulatory climate in which the government has sought to be more obliging than coercive, and industry more collaborative than adversarial.

Although Japan's prefectural and municipal governments have exercised leadership in many environmental issues in recent years, local governments are still strongly influenced by national policy dictates. Authority for the development of policy and regulations relating to the use and development of coastal and ocean resources still lies primarily in several powerful executive branch ministries. The Ministry of Trade and Industry, the Ministry of Construction, the Ministry of Transport; and the Ministry of Agriculture, Forestry, and Fisheries are the most influential ministries with authority over coastal and ocean mat-

ters. In addition, some sub-ministerial agencies such as the Environment Agency, the Science and Technology Agency, and the National Land Agency have considerable though more narrowly prescribed authority.

Regulatory decisions are not conducted pursuant to detailed and judicially enforceable administrative guidelines as in the United States. Instead, they are generally made on an ad hoc basis based upon consensus and mediation. Administrative guidelines, if they exist at all, are developed by each government ministry in coordination with the Environment Agency and are not legally enforceable, at least in the sense of judicial review of agency actions or of compliance by developers.

In keeping with the Japanese Diet's (Japan's national parliament) restraint in environmental matters and the bureaucracy's desire to retain as much flexibility and control as possible, it is not surprising that Japan has enacted far fewer environmental statutes than has the United States. Many of the statutes that form the foundation of the U.S. coastal and ocean management scheme have no parallels in Japan. For example, Japan has no equivalent to the U.S. Coastal Zone Management Act, 16 U.S.C.A. §§ 1451 *et seq.* (West 1985 and Supp. 1991), which gives each state the authority to develop its own comprehensive coastal zone use plan and requires federal agency actions to comply; the Endangered Species Act, 16 U.S.C.A. §§ 1531 *et seq.* (West 1985 and Supp. 1991), which protects endangered and threatened species; or the wetland permit provisions of the Clean Water Act, 33 U.S.C.A. §§ 1251 *et seq.* (West 1986 and Supp. 1991), which grants U.S. Army Corps of Engineers authority to issue permits for even minor development in wetland areas. There is also no statutory mechanism to obtain information from the government similar to the U.S. Freedom of Information Act 5 U.S.C.A. §§ 552 *et seq.* (West 1977 and Supp. 1991). Recently, Japan did enact a national environmental impact assessment procedure that is somewhat similar to the environmental impact statement requirements of the U.S. National Environmental Policy Act (NEPA), 42 U.S.C.A. §§ 4321 *et seq.* (West 1977 and Supp. 1991). However, unlike NEPA the Japanese impact assessment guidelines are not mandated by statute and are not enforceable in court.

This is not to imply that the Japanese government has unlimited discretion in coastal and ocean development planning and regulation. A significant number of laws have been enacted to protect coastal areas from uncontrolled development. However, most of these laws, with the possible exception of certain air and water pollution control standards are decidely less stringent than in the United States. If there is local opposition to development proposals—which is an increasingly common occurrence—the developer and government agencies work very diligently to convince local citizens that everything possible has been done to eliminate environmental and social disruption. These efforts usually consist of some form of environmental assessment coupled with public hearings and informal negotiations with community leaders to determine acceptable compensatory measures.

While the fairness of this negotiating process is commonly criticized for being too heavily weighted in favor of entrenched bureaucratic and commercial interests, it is rarely challenged in court, providing evidence of the traditional reluctance of Japanese citizens and industry to challenge the broad administrative authority of the government. It also contrasts sharply with the lack of deference generally accorded the government in the United States. U.S. experience has shown very little reluctance on the part of citizen's groups, industry, or even state and local governments to challenge the federal government either through formal administrative procedures or by litigation.

Different Environmental Perceptions

Many of the regulatory disparities noted above can be attributed to differences in the way the citizens of each country perceive the ocean and coastal environment. Environmentalism in the United States focuses on the preservation of natural resources regardless of potential economic benefits. In Japan, in contrast, environmental activism has focused on specific pollution episodes, not because of loss or damage to the natural environment, but because of their significant threat to the health of community members or to the resources on which their economic livelihood depends. Japanese environmental activism therefore tends to be local or regional in orientation and may quickly lose its supporters once a local environmental problem has been ameliorated. The local nature of the environmental movement in Japan makes political mobilization quite difficult, at least on a national level.

Environmentalism in the United States, both in terms of content and organization, is clearly nationally based. Because environmental preservation is the primary motivating force behind the movement, environmental organizations can draw their membership from a national constituency and can express the political will of their huge membership base quite forcefully at the national level.

Moreover, in the United States, environmental decision-making has been influenced to a great extent by national public-interest law firms such as the Natural

Resources Defense Council, the Environmental Defense Fund, and the Sierra Club Legal Defense Fund. A large percentage of important environmental litigation is brought by these public interest firms and their success rate is generally high because they are able to pick and choose their targets and are staffed by very competent and highly motivated attorneys. Many of today's most important administrative rules and legal decisions regarding the environment have come about as a result of suits brought by these public interest law firms.

While citizens' groups in Japan have attempted to encourage environmental reform through litigation, their efforts have been few in number and only marginally influential. One knowledgeable commentator has suggested the government's active participation in the negotiation and mediation process has stifled broad-based environmental citizen's movements (See Frank Upham, *Law and Social Change in Postwar Japan* (1987) at 64-67). In a society like Japan's with a tradition of submissiveness to administrative authority, government intervention does more than shift the conflict from judicial to bureaucratic channels. According to Upham, it also tends to substitute *ad hoc* decision-making for the application of universal rules. Confidentiality during the negotiation and mediation processes and the application of individual facts and circumstances to each case presents little need to develop universal legal rules or principles. As a result, conflicts are localized, and the recognition of a commonality of interests among participants in environmental conflicts is made less likely.

CONCLUSION

Although both the United States and Japan place significant controls on the permissible uses of their coastal and ocean areas, there is little question that the economic, political, and legal climate in Japan is more favorable for the commercial development of new ocean uses and technologies. Unlike the United States, there is a recognized need for innovative uses of ocean space to help alleviate the pressure on the nation's scarce coastal resources. This, coupled with strong support from a number of powerful government ministries, has encouraged the private sector actively to investigate the commercialization of new ocean technologies. Huge proposed increases in government funding for public works will also likely stimulate private-sector interest.

In addition, Japanese perceptions of environmentalism and of the role of the government in managing coastal and ocean resources make it less likely that a new ocean venture would be obstructed by government regulatory actions or by public-interest judicial challenges than in the United States. Although significant environmental safeguards and mitigation measures may be imposed on proposed projects, these requirements will normally be determined by negotiation or mediation at an early stage, rather than by judicial decree after years of litigation as is often the case in the United States.

Simply put, there are tremendous opportunities for American business to market new and innovative ocean technologies in Japan. Conversely, many of the constraints to commercialization in the United States described in the National Science Foundation's Ocean Enterprise Workshop Report are significant and will not likely be rectified by the U.S. Government within the foreseeable future. Given these conditions, the governments of the United States and Japan would be well served if they were to encourage close cooperation between the two nations in the area of ocean development.

Cooperative arrangements between U.S. and Japanese companies for research, development, and commercialization of new ocean technologies for use in the Japanese market will provide mutual benefits. U.S. companies will acquire additional capital as well as gain access to new Japanese technologies and marketing expertise. Japanese companies will benefit from the introduction of new U.S. technology, will be able to share financial risk without having to enter into unwanted alliances with Japanese competitors, as well as acquire expertise and contacts that may simplify entry into the U.S. market in the future.

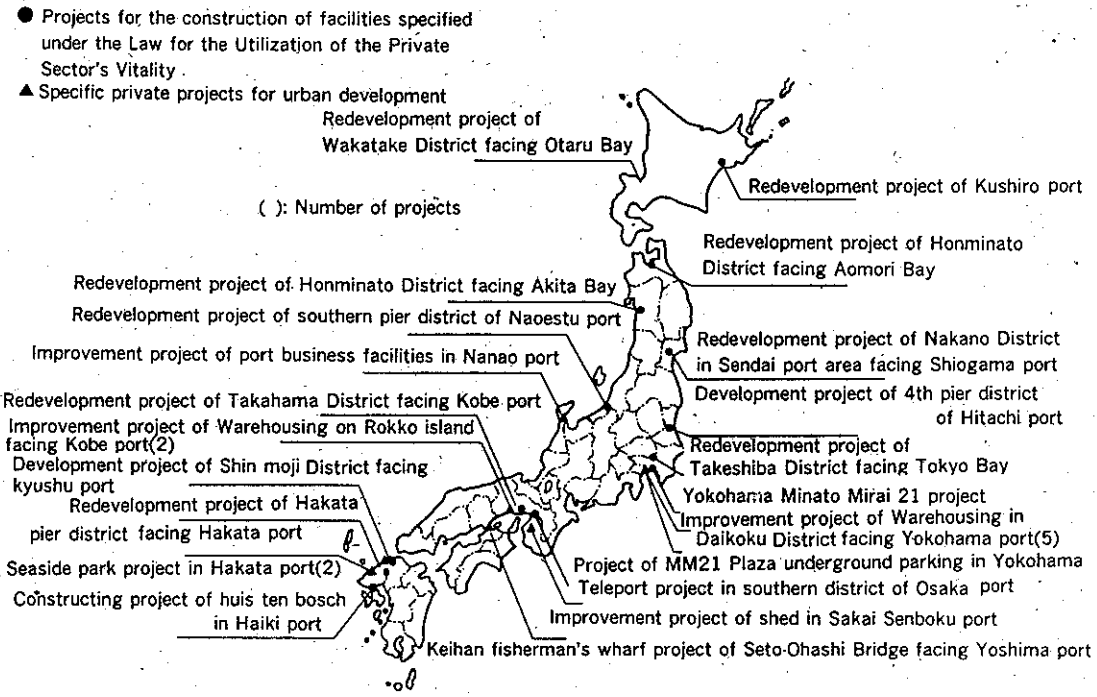
On a macro-economic level, both economies will also profit from cooperative arrangements to develop and market U.S. ocean technology in Japan. The United States will reduce its trade deficit with Japan and will benefit from additional employment of its citizens and from the increased competitiveness of U.S. industry. Japan will take an additional step toward reducing tension over its large trade surplus with the United States, and will improve its ability to find new and innovative uses for ocean space and resources.

Of course, certain barriers exist to cooperative arrangements. In addition to the obvious language difficulties and differing business practices, there will also be some reluctance on the part of existing Japanese companies to open their markets to foreign competitors. However, as long as the cooperative arrangements are voluntary and structured to take advantage of mutual needs and objectives, these obstacles can be overcome. Several U.S. construction companies such as Bechtel Group Inc., Fluor Daniel Ltd., and Ralph M. Parsons have joined forces with Japanese

counterparts and are participating in a number of large offshore construction projects in Japan. Given sufficient support by the U.S. and Japanese governments, there is no reason to believe that other American companies cannot also successfully enter the Japanese market for new ocean uses and technologies.❑

Richard J. McLaughlin is Director of the Mississippi-Alabama Sea Grant Legal Program. Mr. McLaughlin is currently conducting research in Japan under a Fulbright Grant from the Japan—United States Educational Commission. A considerably enlarged and footnoted article on this topic will be forthcoming. This article is intended to serve as a basis for discussion and debate. It is assumed that any ocean use or technology described herein will be subject to intense scrutiny as to environmental suitability. Nothing in this article should be construed as indicative of the author's or the Mississippi-Alabama Sea Grant consortium's support or endorsement of any of the described technologies.

Port and Harbor-Related Projects Undertaken by FY1989
Using Private-Sector Vitality



Source: Annual Report on the Transport Economy, Ministry of Transport, Japan (1990).