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MARINE INDUSTRIAL TECHNOLOGY MONITOR

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CONTENTS

UNIDO's *Marine Industrial Technology Monitor* is established as a mechanism of current awareness to monitor developments in the marine industrial technology sector and to inform governments, industry and academia, primarily in developing countries.

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TO OUR READERS

As stated by the UN Secretary General, Mr. Boutros-Ghali, the UN Convention for the Law of the Sea, which entered into force in November 1994, is one of the most significant legal instruments of the century. One of the areas covered by the Convention is the transfer and development of marine technology, which is a critical issue in terms of the industrializing countries' ability to develop sustainable marine industries as part of their economic development strategy. The utilization of the oceans is expected to become a significant factor for sustaining economic growth and meeting basic development needs, such as food and energy, in the next century. With the accelerating technology gap between the rich and the poor, and realizing the substantial and time consuming efforts required to build technological capabilities, developing countries will have to take action now in order not to be left behind in the development of the oceans.

The Convention recommends the establishment of international and regional cooperation mechanisms, particularly regional centres for marine technology, as a means to facilitate this development process. In 1982, the Third UN Conference on the Law of the Sea concluded that such centres would be the principal institutions through which States, particularly developing countries, receive and disseminate marine technology. More than one decade later, the establishment of regional centres, as called for in the Convention, has not taken place, although the concept has been promoted extensively by the international community, including combined efforts of the International Ocean Institute and UNIDO. What went wrong? In the special article featured in this issue of the ***Monitor***, the concept of regional centres is reviewed based upon UNIDO's work in this field and the changes taking place in the industrial and technological scene in the 1990s. Even though the availability of sustainable financing appears to be the immediate obstacle in the establishment of these centres, other factors such as low national awareness of the ocean development potential, lack of linkages to and involvement of industry, lack of proven cost-benefit and real impacts of the proposed concepts, as well as various political factors, seem to be part of the underlying reason for the unsuccessful promotion of these centres.

In response to the above, UNIDO has, for the last two years, been working on the new concept of *Regional Business Development Centres* for the marine industry sector, an initiative which is closely linked to our core programmes on investment promotion, technology innovation and assistance to small and medium enterprises. This approach is also based on the framework for technology development and transfer as called for by the Convention, but the focus has shifted from pre-commercial S&T cooperation, to cooperation at the enterprise level, including promotion of business alliances and investment flows, matching of technology demand/supply and support to the formulation of competitive technology and business strategies in small and medium enterprises. Presently, this concept is being developed for the Mediterranean region with support from the Government of Greece. A demand assessment and viability study will be carried out during 1996, in close cooperation with industry, R&D institutes and government agencies of the region. The result from this will be reported in a later issue of the ***Monitor***.

Many of our readers will be interested in knowing that all the Monitors will soon be available on the Internet. The UNIDO World Wide Web (WWW) server (http://www.unido.org) was opened to public access on 24 November 1995, with some 140 documents available so far. Any document may be located via an integrated full text searching facility. Interaction is made possible by a growing number of on-line forms and clickable e-mail addresses provided in every document. The system has been designed to accommodate by e-mail delivery service at a future stage of development. The next issue of the ***Monitor*** will include a more detailed description of this system, and it is planned to have a much more extensive portrayal in an up-coming issue.

Leif K. Braute
Technical Editor

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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A. SPECIAL ARTICLE

The Concept of Business Development Centres in the Marine Industries Sector

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Introduction

The global importance of the ocean and its role in enhancing further economic development is widely recognized and has recently been reconfirmed by important international events. The UN Convention on the Law of the Sea mandates and urges relevant international agencies to promote marine technology and to assist States in the establishment of national and regional centres in this field. Through the legal provisions for the establishment of exclusive economic zones (EEZ), the Convention has dramatically increased the industrial development potential for coastal States. Recent negotiations have ensured support for the Convention also from industrialized countries. Agenda 21, the international plan of action adopted by the UN Conference on Environment and Development (UNCED) in 1992, calls for international cooperation to ensure sustainable development of the ocean and its resources. Industrial development has to be promoted within this framework. One of the first follow-up meetings to UNCED was the UN Global Conference for Sustainable Development of Small Island Developing States, held in Barbados in May this year. The Action Plan adopted by the Conference emphasizes the crucial role of the ocean for the economies of small islands.

UNIDO is the lead agency for industrial development within the United Nations system. One of the major objectives of UNIDO's activities is the promotion of international cooperation in investment and technology. This responds to the need for new and strengthened forms of international cooperation through cross-border flows of industrial investments and technology, and anticipates future opportunities for global partnership which arise with such flows. Following the Law of the Sea Convention, UNIDO has in the past actively promoted such cooperation mechanisms in the marine industries sector, aiming at strengthening capabilities in marine technology and improving the linkage between S&T institutes and industry. A central activity was the pioneering work on the promotion of regional centres for marine industrial technology. This concept was developed in very close cooperation with the International Ocean Institute (IOI) in the middle of the 1980s and has been promoted in the Mediterranean and the Caribbean region, although without any centre being established so far.

Since then, the concept of regional centres as a catalyst for industrialization has been developed further by UNIDO. The objective has shifted from focusing exclusively on national S&T capabilities towards creating a mechanism which facilitates technology-driven business development. The new concept supports an industry-driven approach to building national S&T capabilities and seeks to promote industrial innovation and competitiveness by improving the techno-commercial inteiligence of industrial enterprises and R&D institutes. Following interaction with UNIDO, the Government of Greece, in cooperation with the Pireaus-based Marine Technology Development Company S.A., is planning to carry out a feasibility study on the establishment of a Mediterranean Centre for Marine Industries based on similar principles.

In the light of increasing globalization and changing industrial and economical policies, this paper examines the need for new strategies in building technological and industrial capabilities. It summarizes the role and potential of marine industries in developing countries, and presents a critical review of UNIDO's experience in promoting regional centres for marine science and technology. A conceptual framework for regional business development centres is established, emphasizing the industrial innovation process at enterprise level. The last section gives some considerations to a possible business development centre for marine industries in the Indian Ocean region and recommends actions to be taken in this direction.

Building technological capabilities in a changing industrial scenario

The industrial and technological scene in the 1990s is very different from that of the 1960s and 1970s when most developing countries embarked on a strengthening of their technological capabilities. Policies across the developing world and the former socialist world have been liberalized, in reaction to the failure of former policies of import-substitution and wholesale interventions. Every developing region now wants to participate in international trade and investment, and competition for resources, technology and market is intensifying. All countries are offering similar policy packages, though with different degrees of macro-economic and political stability. At the international level, structural adjustment and stabilization programmes by the Bretton Woods institutions, the new GATT agreement and the World Trade Organization all have an impact on regimes for economic development. Although constraining countries from some of the mistakes of the past, this also reduces the flexibility to undertake policies to promote industrialization.[1]

Technology has become one of the most critical assets for industrial production, competitiveness and long-term growth. Globalization of markets and the rapid and sweeping pace of development in high-technology clusters such as micro-electronics, new materials and biotechnology is causing a massive change in the determinants of industrial competitiveness and the location of industry. In most industrial sectors the economic life-cycle of technologies and

products is shortening. To sustain competitiveness, industrial firms are forced to increase their flexibility towards market changes. This demands large investment in the field of R&D, product development and flexible production systems. Adjustment to changing markets and the need to reduce financial risks related to the development of new technologies have created incentives for industrial cooperation and the global integration of industrial activities. This has led to a growing number of strategic alliances relating to technology and business development. Furthermore, transnational corporations (TNCs) are increasingly utilizing international outsourcing of specific production, distribution and service functions to smaller, specialized subcontracters. This is expected to improve flexibility and competitiveness, since smaller firms normally have a more streamlined organization and therefore the ability to react quickly to external changes and new requirements. Subcontractors are closely integrated with the long-term strategy of the end-producers, which tend to become system integrators, focusing their resources on R&D, design, assembling and strategic marketing of the end-product.[2] The globalization process has strengthened the role of TNCs, which today must be seen as the key players in development and transfer of technology.

The weak industrial performance in the less developed countries are due to structural factors such as insufficient technical and managerial skills, poor infrastructure, lack of technological capabilities and institutions, and an uncompetitive local supply structure. Continuous technological change, intensifying competition and the rapid liberalization of markets have introduced additional challenges, but have also provided new opportunities which should be considered when devising strategies for building industrial and technological capabilities.

An increasingly significant factor for industrial growth in the last decade has been the surge of foreign direct investment (FDI) to developing countries. Developing countries, as a group, received US$ 74 billion of FDI in 1993, which is one third of the global FDI flow. However, participation in international trade and investment flows has been highly uneven and limited to developing countries with the capability to mount competitive production, particularly the newly industrialized countries (NICs) of East and South-East Asia. In 1993, 10 countries were able to attract 65 per cent of the total FDI flow to developing countries, and only 2 per cent went to African countries.[3]

Faced with the increasing industrial competition, even in domestic markets, investments directed towards business development in the industrial sector and the associated process of technology acquisition/adaption (technology pull), represent for many developing countries the most relevant opportunity and dynamic framework for structural changes and for speeding up the process of their technological transformation, including the upgrading of local technological capabilities. The most important decisions, having a decisive impact on technological realities of developing countries, are normally not taken by the formal S&T sector (R&D institutes, universities and science councils) but are contained in the investment and technology acquisition decisions taken by the industrial sector and some government institutions. This also reflects the extremely modest capacity of most developing countries to participate in the global technological race. Developing countries count for about 3 per cent of the total world spending on R&D. Although employing 7-10 per cent of the world's total employment in R&D, their contribution to R&D outputs, measured in patents granted, is approximately 1 per cent.[4] The majority of developing countries have neither the lead time nor the necessary resources to develop competitive technologies from indigenous R&D capabilities. Thus, a competitive strategy for most developing countries would be to utilize the advantages of being technology-followers or technology late-comers, aiming at long-term strengthening of local technological and managerial capabilities and related S&T infrastructure. A key element of this strategy is the reverse engineering principle (buy, operate, maintain, adapt, improve, develop) and the establishment of international business linkages which facilitate capability building.[5] However, this in itself requires a minimum base of technological and managerial skills, which is not necessarily readily available, particularly in the least developed countries.

Marine technology and the marine industries sector

UNIDO's involvement in the field of marine technology is limited to technologies with relevance for the industrial sectors. The term *marine industrial technology* is defined as a system of technologies, including its innovation infrastructure, to carry out a viable and sound industrial activity in a marine coastal environment. Marine industrial technology is a trans-sectoral and multidisciplinary field, it is characterized by integration and adaption of technologies emerging from the various engineering sectors and drawing on a knowledge base from ocean marine science. Advancements are directly linked to innovations in high-tech clusters such as micro-electronics, informatics, new materials and biotechnology. Capabilities in marine industrial technology are therefore more than in any other engineering discipline related to the design, construction, operation and maintenance of systems in which many S&T fields are integrated.

The *marine industries sector* is used as a collective term for industrial companies which are involved in the application and/or development of marine industrial technology, and covers a wide range of traditional industrial sectors and activities.

It is useful to classify industries in the marine sector according to the following functional categories:

- Marine resource-based industries
- Marine system design and construction
- Marine operations and shipping industries
- Marine-related industries (equipment and service suppliers)

Marine resource-based industries are companies directly involved in the harvesting/recovery of marine resources and the related downstream (processing and distribution) activities. This spans from large oil companies, refineries, sea-food producers and pharmaceutical industry to local aquaculture firms, fishing boat owners, building material producers, etc.

Marine system design and construction relates to the innovation, design, building and integration of industrial systems operating in a marine and coastal environment. This include shipyards, offshore engineering and construction industry, consultant firms, etc.

Marine operations and shipping industries include companies involved in operation of conventional and fast speed marine transportation systems, installation of offshore floating and fixed structures, underwater diving operations, dredging, waste disposal, etc.

Marine-related industries are defined as suppliers of services and products for marine applications. This includes manufacturers and engineering and consultant firm in fields such as marine equipment, marine electronics and instrumentation, machinery, telecommunication and navigation systems, special-purpose software and decision support tools, support to ocean research and marine environment monitoring, etc. Marine-related industries include a variety of small, medium and large companies. Especially in South-East Asia, the market for marine-related industries is growing, mainly as a result of increasing activities in the offshore oil and gas sector, but also increasingly due to a high activity in ship building, environmental monitoring and ocean science and exploration.

In addition, accelerating population growth and the associated concentration of economic development in coastal areas seriously threaten the sustainability of coastal and marine resources and habitats. This emphasizes the need for improved environmental management and for an integrated approach to sectoral development, including industry. It has resulted in a global priority for marine/ocean science and integrated coastal management, and represents a growing market for marine environment technologies, including coastal protection, exploration, environmental monitoring, pollution remediation and decision support/analysis technologies.

The economic importance of the marine sector is significant: in Australia alone, the annual value of marine industries has been estimated to $16 billion.[6] Similarly, the US market for products and services to ocean users, such as the offshore oil and gas industry, the US Navy, maritime transportation industry and research organizations, exceeds $60 billion annually.[7]

The above elements constitute the marine industries system and are interlinked. A simplified illustration of this is given in figure 1 overleaf.

Opportunities for developing countries

In many respects, developing countries have better economic prospects for both traditional and new marine industries than developed countries. The high influx of solar energy in tropical and sub-tropical zones creates excellent conditions for mariculture and certain types of ocean energy exploitation. The large population concentrations in many of these areas also provide a potential for fast-speed marine transportation and land expansion technologies.

Many industrializing countries, notably China, India, Indonesia, Republic of Korea and Brazil, have established national programmes for development of both traditional and new marine-based industries and technologies. For example, China is rapidly developing its offshore oil and gas production and is presently improving capabilities in design and construction of fast speed vessels and shallow water bulk-carriers (supported by a UNIDO project). Brazil has for a long time been in the forefront of developing deep-sea oil production systems and related underwater technology. In India, the Department of Ocean Development is managing substantive programmes for the exploration and industrial utilization of marine resources through active support of research institutes and enterprises. In addition to reinforcing the traditional marine sector, India seeks to improve capabilities related to new technologies such as wave energy, seabed minerals and advanced marine instruments. Indonesia is heavily involved in offshore oil and gas exploitation and is showing increasing interest in new sectors such as fast speed transportation and wave and tidal energy.

The growing awareness of the marine industrial sector in developing countries is reflected by the recent establishment and strengthening of related institutions. For example, the Malaysian Institute of Marine Affairs (MIMA) was set up in 1993 by the Malaysian Government to conduct policy research on issues related to the marine sector with priority on economics and ocean industries. Similarly, the National Institute for Ocean Technology (NIOT) in India was established recently by the Department of Ocean Development and represents an additional strengthening of an already very capable institutional base. Another example is from the Republic of Korea, where the Korean Ocean Research & Development Institute (KORDI) is running extensive technology and policy programmes related to ocean industries.

A special case are small island developing States (SIDS), where the average EEZ area is about 300 times as large as the average land area, and the potential for marine-based industry is expected to be far more important than land-based industry. One should also note that due to the small land area, most on-shore or near-shore industrial activities would take place in the coastal zone. This has important implications for social and economic development policy and has to be taken into consideration when setting priorities for industrial development. The highest priority should be given to strengthening local capabilities related to exploration and development of indigenous marine resources as a basis for industrial activities, including food production, mineral extraction, transportation and electricity production. Central to achieving this is access to and capabilities in marine industrial technologies as well as improving the SIDS' capacities in ocean development policy and management. Neglecting this will result in the failure to capture the very nature of SIDS and their development potential.

With the exception of the larger industrializing countries, most developing countries, and in particular LDCs, lag far behind, both with respect to the awareness of their development potential in the marine sector and the availability of technical, financial and human resources necessary to utilize this potential. The multifaceted nature of marine industrial technology makes the process of building local technological capabilities a comprehensive task. It should also be noted that industrial innovations in the marine sector are more directed towards developing systems, implying that competitive advantages are generated through innovative integration and adaption of new technologies emerging from various fields.

The multisectoral nature of marine industries implies that the responsibility for setting development policies is very often scattered between a number of governmental agencies dealing with marine-related sectors such as fisheries and water resources, mineral resources, industry, energy, transportation, science and technology and environment. This constrains the formulation of effective national development policies for the marine sector and also makes it difficult to identify focal points for development assistance activities.

There is therefore, an urgent need to strengthen both the policy-making capabilities and the access to and

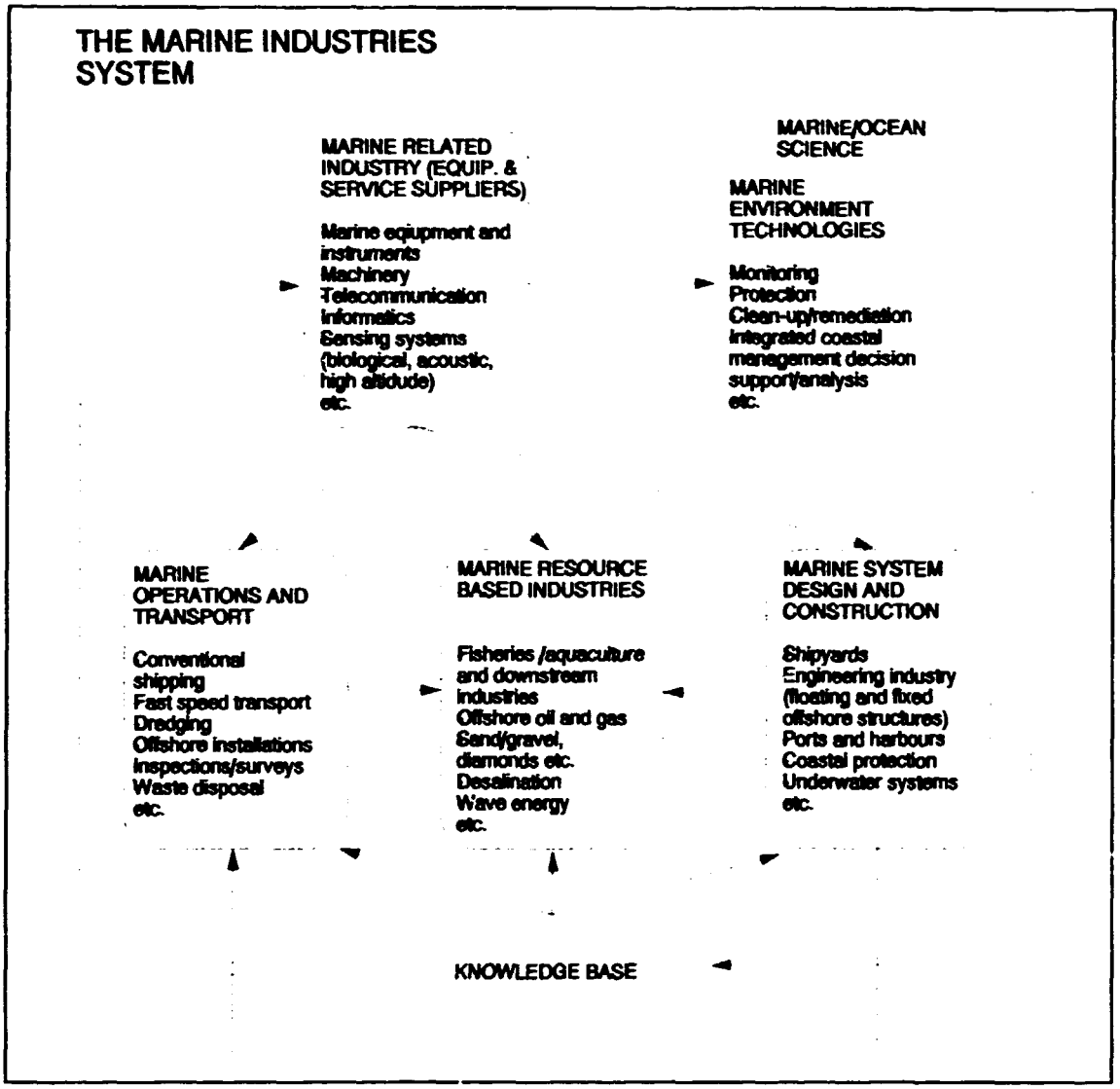


Figure 1. Interlinkages between elements of the marine industries system

capabilities in marine technology. Crucial for this process is to identify and promote commercial investment opportunities, addressing both domestic and international funding sources. We may add what Professor Rødland of the Norwegian Institute of Technology remarked at a recent UNIDO expert group meeting in Jakarta: "*What seems to limit the application of marine technologies in developing countries is the lack of financial and technological capabilities in States that are in need of exploiting their marine resources to pursue further growth.*"

Regional marine S&T centres—a critical review

The UN Convention on the Law of the Sea provides a unique framework for the development and transfer of marine technology. Special reference is given to the need for cooperation at all levels in enhancing the capabilities of developing countries in the marine sector, with a focus on regional marine S&T centres. Article 266 contains the basic objectives, while Articles 276 and 277 refer to the establishment and functions of regional centres (see annex A).

In 1982, the Third United Nations Conference on the Law of the Sea concluded that national and regional marine scientific and technological centres would be the principal institutions through which States, in particular developing countries, foster and conduct marine scientific research, and receive and disseminate marine technology. One decade later, the establishment of regional centres as called for by the Convention has not taken place, although the concept has been promoted extensively by the international community, including the combined efforts of the International Ocean Institute (IOI) and UNIDO. Some important observations and conclusions can be made from the last six years of promotional work.

First, studies and consultations[4] have indicated that regional cooperation in the marine sector has a potential in terms of enhancing technological and industrial capabilities of developing countries, and that developed countries are also expected to benefit from participating in such initiatives. However, existing analyses have been carried out at the macro level, focusing on marine resource endowments, marine S&T capacities, general industrial activities, nature of technologies involved, etc. Few studies have dealt with specific problems and needs at the enterprise level in the marine sector in developing countries. This should be done within the framework of a regional mapping of marine industries, analysing factors such as

products services, company size structure, human resources, industrial linkages (international, regional and domestic), technology level, access to technology and market information, acquisition of foreign technology, innovation, cooperation with local foreign S&T institutes, etc.

Second, the process of establishing regional centres might easily be impeded by disagreements on the location of a possible centre, indicating that regional cooperation in marine technology is "easier said than done". Already established national marine S&T institutions tend to complicate the location issue, since hosting the centre at one of those institutions is related to increased prestige and possibly improved national pay-offs from invested resources. These issues can be alleviated by promoting a decentralizing concept of regional centres, emphasizing networking mechanisms, national focal points and development of centres of excellence in specialized technology fields.

Third, industrial capability equals the ability to generate and benefit from competitive advantages. To generate competitive advantages from being in the forefront of technology development requires vast and continuous investments in R&D. As argued in the previous section, the poor R&D base of most developing countries indicates that the combined process of business innovation and technology acquisition adaption is in reality more important than the formal S&T sector in building long-term industrial and technological capabilities. Thus, in order to enhance the marine industrial capabilities of developing countries, the concept of regional centres has to be reoriented from an approach focusing on S&T *per se*, towards a mechanism which actively assists the industry of the region in its business innovation process, and which promotes a partnership between the local industry and S&T institutions. This implies that the S&T sector must be more demand-driven and respond to actual industrial needs.

Fourth, the highly promoted potential of regional cooperation is in glaring contrast with the lack of willingness, or ability, of developed and developing countries, of multilateral funding agencies and of private industry, to contribute with funding for regional centres, even for a three to five years' pilot period. In promoting future mechanisms for regional cooperation, more concern should be given to the appropriateness of the concept as perceived by potential funders, in particular industry. The limited involvement and response from the industrial side in the conceptualization and promotion of regional centres has been striking, especially since this sector is presumably a major beneficiary. The participation of industrial enterprises and associations in defining the need for, and operation of, regional S&T centres is important, since industrial demand for S&T services has been considered a potential source of income for regional centres.

Fifth, the conceptual mechanisms of the European *EUREKA* programme and the Latin American *BOLIVAR* programme have been adapted and incorporated into the concept of regional centres, resulting in a project-based framework for *pre-commercial* R&D activities. Funding requirements have been split into a core-fund for basic programme activities and administration, and a series of project funds. Each R&D project is financed separately and belongs to the project partners, which both share part of the financial costs and possible profit from commercialization. The concept is a market-oriented, bottom-up approach to technology development that requires a high degree of participation from the private sector as well as from R&D institutions. It gives industrial enterprises an opportunity to carry out joint technology development projects drawing on a regional S&T and industrial base. This approach is cost-effective in terms of utilizing the potential for industrial cooperation and sharing scarce R&D resources within a region. However, the capacity to generate competitive technology will depend on the financial and other resources that can be mobilized for each project. It would be crucial to promote commercially oriented R&D projects and thereby seek to attract international partners and investors. Governmental policies could play an important role by linking access to domestic markets with participation in and funding of joint R&D project in local industry and S&T institutions. Developing countries with an advanced S&T base might be competitive in the field of international R&D subcontracting, and could use this as a strategy to become more integrated in the mainstream technology development efforts of the world.

The Law of the Sea framework for regional marine S&T centres has thus gradually been developed conceptually into a mechanism for demand-driven R&D. This maximizes the utilization of scarce resources available within the region, and promotes joint regional and inter-regional technology development projects. However, with technology inflow rather than indigenous R&D as the dominant factor for generating industrial competitiveness, it could be argued that the immediate industrial significance of regional centres focusing on R&D has been reduced. This does not mean that the need for regional cooperation in the marine sector has been reduced. It implies that the focus of such cooperation should be shifted from technology development *per se* towards assisting enterprises in industrial innovation, technology planning and accessing competitive technologies. This might involve acquisition of foreign technologies, modification of imported technologies or joint development of new technologies.

This represents the rationale for the concept on regional business development centres, which has evolved from UNIDO's previous work on regional centres for marine industrial technology. The concept should be seen within the framework of Law of the Sea, referring in particular to (a), (c) and (e) of Article 268, and to Article 276 which include the transfer of marine technology as an objective of regional centres (see Annex A). The argument is not against regional marine S&T centres, but rather to provide a pragmatic alternative to them. The next section explains the concept of business development centres in more detail.

Framework for business development centres

As argued above, business development based on foreign investment and technology acquisition adaption has been identified as one of the most significant factors in building industrial and technological capabilities. It supplements and utilizes local R&D efforts and provides a strategic framework for building technological capabilities. In support of this process, developing countries would need assistance in several areas, including:

- Promotion of foreign investments and business alliances in the industrial sector;
- Strengthening and matching local capabilities at the enterprise level and in the formal S&T sector to acquire, absorb and adapt technologies;
- Improving the technology management capacity at enterprise level, in particular the ability to access

relevant techno-commercial intelligence and to transform this into competitive business strategies;

- To improve the ability at the governmental level to manage technological changes, and in particular the ability to formulate pro-active policies to maximize synergy effects between the technology acquisition process and domestic S&T efforts.

The concept of regional business development centres addresses the first three areas. Such centres should be free-standing and self-sustaining organizations which, on a predominantly commercial basis, provide information and consulting services primarily to enterprises and R&D institutes operating (but not necessarily located) within the region or subregion. Other clients may include governmental agencies, financial institutions and development aid agencies. The centres might specialize on a specific industrial sector or subsector, with respect to industrial structure, market, technology and financial opportunities. The concept is applicable to all industrial sectors and could be adapted to fit the specific needs of different regions.

The regional dimension of the business development centres is important for several reasons. First, the market for industrial product and services, including R&D, should be considered within a regional context. Second, such centres concept provide a mechanism for intraregional flow of technologies, investments and information. Third, they represent focal points for international contacts and facilitate technology and investment inflow. They provide business contacts and information to companies which are planning activities in the region. Fourth, they represent a cost-effective mechanism for assisting enterprises in developing techno-commercial intelligence, both in terms of general background information and in terms of company specific analysis. Fifth, they represent a possible mechanism for coordinating and focusing resources on selected regional priority areas.

It is recommended that a centre operates with a decentralized structure where a small secretariat is supported by local focal points, industrial associations, centres of excellence and international collaborators. The secretariat would be responsible for establishing and managing the programme and for providing basic services. Centres of excellence are institutions or industrial enterprises which have recognized expertise in specific fields and assist the centre, within framework agreements, in the preparation of analysis and surveys. National focal points are responsible for the coordination within each country and assist the centre in collecting and disseminating information.

The establishment of a centre would need funding for an initial pilot period of three to five years. The actual funding requirement would depend on the scope of the pilot programme, which could be effectively reduced by selecting a smaller pilot region and limiting the industrial sector and technology areas to be covered. During the pilot period, the centre should gradually become financially self-sustainable based on income generated from its services. An introduction of an annual membership fee might also be considered.

The need for institutional support related to technology management and the identification of strategic business partners investors is the main justification for establishing the centre. Many industrial enterprises in developing countries do not have sufficient knowledge about the characteristics of the markets in which they operate, including their competitors, nor about their own critical technological and competitive needs. Their internal capabilities and resources available to monitor and manage technological changes are limited, making it very difficult for them to adapt to increasing competition caused by the liberalization of markets.[1] Figure 2 gives a simplified illustration of the connection between technology and business strategies and the different time horizons involved. Technology decisions constrain or facilitate future business opportunities due to different time horizons, and that business opportunities are generated from long-term technology planning.

The main function of the centre is to provide information and consultant services related to:

(a) Market assessment;
(b) Technology management;
(c) Business linkages and investment promotion;
(d) Project development and related services.

Figure 3 gives some examples of services that might be provided by the Centre within each of the above programme areas.

The concept of regional marine business development centres needs to be adapted to the special characteristics of each region, taking into account differences in terms of size, marine resources endowments, industrial and technological capabilities and infrastructure, human resource base, financial strength, international business and financial linkages, political stability, development policies, etc. Similarly, the differences within a region will have to be reflected in the services provided by such a centre. A more realistic strategy would probably involve the establishment of a network of centres focusing on different country groups, development levels and subsectors.

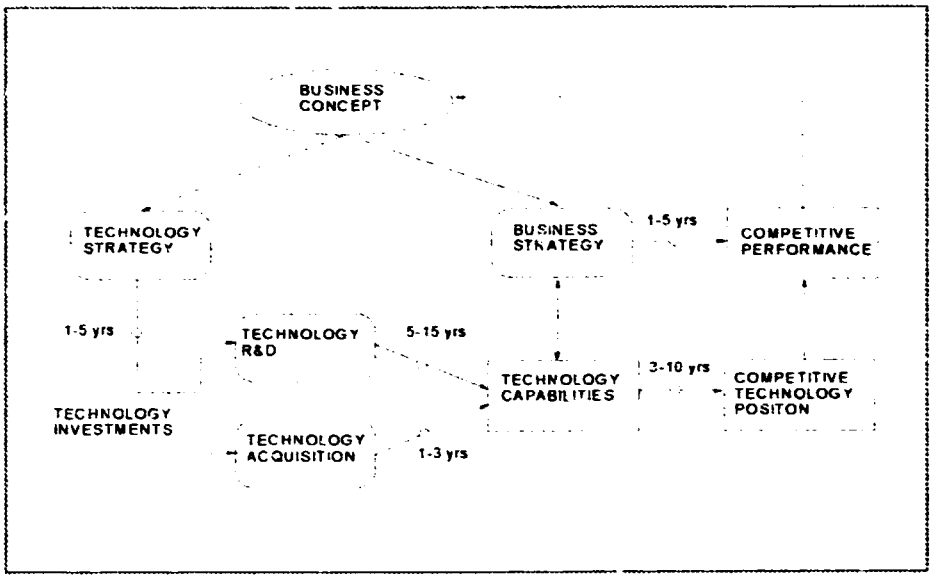


Figure 2
Linkage between business and technology strategies and the different time horizons

	SERVICES DIRECTED TOWARDS SPECIFIC SUB-SECTORS	SERVICES PROVIDED FOR SPECIFIC COMPANIES OR AGENCIES
MARKET ASSESSMENT	• Market trends • User requirements • Quality standards • Socio-economic factors	• Market entry strategies • Product performance • Volume and pricing
TECHNOLOGY MANAGEMENT	• Technology forecasting - monitoring - trends - expert evaluations - scenario based • Technology impact assessments - environment - socioeconomic - industry	• Technology/business strategies • Evaluation of technological competitiveness • Organizational changes • Techno-commercial viability • Technology negotiations
BUSINESS LINKAGES	• Investment opportunities • Technology opportunities • R&D partners • Subcontractor opportunities	• Specific partner search • Contract negotiation
PROJECT DEVELOPMENT AND RELATED SERVICES	-	• Business plans • Feasibility studies • Financial options/advice • Project management • Project evaluations

Figure 3
Example of services provided by a Business Development Centre

In order to develop and evaluate a concept for a particular region/country, and to devise strategies for its implementation, several actions need to be taken, including:

(1) Establish a profile of the marine industries sector in the various countries of the region, including related governmental policies and S&T sector. This could include data on product/services, company size/structure, managerial and technical skills, industrial linkages (domestic, regional, international), technology level/competitiveness, access to foreign technology, innovation/investment process, utilization of local/regional S&T capacity, market perceptions and need for services related to technology management and business development. Based on this, the most effective profile for a business development centre could be established.

(2) Based on the need evaluation, carry out a feasibility study to evaluate the financial basis for establishing a centre, including the expected degree of self-sustainability and the possibility of securing funds for the pilot phase. Evaluate the capabilities needed at the Centre and to what extent this can be supported by existing institutions. Are existing institutions willing to cooperate, and under what terms? What are the criteria for nominating Centres of Excellence, noting that this could also include industrial firms.

(3) Establish a pilot phase to test the operation of the Centre over a three- to five-year period for a specific sector of marine industries and with limited regional coverage. Further operation could be based on evaluation of the performance in the pilot period.

The above could be achieved by a programme of cooperation among the countries concerned. Existing regional or subregional organizations may be able to help in this regard.

The Proposed Mediterranean Centre for Marine Industries

The marine sector is of significant economic importance for the countries bordering the Mediterranean basin and includes subsectors such as aquaculture and fish industry, coastal structures and ports, shipping and shipbuilding/repair, offshore oil and gas-related industries and a variety of support industries, providing equipment and services related to the exploration, exploitation and protection of the sea and coastal areas. It provides a important industrial development potential for countries of the region and has impacts on critical issues such as food supply and transportation. While this sector is highly developed in the north of the Mediterranean, developing countries in the south generally lag behind in terms of technology, investment and human resource capabilities.

The Government of Greece has expressed interest in creating a *Mediterranean Centre for Marine Industries*, based on the business development centre concept and with the objective of stimulating the advancement of marine industries in the Mediterranean region, with particular emphasis on North-South cooperation and assistance to small and medium enterprises.

In the preparatory phase, a concept development and evaluation study will be carried out and consultation will be held with interested countries of the region. This includes an assessment of status and priority areas for the marine industries sector in the region, a preliminary demand analysis for possible services of the proposed Centre and identification and evaluation of realistic financial schemes for the pilot phase and regular operations. The preparatory phase will provide the basis for deciding on the establishment of the Centre and the related network of focal and delivery points.

Annex A

Selected articles from the UN Convention on the Law of the Sea, Part XIV: Development and Transfer of Marine Technology

Article 268
Basic Objectives

States, directly or through competent international organizations, shall promote:

(a) the acquisition, evaluation and dissemination of marine technological knowledge and facilitate access to such information and data;

(b) the development of appropriate marine technology;

(c) the development of the necessary technological infrastructure to facilitate the transfer of marine technology;

(d) the development of human resources through training and education of nationals of developing States and countries and especially nationals of the least developed among them;

(e) international co-operation at all levels, particularly at the regional, subregional and bilateral levels.

Article 276
Establishment of Regional Centres

1. States, in co-operation with the competent international organizations, the Authority and national marine scientific and technological research institutions, shall promote the establishment of regional marine scientific and technological research centres, particularly in developing States, in order to stimulate and advance the conduct of marine scientific research by developing States and foster the transfer of marine technology.

2. All States of a region shall co-operate with the regional centre therein to ensure the more effective achievement of their objective.

Article 277
Functions of Regional Centres

The functions of such regional centres shall include, inter alia:

(a) training and educational programmes at all levels on various aspects of marine scientific and technological research, particularly marine biology, including conservation and management of living resources, oceanography, hydrography, engineering, geological exploration of the sea-bed, mining and desalination technologies;

(b) management studies;

(c) study programmes related to the protection and preservation of the marine environment and the prevention, reduction and control of pollution;

(d) organization of regional conferences, seminars and symposia;
(e) acquisition and processing of marine scientific and technological data and information;
(f) prompt dissemination of results of marine scientific and technological research in readily available publications;
(g) publicizing national policies with regard to the transfer of marine technology and systematic comparative study of those policies;
(h) compilation and systematization of information on the marketing of technology and on contracts and other arrangements concerning patents;
(i) technical co-operation with other States of the region.

Notes

1. *Source*: "Industrialization of Africa within the context of current global economic developments", by S. Lall, paper presented at Meeting of Technical Experts of OAU, ECA, UNIDO and ADB, UNIDO, Vienna, 1994.

2. *Source*: "International strategic alliances between multinational enterprises and SME in the Third World: A perspective on international sub-contracting", by Ja Badenhorts, pp. 17-22, *Small business and its Contribution to Regional and International Development*, proceedings of the 39th ICSB World Conference, Institute of Business Management, Université Robert Schuman, Strasbourg, 1994.

3. *Source*: "Technology, industrialization and development - Perspectives and Programmes of UNIDO's Technology Service" (Draft), UNIDO, Vienna, 1994.

4. *Source*: "A strategy scenario for technology management by developing countries", by Rasto Macus, paper presented at the High-level Expert Meeting on Technology Management, UNIDO, Vienna, 1993.

5. *Ibid.*

6. *Source:* "CSIRO Division for Oceanography: Research Report (1987-1989)" CSIRO Marine Laboratories, Tasmania, Australia, 1991.

7. *Source*: *Sea Technology*, July 1995, Vol. 36, No. 7 (p. 7).

8. "Feasibility study on Mediterranean Centre for Research and Development in Marine Industrial Technology", International Ocean Institute, Malta, 1988.
"Meeting of Experts on the Establishment of the Mediterranean Regional Centre for Research and Development in Marine Technology" (Report), UNIDO, Vienna, 1989.
"Study on the viability of establishing a Caribbean Regional Centre for Marine Industrial Technology", UNIDO, Vienna, 1990.
"Expert Group Meeting on the Establishment of a Caribbean Regional Centre for Marine Industrial Technology" (Report), UNIDO, Vienna, 1991.
"A framework for the institutionalization of technology transfer to industrializing countries", UNIDO, Vienna, 1992.

9. *Source:* "Aspects of technology management at the industrial enterprise level", by F. Machado, paper presented at the High-level Expert Meeting on Technology Management, UNIDO, Vienna, 1993.

B. INDUSTRY NEWS

Faster Marine Vehicles - Future Target?

London-based Marine Technology Directorate Ltd. (MTD) commissioned a study to discover what research needs to be done to enable the design, building and safe operation of innovative types of high-speed marine vessels capable of handling larger volumes, higher speeds and longer distances. The study will consider a number of designs including catamarans and surface effect ships. MTD expects the study to look at potential obstacles, analysing current industrial techniques and capabilities, together with other research programmes in related fields. Other countries have already heavily invested in trying to meet the growing commercial requirement for larger and faster passenger and cargo vessels. (Source: *Sea Technology*, August 1994)

"U-TOW" — Low-cost Underwater Towed Body

Valeport Ltd. (Dartmouth, UK) has launched its data-gathering underwater towed body called "U-Tow". The company say it is a low cost and highly adaptable device. It can be used for a wide range of marine environmental data-gathering tasks, including biological and chemical surveys for water quality monitoring and pollution studies. The vehicle can be towed at speeds of more than 20 knots and can be operated either as a simple fixed-depth towed body or can undulate to depths of up to 100 metres. (Source: *Sea Technology*, August 1994)

Basin Modeller expands in the Far East

After 25 years of research on the Norwegian shelf, IKU Petroleum Research (Norway) is taking its expertise to Asia. The company, which is part of the Sintef research group, already has a network of contacts throughout the world through participants of courses in petroleum exploration and engineering which were held at the company's Trondheim headquarters from 1980 to 1992. It is not planned for the company to maintain a permanent presence, using instead skilled contractors and when required supervisors to work on specific projects with local company personnel.

Elsewhere the company is involved in research in the Barents and Kara seas interpreting geological maps and core sample analysis data. It has also finished a basin modelling project for the Namibian oil company Namcor. IKU has also participated in enhanced oil recovery projects and in the development of technology for deviated and horizontal drilling. (Source: *Offshore*, Novemb[illegible] 1994)

New low-cost sonar system

The acoustic and imaging technology company Simrad Osprey Ltd. (Aberdeen, Scotland) has launched its new MS940 sonar system, which uses the client's own computer to control the system and display the information. The system runs on a user-friendly Windows format with pop-down menus. With the addition of a "video blaster" card in the computer, the system allows the video image from an Osprey underwater television camera to be displayed at the same time as the sonar image. (Source: *Sea Technology*, January 1995)

Integrated bridge control

STN Atlas Elektronik GmbH (Germany) has introduced a new ship control centre (SCC) system integrating all navigation, communication and main control operations into a single-source, low cost package for ships' bridges. This SCC system has been designed for the single manning of bridges and is available in three basic versions. Incorporation of the previous Atlas NACOS navigation command systems as a core component is possible, while in-house communications and automation equipment can be configured to meet individual cost-saving bridge requirements. (Source: *Sea Technology*, January 1995)

Underwater positioning in China

Sonardyne Ltd. (Fleet, UK) has been awarded a contract to supply a permanent underwater positioning system for China's Liuhua 11-1 offshore oilfield. This system will have a key role in the development and operation of the field, which will use ROVs as the primary interface with the subsea production control system. The Liuhua field is some 130 miles south-east of Hong Kong in depths of 315 metres with wells serviced by a floating production system having well fluids brought to a manifold flowing into two production pipelines. (Source: *Sea Technology*, January 1995)

Cableship delivered to Singapore

The CS Asean Restorer, a new type of cableship, has been delivered to the Kvaerner Masa-Yards' Turku New Shipyard. The ship has been developed specifically for the maintenance of the growing fibre-optic submarine cable network in Asia. The ship features a full stern working concept designed to enhance operational performance and response. It will be operated by Asean Cableship Pte and stationed in Singapore. (Source: *Sea Technology*, January 1995)

Gulf of Agaba cable

The contract to lay a 420 kilovolt submarine power cable between Jordan and Egypt across the Gulf of Agaba was signed late last year. The order was placed earlier this year with the Alcatel Kable Norge (Norway) by the respective electricity authorities. The cable, which will be capable of transmitting both AC and DC power and is oil-filled and paper insulated, will run for 13 kilometres and reach a water depth of around 330 metres. (Source: *Sea Technology*, January 1995)

Manned offshore submarine exceeds expectations

With an operating depth of more than 400 metres, a diving period of up to 21 days, exact 3-D positioning and low manning levels, great expectations are awaited from the submarine being developed by Thyssen Nordseewerke (Germany). It is part of an oil and gas production system for inspection, maintenance and repair of subsea installations. Through its Thermie Programme support has been given by the European Union to investigate five key systems of the vessel and their integration in a basic submarine design: energy system, propulsion and dynamic positioning systems, life support, navigation, communica-

tion and control systems and crane and work modules. Testing continues. (Source: *Sea Technology*, January 1995)

Manufacturing project for oil industry

Under a joint project of Westinghouse Marine Division California (USA) and the National Institute of Standards and Technology (NIST), a programme has been started to develop, manufacture and test inexpensive and reliable large composite structures for deep water oil exploration. The long-term goal of this project is to develop polymer composite structures which are technologically and economically an attractive solution to the use of tubular steel structure in deep water drilling programmes. (Source: *Sea Technology*, February 1995)

Haslar Hydrodynamic Test Centre formed in UK

A comprehensive technology centre for the hydrodynamic modelling of ships, underwater vehicles, marine structures and other specialist applications has been established in the UK following a joint venture agreement between the Defence Research Agency and British Maritime Technology Ltd. The Centre's facilities will be enhanced through investments in wave making and shallow water modelling facilities. Although defence work will continue to be carried out, work is also aimed at supporting other fields such as forensic investigation, offshore oil and gas development. Contract research for individual companies or consortia will be carried out. (Source: *BMT News*, February 1995)

Horsepower monitoring system

Mitsubishi Heavy Industries Ltd. (Tokyo, Japan) has developed probably the world's first system to optically measure, transmit and display real-time horsepower monitoring data. According to the company, the system can assist safe ship navigation through provision of more precise measurements than conventional horsepower monitoring systems. This new system optically measures the torsion and then transmits this information to a data processor after conversion to electric signals, thereby providing precise real-time data whilst avoiding disturbance or radio interference. Few ships have installed horsepower measurement devices at present, and Mitsubishi Heavy Industries Ltd. will therefore promote the use of this new system with an emphasis on safe navigation and economical operation. (Source: *Sea Technology*, March 1995)

Electronic charts — advantages

Questions are raised when considering electronic charts. What can they achieve? Can they reduce the workload of the officer of the watch and give him additional information? Are they accurate and up to date? Answers to these questions, and many more, are expected from the Baltic and North Sea ECDIS testbed (BANET) project which is being funded by the German Ministry of Research and Technology and carried out by the Nautical Faculty of Hamburg Polytechnic. Practical tests are being carried out aboard a ferry sailing between Helsinki and Travemunde. Results so far achieved show that navigation using radar, satellite communication and electronic charts ensure safe manoeuvring in enclosed sea areas, which reduces stress and error potential of the office of the watch. (Source: *Sea Technology*, March 1995)

"FastShip" cooperation

The Massachusetts Institute of Technology (MIT) and FastShip Atlantic Inc. (Alexandria, Virginia, USA) are collaborating on a project which is expected to have a dramatic affect on the transportation of high-value cargo across the ocean. They plan to refine and market a new, very high-speed freighter to operate on North Atlantic and Pacific trade routes. The freighter will be able to transport cargo across the North Atlantic in five to seven days as compared to the present 14 to 35 days for conventional freighters. (Source: *Sea Technology*, March 1995)

Marine composites venture

An alliance is being established between DuPont and Kvaerner Industries to develop and manufacture composite structures for the global shipping and offshore sectors. The alliance also involves Conoco Norway Inc., a branch of DuPont's energy subsidiary. The companies will undertake joint projects in the use of advance composite materials for lightweight structures and equipment with increased strength and corrosion resistance. It is planned that this will help to reduce maintenance, improve life cycle costs, give access to deeper waters and raise safety and environmental performance. Various technologies will be used ranging from specialty fibres to thermoplastic filament winding and infusion moulding. To start with, projects will include subsea covers, drilling risers and platform tethers in the offshore area and large hull structures, cabins and masts in shipbuilding (Source: *Chemical Marketing Reporter*, 26 June 1995)

Longest flooded tunnel inspection

Aquatic Sciences Inc. (St. Catherines, Ontario, Canada) has recently awarded Deep Ocean Engineering Inc. (San Leandro, California, USA) a contract to build a vehicle for the longest flooded tunnel inspection in the world. The inspection will take place in the Santiago del Mayolo Antunez (Mantaro) tunnel, which is in the Central Andes mountains in Peru.

The vehicle provides a 50 kilogram payload and supports numerous sensors, including two sonars, three cameras, dimmable lights, multifunction manipulation and a variety of NDT and sampling probes. The on screen overlay displays depth, heading, time, date, elapsed time, pitch and roll angle, umbilical turns, umbilical length deployed, vehicle power condition and leak and error detection. As the tunnel has no intermediate access points, the tunnel must be inspected from each end using a 10 kilometre umbilical tether. (Source: *Sea Technology*, July 1995)

Engineering award for the Auger Platform

The American Society of Civil Engineers has selected Shell Oil's Auger Platform as the 1995 outstanding civil engineering achievement. The Auger Platform is more than twice the height of the world's tallest building as well as being the deepest offshore production facility in the USA and the fourth of its kind installed in the world. At a depth of 2,860 feet, it surpassed previous water depth records for oil and gas production. It reached full oil production capacity ahead of schedule and now has a gross daily peak production of more than 60,000 barrels of oil and more than 120 million cubic feet of natural gas. (Source: *Sea Technology*, July 1995)

Offshore industry installation firsts

The installation of the Troll platform in the Norwegian sector of the North Sea was a major achievement. It is the world's tallest concrete structure measuring 470 metres from skirt tip to flare boom top, weighing 660,000 tons and has been designed to withstand near hurricanes. The construction, installation and commissioning phases have been carried out by Norske Shell; Statoil will operate the project.

The Europe Maghreb Gas pipelines were laid to a depth of 388 metres in some of the most technically challenging underwater conditions to date (three levels of strong currents). The "Gibraltar" pipeline system extends 47 kilometres from Cap Spartel, Morocco, to Zahara, Spain and thus links two continents. (Source: *Sea Technology*, July 1995)

"Gravel Pack" engineering technique

Kajima Corp. and Japan Marine Project Co. Ltd. have jointly developed a new technique to prevent sand from seeping out through the caisson gaps generated in coastal walls and protective banks due to earthquakes and other natural disasters. This new technique is being applied in the reconstruction of the coastal walls and protective banks in Kobe Harbour following the recent Osaka-Kobe earthquake.

Gravel Pack is a net bag made of nylon and polyester ropes holding crushed rocks of 20-40 cm, the capacity is 0.1 cubic metre. By dumping these packs into caisson gaps a protective wall is formed when the packs change shape flexibly to accurately fill the gaps. When dumped from a fixed position a straight vertical wall is formed in the sea to suppress the influences of waves on the front and it can withstand the rear soil pressure and loads impressed from above. This development enables sand seepage to be prevented rapidly, accurately and economically even in places of great depth and with large waves as well as at wide caisson gaps where sand seepage prevention had been difficult using conventional methods. (Source: *JETRO*, August 1995)

New cargo environment system

Moisture damage ruins more cargo than any other form of ocean shipping hazard. L&C Associates, Inc., of North Hampton, New Hampshire (USA), has introduced an automated cargo environment control system called "Bulkcaire System". This system combines a marine-duty desiccant dehumidifier with a sophisticated monitor that can automatically maintain the hold environment in a condition which is best for the cargo being transported.

The system can eliminate sweat damage, detect and combat hatch cover leakage and rapidly drying holds that contain wet dunnage or were loaded during wet conditions. The design allows simplified, push-button operation as the dehumidifier and air circulator, airflow valves and vents, environmental sensors and monitoring module are fully integrated. Built-in sensing features detect combustion, explosive gas or hazardous vapours. As any 4-20mA sensor can be configured in the monitoring system, it can be custom-fit to meet clients' needs. (Source: *MIS Currents*, June 1995)

Chemical tanker inspection system

The volume of chemicals being moved by sea has long warranted an independent, accredited inspection system, both from an environmental and safety point of view. In July this year it was announced that the Chemical Distribution Institute's (CDI) marine transportation initiative was becoming active. The CDI was established to develop and organize a safety, quality and assessment system for marine transportation (SQAS). The primary aim of this system is to improve the quality of the safety performance of marine transportation by providing a uniform inspection system with properly trained inspectors. A secondary goal is to limit the total number of ship inspections carried out. To date, 15 companies have become members of the CDI and are the funders of the Institute. The CDI sees its main role as being one to administer the scheme, train inspectors, maintain inspection reports and to operate the database. The system began in December 1994 and so far 125 inspections have been carried out and are in the process of being entered into the database. This database should be a paperless system containing not only the inspection reports, but lists of ships that have been inspected, when and by whom, together with contact details for charterers, owners and inspectors.

Once an inspection has been carried out, the shipowner has 14 days to respond, any remarks will be entered onto the CDI database together with the report, thus allowing a shipowner to comment on possible poor results. An agreement is then signed by the shipowner and the CDI, with the shipowner paying a fee. The reports remain active for thirteen months, after which they are archived. The inspection report covers a total of 19 items on ship structures and equipment and assesses compliance in three areas: statutory, recommended and desirable. The recommended requirements cover industry codes, whereas desirable ones are mainly items relating to quality, management, safety and environmental protection.

At present CDI has 18 inspectors, mainly based in Europe, but it is envisaged to have a global team of around 40 inspectors soon. (Source: *ECV Chemscope*, October 1995)

C. TECHNOLOGY UPDATE

"The Eel"—towed seabed gamma ray spectrometer

For many years measurement of radioactivity has been used for onshore geological surveys and in laboratories. Much of the equipment used was originally produced for uranium exploration.

The British Geological Survey (BGS) has further developed this equipment for use in the marine environment through the development of seabed gamma ray spectrometer systems. This instrument, known as "the Eel" has successfully been used for sediment and solid rock mapping, mineral exploration and radioactive pollution studies. It has also been used for environmental surveys and surveys of cable and pipeline routes.

Impetus for further development was given by the Committee for Coordination of Joint Prospecting for Mineral Deposits in Asian offshore areas—CCOP. Surveys have been carried out off the Philippines and the Republic of Korea.

The Eel comprises a gamma ray detector that is towed on the seabed at normal survey speeds. The probe containing the detector and the lower end of the towing cable are encased in a 30 metre length of PVC hose that protects the probe from vibration and abrasion and lessens the risk of the cable becoming entangled on seabed obstructions. It is towed from a small electro-hydraulic winch. Signals from the detector are sent up the cable to a 256-channel spectrometer on the survey vessel that provides both digital and analog output. A standard IBM PC compatible computer controls the equipment and logs the data. The Eel is normally operated with other survey equipment including echo-sounders, side-scan sonars, and seismic reflection profilers. It measures gamma radioactivity from the three main natural radioactive elements - potassium, uranium, and thorium. In addition, it can detect artificial radioactivity. Mapping of sediment and rock types can be used to determine the ease with which a pipeline or cable can be laid. The system can also provide radiation dose data for fibre optic telephone cable routes.

The technique has application in exploration for three major types of mineralization: placers, which can be enriched in radioactive heavy minerals; phosphates, which are frequently uranium-enriched; and uranium-bearing veins, which may be associated with ores of other metals such as tin and copper. Other functions include provision of a direct indication of mineralization. The mapping capability can be used to show favourable geological environments. (Source: *Sea Technology*, August 1994)

New developments in offshore erosion control

For centuries man and the oceans have fought over waterfront development. The first breakwaters were plagued by instability or exaggerated and uneven erosion patterns, thus sand replenishment became the accepted recourse in cases of erosion. This battle is now taking on a new outlook through the "Beachsaver" reefs developed by Breakwaters International Inc., New Jersey, USA. The reefs are triangular in shape, weigh 21 tons and are designed to protect beaches from erosion by complementing sand nourishment techniques. The Beachsavers have been designed to be placed at a point in the surf zone where they are approximately 2 metres below the surface at mean low tide.

The Beachsaver enhances sand replenishment in two ways. Firstly, as the structure holds sand in near the shore, the beach requires a significantly smaller amount of sand to bring it to its optimum size. Secondly, the reef holds new sand in place on the beach so that it is not washed back into the sea during the replenishment process. The shape of the reef allows incoming waves to carry sand onto the beach and deflects wave energy without disrupting the natural balance of waves coming ashore. The company says that through the material composition used (the reefs are precast from enhanced concrete enhanced with Microsilica Forece 10,000), a greater longevity is achieved.

Further tough tests are being carried out and the results should enable erosion control managers to produce more definite estimates about the cost-effectiveness of Beachsaver reef sand replenishment combination projects and economic planning for many beachfront and waterfront development projects. (Source: *Sea Technology*, September 1994)

Defence conversion for marine technology

Following the end of the Cold War and new economic policies, the US Department of Defence has reacted quickly to new concepts of dual use of technologies and systems and the conversion of its own resources and capabilities for civilian applications. Not surprisingly, the US Navy offers varied and significant opportunities to the marine technology community for dual use and conversion. This can be seen in two ways: dual use - development or application of a technology or system for both military and civilian uses; defence conversion - finding productive civilian uses for resources and people formerly devoted to defence.

In the past, many conversion success stories seem to have resulted from the initiative of management of specific industries rather than from government support. Key among the factors affecting the success of this industrial technology transfer are the requirements for a "market pull" from the commercial sector before defence technologies are accepted.

An example of this is perhaps the collaboration between the US Navy, the Environmental Task Force and the Government Agency Task Force which identified assets of use for the environmental community such as the Integrated Undersea Surveillance System whose acoustic listening arrays are being exploited for the tracking of marine mammals and the detection of undersea seismic events. The National Ice Center (Suitland, Maryland), which is jointly operated by the Oceanographer of the Navy, NOAA and the US Coast Guard, provides sea-ice forecasts for the polar oceans and the Great Lakes. Using various databases and oceanographic and meteorological observations, the Center distributes its products freely through civil and military channels in support of safety and ice-breaking operations. Recently the Oceanographer of the Navy signed an agreement with the NOAA to allow civilian access to the Naval Oceanographic Data Distribution System, thus permitting dissemination of satellite data imagery and gridded data fields from

numerical atmospheric prediction models. This service should soon be available over a variety of media, including "dial up" computer links.

Further, a number of key marine engineering innovations are approaching implementation, including an intercooled recuperative gas turbine engine, a suite of shipboard waste disposal systems, advanced hull form and structural techniques and reverse osmosis desalination systems. Many environmental measurement systems originally planned for anti-submarine warfare appear to be directly useful for exploration and exploitation of seabed mineral deposits.

The US Department of the Navy sees these initiatives as a two-way street with mutual advantages for all. (Source: *Sea Technology*, November 1994)

High-speed craft research issues

The marine vehicle world has changed dramatically over the past 10 years. High speed vessels now hold a significant share of the market. However, as with most rapidly developing technologies, they bring with them problems which need to be solved. This, in many cases, requires further study, research and development. Such vessels must be safe and their behaviour therefore predictable. Passengers and crew are subjected to large accelerations which can affect the way in which they carry out their duties, or suffer from motion sickness. Therefore, human factors play an important role in the design of such vessels. British Maritime Technology Ltd. is working closely with the Royal National Lifeboat Institute (RNLI) to study handling and sea-keeping qualities of high speed lifeboats. The aim of this work is to use the extensive model and full scale data collected in the past on lifeboats to help naval architects include in their designs good handling and sea-keeping qualities. This obviously needs work to define "good handling and good sea keeping" so as to provide some guidelines. Some criteria have already been produced using model test data and full scale measurement and experience so as to produce high speed craft as good as, if not better, than the successful vessels of today. Means of propulsion, for which water jet testing capability is being developed, and high speed squat behaviour in shallow water is also being explored. (Source: *BMT News*, November 1994)

Satellite navigation system

The Global Positioning System (GPS) has finally matured. Despite its widespread adoption and universal welcome and almost unlimited potential, clouds of uncertainty continue to linger. One source of concern is that the GPSs was, and remains, a primarily military system, financed and operated by a single State – the USA – The Department of Defense (DoD), USA, does degrade the quality of GPS service available to civilian users, but the fact that it maintains the ability and right to do so is seen by some as a flaw in the system. Civilian reliance on the GPS in critical applications such as vessel navigation by electronic chart is therefore compromised.

To become a balance to this, earlier this year Inmarsat formally invited bids for the use of the navigation transponders that will be carried by its satellites. Although these transponders will at first only provide an augmentation to the GPS, it is planned that they could be the first step leading to a fully independent, internationally owned civilian satellite navigation system. Inmarsat is synonymous with mobile satellite communication and the provision of navigation services has been in its constitution since its beginning. The navigation payload will augment GPS by providing ground-derived integrity information, additional ranging signals and wide-area differential corrections. It is planned that the result will be better coverage, more reliability and improved accuracy. The Inmarsat-3 satellites will be the first satellites capable of providing both navigation signals and independently monitored integrity information. The existence of the integrity monitoring network supported by inmarsat-3 would allow a reduction in on-board clock stability and data storage. Inmarsat calls this the Navigation Lightsat Payload. The satellites planned to be launched in the next century will be a likely host for the payload and, thus equipped, the satellites would act more like autonomous navigation satellites than the Inmarsat-3s. (Source: *Ocean Voice*, January 1995)

Starec buoy developed

Inmarsat, together with the Norwegian company Linkom and the Japan Radio company has developed a new device to record and transmit the status of certain crucial conditions aboard a ship at sea, called "Starec". This systems consists of a data logger, a range of sensors and status monitors and an Inmarsat-C transceiver which are incorporated in a buoy which should float free should the vessel sink. The status monitors will record basic voyage details such as position, course, speed and water depth. They can also record parameters such as hull stresses and ship movements, opening and closing of hull doors, wheel movements and engine orders. The logging device can store data generated during a period of up to 24 hours and transmits reports, based on that data, at regular intervals via the internal Inmarsat-C terminal. Should a disaster occur, the buoy should float free from the vessel and broadcast a distress signal automatically – whoever is monitoring the vessel can then easily poll the buoy and down-load the data, obtaining immediate information about what might have happened. (Source: *Ocean Voice*, January 1995)

Oil pick-up system

Environmental Safety Products Inc. have introduced "Oil Grab", a bioremedial oil sweep manufactured from wood and cotton fibres with oil-eating microbes. It apparently collects and transforms hazardous oil into environmentally sound, non-toxic waste within 24 to 72 hours. (Source: *Sea Technology*, February 1995)

Indirect towing tank test

Hvide Marine Inc. (USA) commissioned tests to be carried out at the Haslar Centre (UK) to confirm the performance of a new tug design. This should be a new generation of escort tugs capable of functioning safely in an indirect towing role where a serious risk of environmental damage, or other significant safety hazard should be avoided. This tug design incorporates twin forward mounted ducted thrusters, an exceptionally large fixed skeg and a tow point specifically positioned to allow the tug to resist the motion of the vessel it is escorting by being dragged at an oblique angle by the tow line. The tests were apparently the first ever successfully completed in a towing tank. (Source: *BMT News*, February 1995)

Processor for radar display

Litan Radar International Inc. have produced a radar display processor that interfaces with most existing radar

systems providing state-of-the-art filtering with image storage and display. Specifically it can be used for small target detection in clutter, interface with electronic charts, automatic coastal monitoring systems and ocean surface feature extraction (waves, ice, oil). (Source: *Sea Technology*, February 1995)

Sea water purification dyke

Obayashi Corporation, in cooperation with the Oceanic Space Research Team, has developed a stone-stacked water purification dyke called the "Ecological Rubble Mound Technique" to purify sea water by utilizing the permeation of sea water caused by tidal motion and the natural purification functions of micro-organisms. Sea water is purified in the process of its passage through the stacked stones. The natural ecological food chain of the micro-organisms, such as bacteria and nematodes adhering to the surfaces of the rocks purify turbidity substances, while larger organisms such as barnacles and hard shelled mussels directly absorb and filter these substances. In addition, the shell fish and shrimps living among the stones also consume the plankton and other undesirable substances. The dyke utilizes sea water which permeates through the rocks during the rising and falling tides and requires no aeration system. Since the natural ecological food chain is applied for purification, the dyke is effectively usable for many dozen years with hardly any maintenance. The construction cost, with a system 3-4 metres deep, is about the same as that of the conventional rubble-mound embankment construction method.

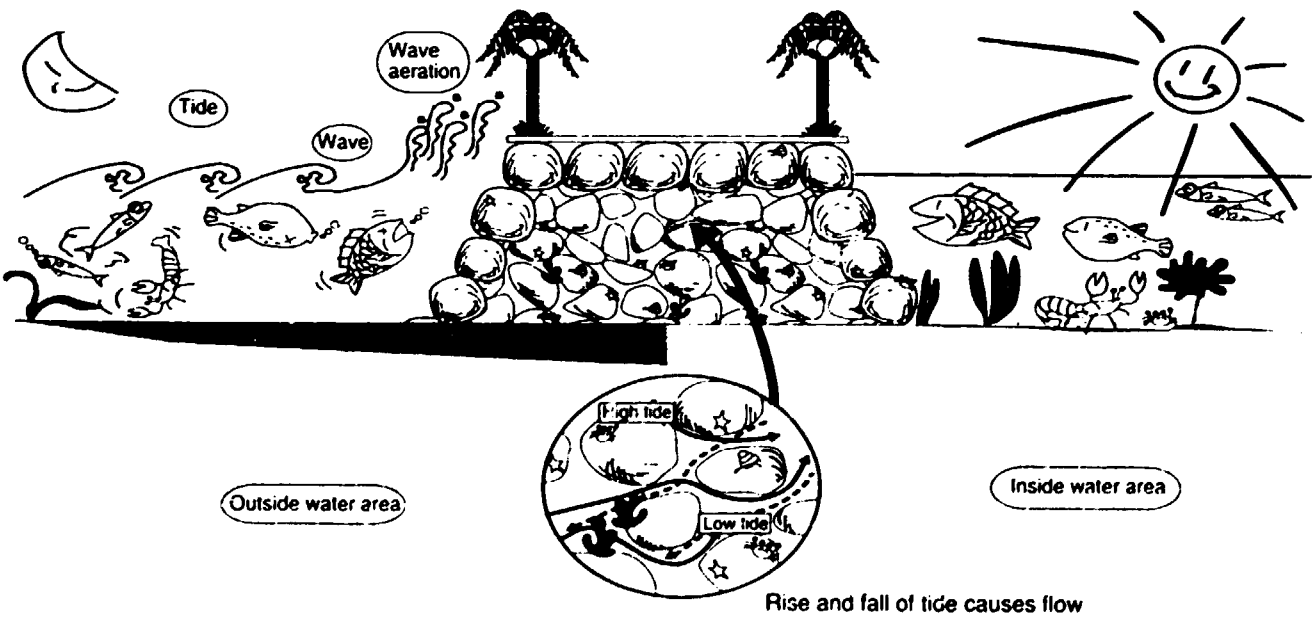
Further information can be obtained from: Obayashi Corp. Public Relations Div. 2-3 Kanda Tsukasa-cho, Chiyoda-ku, Tokyo 101, Japan. (Source: *JETRO*, February 1995)

Thermographic testing method for composite joints

Rogalands Consultants, Norway, have developed a new technique based on thermography which pinpoints defects in composite joints, thus boosting the use of these advanced materials offshore. Use of composites offshore remains limited, mainly for secondary piping systems. Defects have appeared, in some cases joints have come apart. Conventional NDT methods are difficult to apply and at times too expensive and unreliable. This new system, for which a patent is pending, appears to be more accurate using thermography, with the "Agema 470" infrared imaging system. Thermal images are transferred to a PC for diagnosis. Test results so far verify that infrared thermography is a reliable method for detecting defects in welding/gluing in composite pipe materials, providing extreme precision in the area at fault. (Source: *Offshore*, March 1995)

Ore from the ocean

The National Metallurgical Laboratory in Jamshedpur, India has developed a technology to extract metals from manganese nodules. These nodules, when mined from the seabed, contain metals such as iron, copper, nickel and cobalt. The Laboratory has set up a pilot laboratory plant with a capacity of processing 100 kgs of nodules per day. As the nodules contain roughly 1.0 per cent copper and 0.2 per cent cobalt, ocean mining could become economically viable. Through the process used, roasting in a "reducing" atmosphere followed by leaching with ammonia, solvent extraction and the separation of metals in electrolytic cells, 85 per cent of the metallic content in the nodules can be successfully removed. The Laboratory is also trying alternative methods to "reduction-roasting", such



Rise and fall of tide causes flow

as using finely powdered manganese nodules in a fluidized bed reactor with reducing gases. They believe that this method could increase the yield of metals and also save power. (Source: *Technology Monitor*, March April 1995)

New system for container handling

TTS (Norway) has developed a new container handling system called the "Container Pallet Transfer System" specifically designed for loading and unloading high-speed container vessels. A reduction in the time needed for loading and unloading vessels is anticipated in the region of 50 per cent. As the development of high-speed container vessels progresses, this new system from TTS can be successfully adapted for any of these vessels. It has a capacity of 900 TEU per hour, meaning that the system is capable of loading and unloading 900 20-foot containers within two hours. The main part of the system is a "Mega-pallet" which carries 20 containers. It is transported on and off the vessel by a fully automated computer-integrated transport system, which also communicates with the ballast system of the vessel to ensure the correct trimming. (Source: *TTS News*, June 1995)

Cooperation Agreement signed between TTS and KCS

Kockums Computer Systems AB (KCS) (Malmo, Sweden) and TTS (Norway) have entered into a cooperation agreement for the marketing of computer integrated manufacturing solutions for the shipbuilding industry. The agreement ensures that software developed by one company will be technically compatible with software developed by the other. This agreement contributes to the ongoing rapid development and implementation of CIM solutions for the shipbuilding industry. (Source: *TTS News*, June 1995)

Collection of scarce metals from sea water

The Material Development Division of the Japan Atomic Energy Research Institute (JAERI) has carried out research on collection of scare metals such as uranium, titanium and cobalt from sea water using graft polymers. An experimental test is planned to start in the Sekinehama of Mutsu City, Aomori Prefecture. Further projects are planned to substantiate the data obtained in the experimental stage.

The materials used are resin fibres, which are an application of the non-woven fabric oil fence often used in tanker accident cleanups. Their features are: (a) high contact efficiency with sea water; (b) fast selective adsorption of metals; (c) large adsorption capacity and (d) capability of separating and recovering scarce metals such as uranium and vanadium.

Tests so far show that 95 per cent of the uranium in sea water can be collected and approximately 2.7 g of uranium was adsorbed onto the collection material whilst floating in sea water for 20 days.

The collection method uses only natural ocean currents and wave force and therefore has the advantage of collecting resources without changing the shape of the earth as mining would. Additional advantages include the fact that no well boring is needed and that the process of purifying sea water uranium is simpler than that of land uranium. One disadvantage at present is the economic cost when sea water uranium is used for electric power generation, being slightly higher than that of mined uranium. (Source: *Nikkei Sangyo Shimbun*, April 1995)

Communication system aid for diving centres

The staff at the Diving Diseases Research Centre, Plymouth, UK, were often required to sit outside decompression chambers for up to eight hours relaying the medical requirements of the patient inside the chamber. Following the installation of a "Hydrocom" communication system, which utilizes radio equipment manufactured by Wood & Douglas (Basingstoke, UK), the DDRC staff members can now move freely around the Centre whilst remaining in voice contact with both the dive control and the medical team within the chambers. The system runs parallel to the existing hard-wired system and is a full duplex radio system allowing an unlimited number of people to be in constant contact. The system includes a base station and portable transmitters receivers worn on the belt and a head-worn speaker microphone combination with excellent filtering to ensure clear reception, even in high ambient radio frequency levels. (Source: *Sea Technology*, June 1995)

Design for production

If design is seen as production planning, perhaps rapid planning is a key to process the creation of a good design at the start of the design process. Even at the point when general arrangement and preliminary system designs are being set up, it is possible to create rough plans that can be used for immediate action to prepare for production. For instance, the content and extent of fitting out in different zones of a ship can be combined with a preliminary production plan to verify whether the production plan should be modified and to establish plans for the further design process — which functional design should be finished first. A further use could be preliminary purchase planning. As information is obtained, better plans for the later stages evolve.

Using pre-defined standard patterns improves the likelihood that the design will be optimal for production and the possibility of making good production plans early. They should be closely related to the production process and particularly outfitting work. Simulation tools giving decision support are gradually being developed. They can operate on representations of the ship as shown in midship section drawing. Results will give indications of consequences of production and thus support to the designer. As the product is engineered, it is possible to use more advanced simulation methods integrating a shipyard model, detailed product information and a plan.

The ultimate vision, which is being made possible through the development of virtual reality and product model technology, is to be able to visually inspect and evaluate a "virtually" manifested design solution and to rearrange it through "virtual" hands-on manipulation. (Source: *MARINTEK*, May 1995)

Conventional tension base platform — problems and solutions

Major oil companies plan to continue investing heavily in deepwater exploration and development, however, field development system designs for water depths in excess of 4,000 ft. are very limited. Following the installation of the Auger tension leg platform (TLP) at a depth of 2,860 ft, designers are now more or less convinced that the conventional TLP concept is not very economic at a water depth of more than 3,000 ft. The reliability of the system is also being questioned.

The TLP at these depths can behave like an inverted pendulum with excess buoyancy of the hull maintaining tension in the tether mooring system. With this sway period of 15-250 seconds, the TLP moves compliantly to waves and can produce excess vertical setdown, thus causing design problems and reducing tension resulting in slacking to the aft tethers, hereby weakening the reliability of the concept. A second problem is that the vertical heave motion becomes very severe causing a kind of vertical resonance, which is a potential disaster for TLP tethers.

The new generation of TLPs called tension base tension leg platforms (TBTLPs) base themselves on the conventional system but consist of a reduced size TLP where tendons are moored on a deeply submerged buoyant base, which is again vertically moored by another set of lower tendons to the seabed. Optional lateral resisti g mooring lines can be used for the submerged base to ease installation and to improve in-place behaviour.

The new concept is mainly aimed at avoiding tether slacking in very deep water without increasing the size of the hull near the water surface. It provides large pretension for the bottom tethers, which support the submerged buoyant base to the seabed. Due to the reduced size of the water surface hull, wave forces are much smaller than in the case of a conventional deepwater TLP. Reliability in deepwater is enhanced through the wave offset, set down and consequently the tendon slack effects are reduced to a greater extent. Stability is increased through the lower set of tendons being subjected to a larger tension than that of the upper tendons, hence the slacking effect of the lower tendons is eliminated. (Source: *Offshore*, March 1995)

The OSPREY venture in Scotland

The Ocean Swell Powered Renewable Energy (OSPREY) venture was meant to be the world's first operational sea-based wave energy machine. Launched in August this year, it worked on the principle of incoming swells compressing air which was then used to turn turbines. The main requirement was to have around 500 miles of open sea, which was available off the coast of Dounreay (Scotland). Unfortunately, the OSPREY succumbed to nature's forces. On installation it was found that two of the nine ballast tanks had been ruptured and repairs could not be organized in time before summer storms aggravated the damage so much that the OSPREY became inoperable. However, the designing company, Applied Research & Technology, plan to construct a new machine if the salvage and repair of the original machine is not viable. The OSPREY was an 850 ton steel structure containing four 0.5 Mw Wells turbo generators which was supposed to produce about 2 megawatts of power, roughly enough to power 2,000 homes. (Sources: *Engineering*, September 1995; *MariNet*, Summer 1995)

Synthetic materials for buoys?

A research project has been undertaken by an engineering team from the US Coast Guard's Research & Development Center (Connecticut) and the National Oceanic & Atmospheric Administration's National Data Buoy Center (Mississippi), to investigate the feasibility of using new materials and methods in the construction of navigation buoys. The main aim of the study was to identify and evaluate a new lighted buoy made from colour-impregnated synthetic materials for exposed, coastal marine locations. Previous studies showed that significant advantages in reduced maintenance and environmental impact were possible if larger buoys used more synthetic materials and a modular construction. The research team identified an ionomer-foam buoy design which incorporated a foam flotation element made from the same material used for golf-ball skins and an aluminium tower with an integral foil-lined foam panel providing both a maintenance free dayshape and a passive radar reflector. The new shape of the buoy had to take into consideration the recommendations of the International Association of Lighthouse Authorities—a top structure or tower with shape significance (conical for red, cylindrical for green).

As with many other vessels, successful buoy designs result from years of evolutionary changes to correct or compensate for various weaknesses. Whether this synthetic buoy is a cost-effective replacement for steel buoys with an equivalent capability will depend on the results of the prototype evaluation. (Source: *Sea Technology*, August 1995)

4D seismic acquisition by British Petroleum

The first use of 4D seismic technology in deepwater is due to start in the UK's Foinaven Field, west of the Shetland Islands which is developed by British Petroleum (BP). The company plan to utilize time-lapse 3D seismic acquisition, shot at intervals of about one year, to monitor fluid movement within the reservoir. Previously this technology has only been used in shallow water and should provide considerable savings in development costs by reducing the number of wells necessary to access the oil. BP and its partner Shell, have contracted the work to Geco-Prakla to carry out the geophysical acquisition and processing services. Six custom-designed, five kilometre hydrophone cables will be buried in the sea bed at a depth of 480 metres. Once the cables have been deployed, in straight lines, the first survey will take place. Such continuous seismic monitoring on such a scale is so far unprecedented.

For the first survey, a seismic shi will shoot over the area of the cable array for a week. Signals picked up by the buried seabed hydrophones will be transferred to a receiving vessel via a cable connector and stored in a computer for digital processing. 4D seismic will assist subsurface teams in pinpointing and assessing the volume of unswept oil with a high degree of accuracy throughout the productive life of the field. This processed and interpreted information will be matched against the reservoir model, production data and to previous surveys so as to identify any changes in the reservoir. Thus, it is hoped to ascertain fluid movement to assist reservoir management, knowledge which can then be extended to other exploration areas. BP say that conventional 3D seismic in Foinaven allows then to distinguish between oil-filled and water-bearing sands, but 4D is expected to be a method of monitoring fluid movement over time. In the past the accuracy of models has been questionable, since sample points can be far apart and the interpretation of data is difficult. 4D seismic offers the possibility of highly accurate data to improve reservoir management and thus avoid problems. By plotting fluid contacts during production, flow models can be confirmed or rejected in order to change recovery schedules. Further, mapping steamflood fronts during enhanced oil recovery can indicate zones that were by-passed and which might be future targets of remedial works. Well placement, stimulation

treatment and waste disposal can be facilitated by mapping hydraulic fractures to reveal local stress fields that govern permeability anisotropy. (Source: *Offshore*, July 1995)

New seismic vessel in action in the North Sea

3D seismic surveys have become a necessity before an oil company commits itself to a production campaign, or an exploration well. 3D seismic technology is unique in that it provides quantitative information on st. 'cture, reservoir continuity and fluid content away from the planned borehole. As a result of the strengthening of the position of 3D seismic, service companies are investing in new technology and designs. The recent appearance of a completely new vessel concept for marine surveying is considered as dramatic.

This vessel's design is characterized by its wide maximum beam of 40 metres in relation to its overall length of only 80 metres. As the maximum beam is at the transom, the vessel has an unusual delta shape. The vessel was launched in May this year and is called the "Ranform Explorer".

In marine seismic surveying a vessel tows an acoustic energy source and one or more streamer cables containing highly sensitive pressure sensors called hydrophones. Acoustic energy sources, based on the emission of high pressure air into the water, are fired at regular intervals while the vessel traverses the survey area. Acoustic waves emitted from the source travel through the water column into the subsurface, with a portion of the acoustic energy reflecting from geological boundary layers that the wave field encounters along its path. As technology has developed, there has been an increase in the number of streamer cable towed by the vessels, caused by demands for improved cost efficiency. Seismic fleet operators have invested heavily in increasing the streamer capacity, the first five-streamer vessel appeared in 1993, six streamer vessels in 1994, eight and even twelve streamer vessels have appeared in 1995. Each step has seen consequent reductions in acquisition costs for the vessel operator and the end-user. The Ramform Explorer has been designed to have a minimum capacity of twelve streamer cables, comprising a combined weight of cable and drums of about 240 metric tons, with no need for counter-ballasting. These streamer drums can be accommodated side-by-side on the Ramform, the instrument room has more than 400 square metres of floor space, around three times more than on traditional vessels. The Ramform, in addition, is extremely stable, according to data obtained from operations in the Norwegian North Sea. Tests have shown that accelerations of the ship in bad weather conditions are modest, implying that even in poor weather the trailing equipment can be left in the water with little risk of damage, meaning in turn that the equipment does not need to be continually retrieved and deployed during changeable weather. The Ramform possesses three propulsion units of equal output giving a thrust at towing speed of about 70 metric tons. The drive motors are electric with a current supplied by a large diesel generator in the bows of the vessel. Two of the thrusters are located at the stern, with the third at the bow. Ramform motion characteristics contribute to safe operation in terms of the effectiveness for the crew, reduced requirements for equipment handling in poor weather and extended helicopter operations for medical evacuations. The security of the vessel is improved by the possibility of building watertight chambers inside the hull. Calculations show that the vessel would survive flooding as a result of damage that opened a complete hull side to the sea, however, there are no plans for a full-scale field test of this capability. (Source: *Oil & Gas Journal*, August 1995)

Computer-integrated manufacturing for shipyards

Faced with pressure from foreign competition in shipbuilding, Japanese companies are placing more importance on the development of new technologies to streamline shipyard operations and to bring the benefits of computer automation to shipbuilding. Although computer-aided design and manufacturing have been an important part of shipbuilding for many years, developments in Japan are now moving towards computer-integrated manufacturing (CIM). The leading company in this move is Hitachi Zosen Corp., Osaka. Since the company started research in this field, it has developed a system which starts with an object-oriented database called PHI for each new ship. Data are linked with the company's HICADEC 3D computer-aided design system and with computer-aided production planning and management systems, the ship is followed at each step from design to launch. (Source: *Industry Week*, 18 September 1995)

Wave making at Haslar Hydrodynamic Test Centre

Haslar Hydrodynamic Test Centre has installed a new wave making machine enabling the Centre to carry out comprehensive sea-keeping testings. These will include the evaluation of slamming, the prediction of extreme motions and hull loading together with deck wetness and propeller emergence. Designed at Haslar, the methods are described as unique and are computer controlled to optimize the duration of testing and the accuracy of the wave spectrum in which the tests are carried out. A further feature is the ability to generate large sea states on large scales. Haslar state that the testing to be carried out using the wave maker is important for assessing human factors, for instance, passenger comfort in high speed craft as well as in naval applications. (Source: *BMT News*, September 1995)

Hull designs for ships

Ship makers have always been quick and ready to change the means of powering their vessels to increase speed and range. For millennia the monohull has prevailed by virtue of its simplicity, buoyancy and dynamic lift. Now, with the aim of greater speed and stability, developments are taking place remarkably quickly to develop new kinds of hulls. Clusters of technologies are making radical ideas, some of which may be old, appear practical and economical. Aiding factors in these developments include gas turbines, water jets, control systems for fins and stabilizers, not forgetting computers and electronic devices.

Oil and gas explorers are already reaping the benefits from these developments whilst working in deeper waters, cruise ships and ferries are improving passenger comfort. The prospect of faster hull designs is enticing cargo transporters with the thought of being able cut transoceanic shipping times. Many large vessels will probably maintain the monohull especially where neither speed nor stability is considered as being a main priority.

Many of the new designs are seeking to exploit the calmness of subsurface waters. One of the first designs to try and take advantage of this calmness beneath the surface was the Small Waterplane Area Twin Hull (SWATH). This

design was conceived around the beginning of the twentieth century and perfected by the US Navy. SWATH ships have two hulls, similar to catamarans, but each is deep underwater and can be described as being a submarine. It is claimed that this design is extremely stable with buoyant twin submarine hulls holding the power trains and propellers. Thin, strong struts run upward from the hulls and are linked in the air to form the ship's superstructure. (Source: *International Herald Tribune*, 17 August 1995)

Stress monitoring for ships using SHIP

Concern has been growing about the safety record of bulk carriers and has brought about the development of hull monitoring systems which provide the ship's crew and shore management with real-time information about the stresses and strains caused to the structure of the ship during loading and at sea. The European Union has funded a research programme, which is being led by British Maritime Technology, called the Ship Integrity Programme (SHIP). This programme is intended to integrate and extend current ship monitoring technologies and exploit new expert systems techniques to aid decision making.

SHIP aims to develop a system combining comprehensive physical sensor and radar-based monitoring with innovative, on-board data mining methods. The latter utilizes genetic algorithms and conceptual clustering techniques as an aid to pattern recognition in stress, fatigue, motion and sea state data clusters. Emphasis is placed on the automatic interrogation of significant deviations of loading computer predictions from actual stress levels during loading and discharge. Tests carried out so far, using ships from British Steel, which resulted in damage to internals within the fore part of the vessel have practically been eradicated due to the system of warning conditions where bow wave impacts and possible structural damage may occur. This has been particularly significant on the North Atlantic westward ballast passages in bad weather with the system prompting increased ballast or implementing speed and heading charges. It is anticipated that the prototype system will become fully operational at the end of November 1995. (Source: *BMT News*, September 1995)

D. OCEAN RESEARCH

Biomedical Marine Research

The oceans of the world continue to provide opportunities for the discovery of marine-derived medicines. Developments in the tools available for exploration of the deep sea has expanded the habitats that can be sampled and improved the opportunities for discovery. As the understanding of the biochemistry of various diseases improves, better methodologies for quickly assaying the biomedical potential of marine organisms can be developed.

Terrestrial plants and micro-organisms have always been an important source of natural products used in the development of new drugs. It has been estimated that by the end of the 1980s, approximately 75 per cent of the top 20 drugs used in hospitals and approximately 20 per cent of the top 100 most widely prescribed ethical drugs were derived from natural sources. The oceans have the potential to provide an equally important resource as they cover approximately 70 per cent of the earth's surface and are estimated to contain up to 200,000 invertebrate and algal species, and research has shown that marine plants, invertebrates and micro-organisms are an excellent source of natural products with exceptionally diverse chemical structures.

According to the Division of Biomedical Marine Research at the Harbor Branch Oceanographic Institution, Fort Pierce, Florida, over 5,000 natural products have been reported from marine organisms over the past 10 years. These compounds encompass a wide variety of chemical structures including acetogenins, terpenes, alkaloids, peptides, and many compounds of mixed biosynthesis. The therapeutic potential of the majority of these compounds needs to have further research, requiring a multidisciplinary team approach. This discovery process may require the input of scientists from a number of disciplines—marine biologists to collect, document, and identify the organisms; immunologists, tumour specialists, microbiologists, virologists, and biochemists to evaluate potential drug targets and to design appropriate models for evaluating extracts of the organisms collected. Natural product chemists would be required to purify and determine the structures of the active principles present in the marine organisms. (Source: *Sea Technology*, August 1994)

Deep sea mining — environmental impact

Deep sea mining creates disturbances on the benthic environment and is a matter of concern specifically relating to the impact a mining collector has on the sea floor environment. This impact would include destruction of benthic organisms, smothering of the benthos, and the dilution of food supply in the general vicinity caused by a redistribution of the disturbed sediments.

Research is being carried out through joint efforts of the National Oceanographic & Atmospheric Administration (NOAA, USA), the Committee of Geology and Yuzhmorgeologiya Association of the Russian Federation, and the Metal Mining Agency of Japan, to simulate deep sea mining disturbance to the benthic environment and to assess the impact. Scientific inputs are also expected from Korean, Chinese and other Eastern European groups. (Source: *Sea Technology*, August 1994)

Ocean circulation experiment

An oceanographic milestone will be passed in the 1990s along the road to understanding the mysteries of ocean circulation called the World Ocean Circulation Experiment (WOCE). This is a ten-year programme with scientists from over 40 nations studying the physical and chemical properties of the oceans. One key participant is the Scripps Institution of Oceanography with support from several agencies for ship time, data collection, instrument development, satellite remote sensing and computer analysis. The results achieved from WOCE will be compared with older data collected during previous large-scale oceanographic programmes (1950 and 1970). Understanding ocean circulation is important. Oceans absorb energy from the sun, mix it to varying depths, transport it in meandering currents and release it into the atmosphere at times and places far removed. This process influences temperatures, rainfall and weather patterns throughout the globe. Oceans also absorb much of the excess carbon dioxide and other greenhouse gases from the atmosphere: their capacity to hold and mix these chemicals into great depths is a major unknown climate factor.

The observations being carried out fall into four broad categories, cutting across disciplines and academic departments: hydrographic surveys, current measurements, voluntary ship observations and gas absorption. (Source: *Explorations*, Scripps Institution of Oceanography, 1995)

European marine technology research venture

A European marine technology research venture has been started called "BISCUIT" (benthic *in situ* sediment carousel European integrated technology). Chelsea Environmental Ltd. of East Molesey, UK, is leading the venture which is funded under Euromar.

BISCUIT is a 1 metre high by 2 metre diameter seabed-mounted chamber for integrated measurements of sedimentological, chemical and biological processes. It has an annular flume open at the base which allows an area of undisturbed sediment to be sealed from the surrounding water when deployed by a survey vessel. A rotating top plate applies controlled and known shear stresses to the internal water column so that natural bed shear stresses are applied to the sediment.

The measurement of environmental conditions in the littoral zone, at both the lower boundary layer and within the water column itself, is necessary for understanding the effects of the physical processes involved in the region and for the validation of various prediction models. In addition, this information is considered essential when taking into account bed sediment stability for proposed marine or coastal engineering works. (Source: *Sea Technology*, May 1995)

Storm study being carried out in Europe—NEPTUNE

A major European research project called NEPTUNE is being carried out to develop an approach to the calculation of the integrated effects of wave and tidal conditions during extreme storms on shoreline and structures along the north-west European coastline. It is a two-and-a-half year project, partially funded by the

European Union through its Marine Science and Technology (MAST) Research Programme. It involves seven prominent European scientific organizations. The project was developed due to the importance placed on integrating the link between extremes of wave, surge and tide at the coast and the causative storms involved. It is hoped that the project will be able to provide a method for determining more confident estimates of extreme sea levels of assistance in coastal engineering design. (Source: *BMT News*, November 1994)

Study to examine glowing fish

The Scripps Institution of Oceanography, University of California, are researching the role played by a glowing bacteria grown by marine animals which emit light to lure prey, fool predators, or to see better. The study also involves theories on the evolutionary process which transformed the fishes' luminescent bacteria from free-living organisms to ones that are dependent on their host for survival. The study is concentrating on flashlight fish and anglerfish, both of which produce light from bacteria housed in elaborate light organs. Research so far has shown that the bacteria was a member of two previously unknown groups. Practical applications are expected from the results of this study—luminescent bacteria are currently used as a marker to detect toxic contaminants in waste water, and they may also be useful for medical purposes. (Source: *Sea Technology*, August 1994)

Deep water mooring in Bermuda

The oceanographic community now has a deep water testbed mooring facility for developing, testing, calibrating and intercomparing instrument systems located 80 kilometres south-east of Bermuda at a water depth of 4,500 metres. The site, which is near the Joint Global Ocean Flux Study's (JGOFS) Bermuda time series (BATS) station, has many advantages. a historical database is available from the 40-year Hydrostation S programme and the more recent Bermuda Atlantic time series activity; a nearby sediment trap mooring has been deployed for 18 years. Atmospheric sampling programmes provide a 14-year record of trace gas concentrations, atmospheric deposition and a suite of atmospheric optical measurements.

The mooring is a surface mooring with a large surface buoy with a tower and instrument well, which supports the mooring's wire rope. Meteorological sensors can be placed on the tower and oceanographic instruments can be placed on the buoy or on the wire rope section of the mooring. More information can be found on the Internet BBSR Web Site(http://www.bbsr/edu/).(Source:*SeaTechnology*, July 1995)

E-Mail to aid recovery of lost instruments

The Center for Coastal & Marine Geoscience, US Geological Survey, Woods Hole, Massachusetts, is sponsoring an e-mail list-server on Internet to aid the oceanographic research community in the recovery of instruments lost at sea. For those with no access to Internet, it is also available through the telephone system. The network, called the Lost Instrumentation Network, was established under the premise that private companies, research institutions and other agencies involved with oceanographic research, would subscribe to the network via e-mail. When an instrument is found whose owner cannot be easily identified, a message is passed to the list-server and distributed to the various subscribers in the hope that one of them can identify the owner of the equipment. There are three ways to participate in the network: subscribe to the mailing list; search the lost instrumentation list to identify the owner of something found; and finally to know the service exists and report instrumentation found to it. More information is available from the project chief, William Stahle via Internet (listpro@nobska.er.usgs.gov.) The only line in the text should be: info lost instruments. (Source: *Sea Technology*, July 1995)

Millions of undiscovered species in the oceans?

Dr. Edward Wilson, of Harvard University, has presented an hypothesis that most life within our oceans is undiscovered. Whilst the number of known species of living things is roughly between 1.5 and 1.7 million, biologists believe that the true number may lie somewhere between 10 and 100 million. He noted that 11 of the 85 known whale and porpoise species were only identified this century, including a beaked whale which was discovered in 1991 in the eastern Pacific Ocean. In one gram of marine sediment, thousands of species of bacteria can be found, most of which are unknown to science. (Source: *Sea Technology*, May 1995)

Fish-killing algae

Pfiesteria piscimorte, also called "killer algae", has been linked to numerous fish deaths and is one of a growing number of algae known to be toxic to fish and other organisms. This killer alga lives on the bottom of estuaries as microscopic cysts or dormant cell-forms until fish swimming by release an unknown chemical substance which triggers the algae to break their dormancy and become active cells. Once active, they produce a nerve toxin that rapidly kills fish, allowing the algae to feed off the dead fish tissue. While some algae make their presence known through red tides—blooms of cells which discolour the water—more often minute concentrations of cells are only noticed by the harm caused by other highly potent toxins. After having killed perhaps thousands of fish, the algae seem to disappear within a few hours, having formed new cysts and sunk back into the sediment. A few dozen of the thousands of species of microscopic algae at the base of the marine food chain produce toxins which endanger the entire food chain. Research being carried out at the North Carolina State University in Raleigh and funded by the National Science Foundation's biological oceanography programme could show that the increasing number of these algae could be a result of increased ocean pollution. (Source: *Sea Technology*, January 1995)

"El Nino" in the Indian Ocean

Research being carried out at the Scripps Institution of Oceanography, University of California has shown that the Indian Ocean has an "El Nino", like that in the Pacific Ocean, which causes cyclic shifts in upper ocean temperature, affecting the world's weather. This research is linking the two oceans in a related pattern whose effects on the world's climate could be more far-reaching than previously thought. The discovery of a more global aspect to the El Nino could advance scientists' understanding, thus improving their ability to forecast El Nino-spawned droughts, floods and storms around the world. (Source: *Sea Technology* January 1995)

Alaska marine institute founded

Using funding received as a result of the Exxon Valdez oil spill settlement, construction of a cold water marine institute has begun. The Alaska Sea-Life Center will conduct research and monitor ongoing progress in restoring affected ecosystems in the Prince William Sound and the Gulf of Alaska. Genetic studies are already being carried out and focus on the conservation and restoration of the native populations of salmon following the 1989 tanker accident. Scientists have already discovered that the genetic structure of the pink salmon in the Prince William Sound is more diverse than previously realized. Evidence has been gathered as to genetic damage directly resulting from the accident. A further research project uses nuclear and mitochondrial markers to identify and conserve anadromous populations of sockeye salmon in mixed-population fisheries. (Source: *Sea Technology*, August 1995)

Kilauea volcano sliding into ocean

Scientists at the Hawaiian Volcano Observatory, the US Geological Survey and Stanford University are monitoring the motion of the Kilauea volcano (Hawaii) using the global positioning system. They have noted that the volcano is moving away from the rest of Hawaii at a rate of 10 centimetres a year. Concern is increasing that the southern section of the volcano will crumble into the water and result in an earthquake followed by a tidal wave causing destruction in parts of the Hawaiian islands and possibly the Pacific rim. Concern is based on events in 1975 when a tremor caused a tidal wave killing campers and further damage to boats and piers. (Source: *Science News*, 1995; *Sea Technology*, August 1995)

E. ENVIRONMENT/POLLUTION

Marine salvage

During 1994, marine salvage companies responded to more than 120 shipping casualties around the world, recovering almost 1.25 million tons of oil and hazardous chemical pollutants. These figures were reported by the International Salvage Union, London, UK. The findings have shown that salvage is a most effective means of pollution prevention as the pollutant is kept in the ship. Even though Governments should continue to invest in spill clean-up resources, salvage intervention is a cost-effective way of protecting the marine environment and vulnerable coastlines by preventing the release of oil and chemicals in accident situations. (Source: *Sea Technology*, May 1995)

An IOC priority—harmful algae

Occurrences of marine micro-plankton appear to be increasingly causing damage to human health, fisheries, aquaculture, marine ecosystems and tourism due to their production of potent toxins, or simply due to a massive accumulation of cells, often known as blooms. The annual losses to fisheries, mariculture and tourism are substantial and often critical to sustainable development. The improved monitoring and management of harmful algae is an important component of coastal zone management. The IOC has defined these blooms a priority within the framework of its Harmful Algal Bloom (HAB) activities, which in turn is part of a broader IOC-FAO Programme on Ocean Sciences in Relation to Living Resources. The IOC has noted that about 60 to 80 Member States have problems with harmful algae, but not all have the required expertise to deal effectively with the related scientific, social and economic problems. Member States are assisting developing countries in training and capacity building to combat these harmful algae. (Source: *IMS Newsletter*, No. 73/74, 1st Semester 1995)

Wetlands able to remove pollutants

A study recently carried out at the South Carolina Sea Grant Consortium has shown that saltwater wetlands act as sponges for some pollutants, reducing damaging algal blooms in coastal waters, and thus protecting them. If these wetlands are protected, communities will be able to protect their coastal waters from algal blooms. These blooms, which starve oxygen from the water and kill fish, are mainly caused by the over-abundance of nutrients in estuaries. Wetlands can absorb many of these nutrients, in particular they seem to absorb forms of nitrogen, which is thought to be the most problematic nutrient in creating algal blooms. Whilst absorbing nitrogen, they export organic carbon, but not in a consistent manner. (Source: *Sea Technology*, January 1995)

Waterway marine organism treatment by bio-technology

Environmental Projects Co. Ltd., Tokyo, Japan, has developed a system which applies biotechnology to remove shellfish and algae adhering to the waterways of power stations situated in coastal regions.

At present, power stations dispose of these shellfish and algae by burying them inside their compounds or subcontracting the work to industrial waste treatment companies. The new system utilizes the anaerobic nature of microbes and reduces the cost of treatment to less than 50 per cent when compared with the traditional method.

Using this new system, the shellfish and algae are removed from the waterways, fed into an anaerobic bioreactor which is hermetically sealed. The bioreactor contains microbes, which are cultured beforehand and capable of opening the shellfish within two days. These microbes completely dissociate the shells and soft tissues within five days whereafter the soft tissues decompose. The inside parts, which usually generate offensive odours, are liquefied within one month by microbe action and converted into methane or carbon dioxide gas in two to three months. The methane gas is utilized to maintain the bioreactor at a fixed temperature of 35° C. The water used is recycled and used for shell washing, the shells being utilized further as a source of calcium.

Further information can be obtained from: Environmental Products Co., Ltd., 2-9-1, Omorihoncho, Ota-ku, Tokyo 143, Japan. (Source: JETRO, August 1995)

Marine biodiversity

A report from the US National Research Council illustrates how human activities have led to dramatic and possibly irreversible changes in ocean biodiversity. These changes have caused reductions in popular edible fish and shellfish species together with a reduction or loss of species with potential for biomedical products. Development activities such as dredging and filling have altered many coastal habitats, including coral reefs, bays, marshes, rocky shores and beaches.

The ability of scientists to evaluate the scale and consequences of these changes is hampered by the inadequate knowledge of the basic processes that control the diversity of life in the sea. The report argues that scientists should pursue interdisciplinary research in examining multiple sites within a larger regional system to measure and study marine biodiversity. Following recent advances within ecological, molecular and oceanographic sciences, together with a new commitment among researchers to link these disciplines, this strategy may well be feasible. (Source: *NewsReport*, USA, Summer 1995)

Biodiversity initiative for the White Sea

Within the framework of UNESCO's Coastal Marine (COMAR) Programme, a field workshop has been carried out to study the biodiversity and adaptation strategies of Arctic coastal marine benthos in the White Sea. The COMAR Programme has, since its inception, led to the establishment of a project including annual research cruises and coordinated on-land studies of collected samples. The recent activities in the White Sea were aimed at understanding the influence of extreme environmental conditions, both natural and anthropogenic, on Arctic benthos, as well as assessing the present biodiversity of the area's coastal ecosystems and the changes caused by such disturbances. (Source: *IMS Newsletter*, no 73/74, 1st Semester, 1995)

Solid-state marine nitrate sensor

Valeport Ltd. (Darmouth, UK) has launched the first fast-response, solid-state marine nitrate sensor to be used in

a wide range of marine environmental monitoring and fisheries research programmes. The sensor, which was developed at the Institute of Oceanographic Sciences Deacon Laboratory, UK, and manufactured by Valeport Ltd., is suitable for mounting on fixed moorings, on vertically profiling systems or on undulating towed bodies.

Until now, the nitrate content of estuaries and the open sea was measured by either taking samples to a laboratory, or in the field with instruments requiring renewable wet chemicals and up to four minutes to take a measurement. The new sensor provides real-time measurements at 1-Hertz rate and requires no chemical consumables. (Source: *Sea Technology*, August 1995)

Study on carbon dioxide level in sea water

Even though scientists are now fairly convinced that an increase in the level of atmospheric carbon dioxide will affect the world's climate, the amount of carbon dioxide in the surface layers of sea water remains unknown. Chelsea Instruments Ltd., of East Molesey, UK, is undertaking a study to develop an instrument buoy to measure these carbon dioxide levels. It is expected that this buoy will be able to provide data on the atmosphere-ocean carbon dioxide exchange which is crucial to understanding global environmental changes –the greenhouse effect. (Source: *Sea Technology*, August 1995)

Offshore pollution modelling

The Offshore Pollution Liability Association (OPOL), UK together with the Department of Trade and Industry (UK), has retained BMT to assess whether current liability levels for a pollution incident from offshore facilities around the UK are adequate. OPOL is a voluntary oil pollution compensation scheme to which all UK offshore operators are parties and satisfies the UK Government requirements for the availability of funds should a pollution incident occur. The Association reviews the liability levels from time to time. At present the BMT Oil Spill Information System (OSIS) is being used to model a wide range of possible pollution scenarios. OSIS allows a more detailed study than past studies particularly in respect of the impact of tides, currents and wind at certain locations, including shallow waters close to the coast. The system is also being used to look at scenarios with floating production systems which are now becoming a more common feature of offshore production. OSIS is already widely used by offshore operators and port authorities throughout the world for incident planning and for coordinating oil spill information during actual incidents. (Source: *BMT News*, September 1995)

The IMO and the prevention of marine pollution

During the last few decades, pollution of the world's oceans has become a matter of increasing international concern. The majority of this pollution comes from land-based sources, including industrial by-products, run-off from agricultural pesticides and herbicides and effluents discharged from urban areas. However, a significant amount is caused by shipping and maritime activities, the most important pollutant resulting from shipping operations being oil. Here, the most well-known cause of oil pollution arises from tanker accidents. Even though this may only contribute a comparatively small percentage of the total oil entering the sea in a year, the consequences of an accident can be disastrous to the immediate area. Many of the chemicals carried by sea are however far more dangerous to the marine environment. They are only a fraction of the amount of oil transported each year and the majority are carried in bulk form in tankers especially designed for the purpose. The cargo must be given maximum protection, but the ship may carry many different substances at one time, each with particular properties and requiring different handling. Other chemicals are carried in a packaged form, such as drums or portable tanks. The environmental threat here can be so great that, for instance, the IMO has recommended that the carriage in bulk form of poly-chlorinated biphenyls (PCBs), by ship, should be banned.

Garbage and sewage from ships have traditionally been dumped into the sea and in the past were not considered excessive. Today, however, with the growing everyday use of substances such as plastic, the situation is changing: once thrown into the sea, they remain there, being non-biodegradable. In many countries, industrial and municipal waste generated on shore are dumped at sea. Most of these materials can be assimilated by the marine environment without any harmful effects, but other materials such as radioactive waste are very controversial.

Marine pollution is an international problem. The IMO tackles these, and other problems, through international conventions. These conventions can cover the following subjects: prevention of operational pollution; accident reduction; reducing the consequences of accidents; provision of compensation and help in implementing these conventions. (Source: *IMO Focus*, March 1995)

F. COUNTRY NEWS

Asia

Offshore drilling in Cambodia

Exploration activities offshore in Cambodia are beginning to take off again following the drilling of four exploration wells, three of which are supposed to have tested oil, gas or condensate, thus confirming industry's view of the Khmer Trough acreage first offered in 1991. Whilst it is still early days, initial signs from the exploration have been fairly positive and should lead to an increase in activity. Further licensing is expected soon. (Source: *Offshore*, November 1994)

China increases field developments

Industrialization is rapidly taking place in China which has led to the country becoming an oil importer. Aiming at regaining self-sufficiency, the China National Offshore Oil Corporation (CNOCC)is encouraging foreign investment in developing offshore oil fields through joint ventures. Approximately US$4 billion has been invested so far. Twelve major fields are in production now, several large fields are due to go into production in the next few years. (Source: *Offshore*, February 1995)

Offshore seismic market — China's interest

The China Offshore Geophysical Company (COGC) has recently upgraded and refitted its fleet of bluewater and shallow water vessels with the intention of providing surveys of China's waters, and also to become active in the seismic acquisition projects in South-East Asia, the Pacific Far East and offshore India. With the tremendous growth in exploration in South-East Asia, seismic vessels are much sought after in the area. The CIGC has a fleet of five bluewater and three shallow water vessels. Each have recently been fitted out with the SeisNet integrated navigation system from Polaris International (UK) to calculate vessel positions and to display navigational data and real-time 3D binning. (Source: *Offshore*, March 1995)

China's ocean protection project

China has announced plans to increase its efforts to protect its coastal marine environment from overfishing and industrial pollution. The country is trying to balance the often opposing forces of increasing economic development and protecting the marine ecosystem. Due to China's large population and the significance of the fishing industry, the problem is acute. China is the world's largest producer of fish and is faced with growing demand for the product. Water pollution control needs to be enhanced: each year some 9 billion tons of agricultural and industrial wastewater is dumped into the ocean. (Source: *MariNet*, 1995)

International container shipping increases in China

According to China's Ministry of Communications, China's international container shipping has increased by 24 per cent over the past year. This increase has been attributed to regional economic development (more than 50 ports were involved), China's taxation and foreign trade reform. Shanghai is presently upgrading old wharves to add five new container berths by the end of the year. It is expected that Shanghai will be among the world's top 20 ports by next year. Around 30 more berths will be established in eastern and southern China, in the Tianjin, Fujian and Zhejiang provinces, during the country's next five-year plan. (Source: *American Metal Market*, September 1995)

Aquaculture prospects in India

Aquaculture has emerged as an important export sector for India and the nation is gaining benefits through increasing its share of the world market in shrimp production. Biotechnology is being applied to increase output and to control the environmental pollution caused. In particular, biotechnology is being applied to improve the quality of fish feed and genetic engineering is being applied to improve the protein value of fishes, to diagnose fish disease, for the reproduction of recalcitrant species, for hybridoma technology for the production of vaccines which could be expected to significantly enhance the productivity of aquaculture. Biotechnology is also widely used for the treatment of effluents and other pollutants generated by aquaculture.

The Indian Department of Biotechnology has funded various programmes on the above fields together with research on transgenic fish. Of particular note is a four-year project for environmental monitoring of semi-intensive aquaculture farms in various parts of India. The project expects to study the possible biotechnological methods of dealing with the adverse environmental implications of aquaculture. The development of aquaculture does have other problems, for instance it can severely affect agricultural communities. Paddy fields which are being converted into hatcheries result in not only decreasing production of food, but also in a growing number of displaced farm workers. Using saline water has far-reaching implications—the converted land cannot be easily re-used for agriculture should the need arise. The large-scale use of chemicals, discharge of toxic effluents and the deterioration of the quality of groundwater have adverse effects on the environment and rural communities. Fishermen fear that the effluents which are released may damage fishing in the estuaries upon which their livelihoods depend.

A legal framework to cope with the various side effects of the increase in aquaculture is under process. (Source: *Biotechnology and Development Monitor*, December 1994)

Tidal energy in Indonesia

A feasibility study has recently been completed by the Gaja Mada University in Indonesia on the construction of a tidal power plant. This plant is planned to be constructed on the coast of Java. (Source: *Solar Energy Intelligence Report*, April 1995)

Minerals from the ocean in the South Pacific

Imperial College, London, UK, is conducting research on the exploration of seabed minerals extending beyond the present 200 mile limit. Where an exclusive economic zone has been declared, a country has sole rights over an area of sea up to 322 kilometres from their coast. When the United Nations Convention on the Law of the Sea came into force,

it was expected that there would be major developments in mineral exploration beyond these exclusive economic zones. The research team is concentrating on evaluating the resource potential of manganese nodules in the exclusive economic zones of some Commonwealth South Pacific island nations. The team is also estimating the likely occurrence of valuable polymetallic sulphide deposits around some of these islands. There are suggestions that the seas near land-based gold deposits should be explored as gold-rich sulphide deposits have already been discovered in the region. (Source: *TECH MONITOR*, April 1995)

New port development in Thailand

British Maritime Technology Ltd. (BMT) has been awarded a contract to design the new Royal Thai Navy's Dockyard at Sattahip. The new base will be located in the commercial port area and should ease congestion problems in this increasingly important port where presently offshore and commercial traffic vie for space. Another important development could flow from the presence of the base. It is likely that much of the offshore plant will be constructed in Thailand so a fabrication yard will be needed. A possibility exists for marine training facilities to develop the domestic maritime infrastructure. Thailand offers considerable port development potential, both for the general modernization of cargo handling facilities and with the dramatic offshore exploitation now beginning to take place in the Gulf of Thailand. This is increasing rapidly as the potential for both oil and gas development is proved by drilling--up to 30 production jackets may well have to be built and placed in the Gulf waters. Design studies exist related to a proposed purpose-built offshore logistics base at the port of Songkhla. (Source: *BMT News*, February 1995)

Vietnamese developments in Vung Tau

The southern coastal towns of Viet Nam are rapidly developing into Viet Nam's main offshore construction and supply complex, in particular Vung Tau. Original plans showed Vung Tau as the key port for oil operation. In addition, plans now envisage it as a gas terminal and distribution centre. Various major international companies are already in competition for the best facilities. If interest continues at the present rate, other towns close by will inevitably be drawn into the development plans, such as Ben Dinh and Ba Ria. (Source: *Offshore*, February 1995)

Vietnamese gas production - Bach Ho

Until recently Viet Nam was flaring away most of its offshore gas. Following developments in the main producing oilfield, Bach Ho, this looks set to change with efforts from a international consortium comprising British Gas, Mitsui and PetroVietnam. The aim of this project is to extract Liquid Nitrogen Gas from Bach Ho's associated gas for power generation. It is planned that gas export would start next year, mainly to countries in South-East Asia. To further facilitate the finds, a State organization for planning gas infrastructure would be needed. (Source: *Offshore*, February 1995)

Private port in Viet Nam

An agreement has been signed between the Baria Serece Joint Venture Company (BSJVC) and foreign investors, including the International Finance Corporation and the Norwegian Agency for Development, to build a deep water port on the Thi Vai River, 70 kilometres from Ho Chi Minh City. The port will have bulk handling facilities and it is planned that it will contribute significantly to the expansion of economic activity in the area. It is hoped that the port will boost the distribution efficiency of goods such as fertilizers and agricultural products and act as an alternative to the congested Saigon Port. The total cost of the project is around US$10 million. (Source: *IFBN*, June 1995)

European loans to bolster Asian gas infrastructure

The European Investment Bank has made a number of loans to help provide gas network links in Asia. The project falls within the scope of a European Union-Association of Southeast Asian Nations cooperation agreement, particularly in energy development and environmental improvement. US$21 million have been earmarked for a 100 kilometre extension of the Erawan gas pipeline from Bang Pakong to Wang Noi, north of Bangkok. This project aims to replace oil and coal with natural gas to supply fuel to new power plants and the Bangkok gas network for industrial and household customers. Further energy cooperation agreements have been signed with India, Pakistan and the Philippines. In Indonesia it is planned to construct a gas pipeline from South Sumatra to Central Sumatra and Batam Island. This should help develop gas supplies for power production in the oil fields of Central Sumatra and support industry on Batam Island. (Source: *Oil and Gas Journal*, August 1995)

Latin America

Partnership to install electrical subsea pump in Brazil

A partnership comprising Tronic Electronic Services (Ulverston, UK), Petrobras, Reda, Pirelli, Cooper and Sade-Vigesa, has been established to install probably the world's first electrical subsea pump. This pump is expected to prove how economies of oil fields and field extensions can be improved.

The subsea well chosen for this installation is situated within the north-east Pole region of the Campos basin, 500 metres from the Carapeba I platform at a water depth of 90 metres. Tronic will supply the complete subsea wellhead electrical connector comprising of the following: wet mateable receptacle connector (tubing hanger-mounted); wet mateable plug connector (wellhead-mounted); power penetrator and diver mateable power connector. The receptacle connector is designed to be installed into the tubing hanger and directly terminated to the ESP motor cable without a need for a separate splice in the well annulus. The design features a field-installable and testable termination which is gel-filled and pressure-balanced. (Source: *Sea Technology*, October 1994)

Petrobras (Brazil) identifies research targets

Petrobras has outlined development needs in its "Procap 2000" programme which aims at maximizing the technological capability of the company in deepwater oil exploitation. The two main goals of the programme are: (1) to focus efforts on technologically innovative projects, as well as in advanced development projects. The ultimate aim is to reduce investment and operational costs and to enhance final recovery of oil and gas as well as extending the useful life of wells situated in waters over 300 metres

in depth; (2) the development of offshore drilling and production technologies, enabling the company to produce oil and gas from fields situated in deepwater (1,000-2,000 metres). The programme plans to optimize reliance on know-how and sources available locally and abroad, and to reduce the costs of the development of deepwater technology. Participation of Brazilian technological and industrial communities is stressed as being important so as to concentrate efforts towards desirable achievements. Through joint industry projects, cooperation with international companies is being sought through agreements, service contracts and consultancies. Efforts to improve technological know-how are being concentrated on the main objectives of the programme. Funding is being mainly provided by the Brazilian Government with the possibility of external funding. (Source: *Offshore*, September 1994)

Africa

Potential for abyssal hydrocarbons off West Africa?

Extensive hydrocarbon deposits have been found in 4,000 metre deep abyssal plains off the north-western coast of Africa south of the Cape Verde Islands in the Gambia Basin. These finds were discovered through seismic evaluations carried out by University College, London, UK. In addition, drillers also found accumulations that were rich in phosphorus and ferro-manganese oxides in depths of around 800 metres. (Source: *Offshore*, March 1995)

Arabian Peninsula

Revitalization of Safaniya in Saudi Arabia

The revitalization of probably the world's largest oil field has been completed in the Northern Area Producing Region of the Saudi Arabian sector of the Arabian Persian Gulf. The revitalization programme was divided into three phases -Marjan, Zuluf and Safaniya so as to have an ordered expansion programme. It was realized that this revitalization was necessary so as to meet future export requirements and achieve a totally diversified petroleum industry. The programme has been accomplished with three major thrusts: a countrywide exploration programme; prospecting in non-traditional locations and offshore; and expansion and recompletion of shut-in and marginal wells. New finds have been discovered, including 12 off Saudi Arabia's west coast in the Gulf of Aqaba region of the Red Sea. In the Northern Area Producing Region, 19 oil fields are in operation with drilling continuing. Safaniya is the world's largest oil field, being some 48 kilometres long and 15 kilometres wide and most probably an extension of the largest onshore oilfield, Ghawar. Five of the six well platforms have been upgraded for safety and pollution control, whilst ten other tie-in platforms have been replaced so as to add additional slots and improve testing capabilities. Associated onshore gas compression and wet-crude handling facilities have been improved. Saudi Aramco has further plans for the region, including a large-scale offshore gas lift project. (Source: *Offshore*, July 1995)

Bukha Field goes onstream in Oman

The International Petroleum Corporation (IPC) Vancouver, Canada, and its partners, have brought Oman's Bukha Field onstream. The field was discovered in 1986 but actual development only began recently for varying reasons. With the field going into production, gas projects are now being developed to expand production and export deliveries, of notable interest being the proposed Oman-India gasline, which is planned for completion by 1997. (Source *Offshore*, July 1995)

Undersea pipeline for Qatar and Pakistan

Qatar and Pakistan have agreed to support an undersea pipeline to transport natural gas between the two countries. The 1,000 mile pipeline will transport the natural gas from Qatar's North Field to Pakistan. Qatar has the third largest gas reserve in the world. (Source: *MarNet*, 1995)

Russian nuclear submarine wreck to be shielded

A Russian research ship left St. Petersburg with the task of building a shield around a nuclear submarine which sank off northern Norway to prevent radiation leaking. The submarine is embedded in mud in international waters at a depth of 1,685 metres. The vessel was armed with 20 conventional and two nuclear-tipped torpedoes when it sank and is estimated to contain about 10 to 12 kilograms of plutonium. Russian and Norwegian environmental experts have expressed their concern that radioactive material from the submarine could pollute the seabed. (Source: *ITAR-Tass News Agency*, 1995)

Caspian sea developments

A plan has been agreed upon for a proposed pipeline to export Caspian region crude oil through the Black Sea which could begin construction in January 1996.

Phase I of these developments would be the construction of 250 kilometres of pipelines between Kropotkin and a Black Sea port which should be built north of the Russian port of Novorossiisk. These facilities could also receive crude shipments from other regions in the Russian Federation. It was agreed to build the facilities in this area after studies showed that it would reduce the environmental effects and lessen port congestion. The planners also concluded that the new port would have far more oil handling capacities than would be possible at Novorossiisk. Facilities should include onshore storage and a single point mooring system for tanker loading.

Phase II construction would include a new crude pipeline to Kropotkin from Komsomolskaya. Oil from Kazakhstan's Tengiz field would flow around the Caspian Sea through an existing pipeline.

Members of the Azerbaijan International Operating Company (AIOC) believe that a Chirag-1 platform in the Caspian Sea can be used in the development of finds in the Caspian Sea. This Chirag-1 platform includes a jacket that is reusable and an incomplete set of outdated processing modules and has never been operated. It is planned that the modules should be brought back to shore to be rebuilt as an initial separation unit. With the addition of drilling equipment, the structure could serve as an early production platform. Liquids could be sent to shore through existing shallow water Guneshli platforms.

Negotiations are under way for exploration and production rights for a prospect off Azerbaijan. It is estimated that more than 2 billion bbl(?) of oil are available, but no drilling has taken place as yet. (Source: *Oil & Gas Journal*, September 1995)

G. INTERNATIONAL FOCUS

UN declares 1998 as ocean year

The United Nations General Assembly has declared 1998 the International Year of the Ocean in response to an initiative of the International Oceanographic Commission. The objective of the Year is to stimulate public action and to provide a general framework for initiatives at all levels for world-wide public information efforts that emphasize the growing importance of oceans and coastal zones in national and international affairs. It is also expected to improve general public awareness and influence decision makers as to the need for a sustainable development of marine resources and environment based on scientific knowledge and social goals. (Source: *IMS Newsletter*, No. 73 74, 1st Semester, 1995)

The UN Convention on the Law of the Sea (UNCLOS)

The United Nations Convention on the Law of the Sea is the product of arduous negotiations and general compromise. It may now be considered as a model of the comprehensive and integrated approach required by the new global challenges confronting humanity. A distinctive feature of the Convention is its comprehensive scope providing general and specific rules determining the legal status of all ocean areas, internal waters, territorial sea, navigation, exclusive economic zones (EEZs), the continental shelf, the high sea and the international seabed beyond the national jurisdiction of coastal States. It contains rules, standards and appropriate institutions inherent for all maritime activities, such as navigation, exploitation of marine living and non-living resources, the protection and preservation of the marine environment, the conduct of marine scientific research and the development and transfer of marine technology. Importantly, it also provides an elaborate system of procedural rules and institutions for the peaceful settlement of disputes concerning its interpretation or application. This system includes the International Tribunal for the Law of the Sea; adjudication by the International Court of Justice; submission to binding international arbitration and submission to special arbitration tribunals with expertise in specific types of disputes.

The Convention has emerged as a legal mechanism for maintaining a balance among national economies, security and other interests of States in the multiple uses of the seas and the exploration of marine resources. As the UN Secretary-General, Mr. Boutros Boutros-Ghali, states, "it is possibly the most significant legal instrument of the century".

Sovereign rights in exploration and exploitation need to be reconciled with the freedom of innocent passage, navigation, overflight and the laying of submarine cables and pipelines. The Convention states that coastal States "shall, in normal circumstances, grant consent for marine scientific research projects by other States, or competent international organizations, in order to increase scientific knowledge of the marine environment for the benefit of all mankind. To this end, coastal States shall establish rules and procedures ensuring that such consent will not be delayed or denied unreasonably."

The Convention has set down, for the first time in a multilateral treaty, the legal principle of the obligation of States to protect and preserve the marine environment, including, among others, the elaboration and enforcement of national laws against marine pollution.

It is hoped that the entry into force of the Convention will mark a new era in international cooperation for the peaceful and sustainable usage of the oceans especially bearing in mind the future generations of the world. (Source: *IMS Newsletter*, No. 73 74, 1st Semester, 1995)

General Assembly takes follow-up action on UNCLOS

The UN General Assembly has taken a number of actions related to the Law of the Sea (General Assembly resolution 49 28) which have focused on the responsibilities of the Secretary-General in connection with the entry into force of the Convention, as well as impact assessment and other follow-up action. In particular, the preparation of an annual comprehensive report on developments relating to the Convention is included, which should take into account relevant scientific and technological developments, as well as recommendations for related action by States and competent international organizations. Other measures deal with the collection, compilation and dissemination of relevant information, notably the development of a centralized system with integrated databases for providing coordinated information and advice. The Secretariat for the Convention, the Division for Ocean Affairs and the Law of the Sea (part of the UN's Office of Legal Affairs), is charged with carrying out activities in response to the directives of the General Assembly relating to the Convention. Preparations are under way to establish the Commission on the Limits of the Continental Shelf as one of the three new institutions created by the Convention, the others being the International Seabed Authority and the International Tribunal for the Law of the Sea. (Source: *IMS Newsletter*, No. 73 74, 1st Semester 1995)

The UN Convention on the Law of the Sea—Petroleum rights

Several sections of the Convention are of particular significance to the offshore petroleum industry. These are that (a) coastal States hold the exclusive right to authorize and regulate drilling within their exclusive economic zones (EEZs), but cannot prevent seismic acquisition outside their national aquatory; (b) coastal States are obliged to adopt measures to prevent and limit pollution of the seas within their EEZs, including enforcement of their national standards and anti-pollution measures; (c) such States may not base their territorial boundaries on artificial islands, offshore platforms, or other man-made structures; (d) only above-water land can be considered as a point from which EEZs can be drawn – atolls beneath the sea at low tide cannot be base points; (e) coastal States must provide notice of the construction or removal of offshore installations and make provision for permanent warnings of their presence; (f) abandoned or disused offshore platforms must be removed following international standards; (g) these States may not impede the laying of pipelines, but such pipelines going through their aquatories must be approved

by them; finally (h) after 1995, if coastal states allow drilling beyond 200 miles, they will be required to pay into a common treasury maintained by the International Seabed Authority, either by value or volume of production after the first five years, which increases to a maximum of 7 per cent by the twelfth year. Such funds will be distributed evenly to the participating States. (Source: *Offshore*, October 1994)

International Maritime Organization

After the recent increase in the number of accidents at sea, in particular the 1994 sinking in the Baltic of the ferry *Estonia* with the loss of 910 lives, pressure is increasing to give the International Maritime Organization (IMO) more powers. The 152 Member Countries of the IMO jointly draw up conventions, safety codes and agreements, although not many have been legally binding. This pressure could mark a shift away from the IMO's previous mainly consulting role. (Source: UN and *MariNet*, Summer 1995)

IMO aids African environment project

Through a Regional Integrated Technical Cooperation Programme, the IMO and the Port Management Association of Eastern and Southern Africa will assist the coastal States of eastern and southern Africa which is aimed at safer shipping and cleaner oceans. The following activities will be emphasized: (a) a regional seminar on the ratification of international conventions dealing with marine environment protection; (b) a training programme for inspectors to enhance the effective enforcement of port State control in the subregion; c) a survey study on port reception facility requirements and costs; (d) the development of a harmonized regional system for ship surveying and inspection; (e) the establishment of a regional emergency response centre; (f) the development of a regional system for marine pollution surveillance; (g) a regional seminar workshop on environmentally sensitive area mapping, preparation of environmental sensitivity maps; (h) a regional seminar workshop on the integration of international maritime law into national marine environment protection legislation; and (i) a regional seminar workshop on handling of hazardous materials in ports.

Recently there have been a number of maritime disasters where the loss of life, oil spills and other environmental hazards from ships have had disastrous consequences for the environment and the economic development of the subregion. As seaborne trade continues to grow, the possibility of threats of pollution of the marine environment from ships will also increase. The programme will be implemented in consultation with other related regional organizations and it is hoped that additional funding will be eventually forthcoming so that the activities identified in the programme can all be implemented. (Source: *IMO News*, No. 1 1995)

Oil pollution Convention enters into force

The International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC) became international law on 13 May 1995. The Convention recognizes that, in the event of a pollution incident, prompt and effective action is essential which in turns depends upon the establishment of oil pollution emergency plans on ships and offshore installations, and at ports and oil handling facilities, together with national and regional contingency plans as appropriate. The Convention is designed to facilitate international cooperation and mutual assistance in preparing for and responding to a major oil pollution incident and to encourage States to develop and maintain an adequate capability to deal with oil pollution emergencies. It is concerned with preparedness and response issues related to oil pollution emergencies posing a threat to the marine environment, or to coastline or related interests. It is also to be applied to hazardous and noxious substances, pending revision of the Convention to cover such substances. (Source: *IMO News*, No. 2 1995)

MARPOL amendments from 1992 take effect

Effective 6 July 1995, important new measures to improve the safety of existing oil tankers came into effect. These measures include a more enhanced programme of inspections applying to all oil tankers aged five years and more; important new changes to the construction requirements for tankers of 25 years of age and older, including the mandatory fitting of double hulls or an equivalent design. These changes were included in amendments adopted in March 1992 to the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). (Source: *IMO Briefing*, 3 July 1995)

1989 salvage Convention to enter into force

The International Convention on Salvage, which was adopted in April 1989, will enter into force on 14 July 1996. This Convention will replace a convention on the law of salvage adopted in Brussels in 1910. The new Convention seeks to make a provision for an enhanced salvage award taking into account the skill and efforts by salvors in preventing or minimizing damage to the environment. It further introduces a special compensation to be paid to salvors who have failed to earn a reward in the normal way, i.e. by salving the ship and cargo. Damage to the environment is defined as "substantial physical damage to human health or to marine life or resources in coastal or inland waters or areas adjacent thereto, caused by pollution, contamination, fire, explosion or similar major incidents". Compensation should consist of the salvor's expenses, plus up to 30 per cent of these expenses if, thanks to the efforts of the salvor, environmental damage has been minimized or prevented. If the salvor is negligent and consequently fails to prevent or minimize environmental damage, special compensation may be denied or reduced. Payment of the reward is to be made by the vessel and other property interests in proportion to their respective salved values. (Source: *IMO Briefing*, 20 July 1995)

Global Ocean Observing System (GOOS)

The Global Ocean Observing System (GOOS) is being designed for routine diagnostic descriptions and forecasts of the state of the world's oceans and coastal seas. The service could help in improving the efficiency, profitability and safety of hundreds of activities in coastal zones and the open ocean. The data collected should provide an understanding of the mechanism of long-term climate changes. GOOS was started by a memorandum of understanding between the Intergovernmental Oceanographic Commission (IOC), the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP) and the International Council for Scientific Unions (ICSU).

The applications of GOOS are presented in five modules aimed at different customers: climate, living

marine resources, marine services, health of the ocean, and the coastal zone. The climate module has so far received the fullest scientific analysis preceding the design of an operational observing scheme. The economic benefits of GOOS can be calculated in several ways. Industries, services and social amenities that are sensitive to marine environmental conditions can be identified, their turnover estimated, together with an estimate of the percentage improvement that could be obtained from GOOS services from which a nominal benefit may be calculated. This can then be converted to value-added by standard economic methods. However, some companies will probably use the data obtained quickly and innovatively whilst others will not be willing to do so. Surveys of commercial marine companies and service organizations do show a high degree of readiness to consider new services of the kind proposed by GOOS. Decisions based on predictions of maritime and subsea conditions will have to be tested in practice before companies can decide on the level of reliability they can expect and trust. It is anticipated that maritime industries and services could benefit in the region of 1 to 2 per cent or more of the value added as a result of using the predictions and forecasts from GOOS in a time span of five to ten years. In addition, the benefits of including oceanic forecasts into coupled ocean-atmosphere models and predicting events and climate variability should not be ignored. This would be of most assistance to agriculture, land-use, forestry, water management and energy generation. These land-based benefits of GOOS are probably as large as the maritime benefits, but they are harder to quantify and require considerable advances in coupled ocean-atmosphere modelling and prediction.

GOOS must produce economic and social benefits that make it worthwhile. Some aspects of the services and value-added products can be handled commercially, parts of the observing system can be contracted to commercial operators or satellite launching agencies, but the infrastructure and global completeness of GOOS can only be funded if the costs are seen to be justifiable by government agencies, and that the products from the primary observing systems are distributed in the public domain. GOOS must therefore establish its usefulness, both as a public good and as a service to commercial enterprises.

There are powerful factors in favour of developing GOOS. Operational oceanography is already happening. Global ocean science experiments such as TOGA, WOCE, JGOFS and GLOBEC all envisage that a part of the scientific network they establish will become part of a permanent observing system.

Estimating the cost of GOOS is still in its early stages. Satellite missions for the next five years are already committed: on a longer time-scale, GOOS will need additional ocean observing sensors with a strong emphasis on increasing the data rate and geographical coverage without a proportional increase in manning and ship-time. (Source: *Sea Technology*, January 1995)

Global Environment Facility (GEF) financing in India

Among new non-conventional projects proposed for financing by the Global Environment Facility (GEF) are a 35 MW solar thermal power project, a 4.3 MW solar thermal project, a 10 MW photovoltaic power project, a 1 MW fuel cell plant and most interestingly, a wave energy project estimated at US$17 million.

The GEF provides grants and loans to developing countries for projects designed to reduce pressure on the global environment. To be eligible for GEF financing, projects must meet one of the following objectives: to halt the pollution of international waters; to check further depletion of the ozone layer; to reduce and limit greenhouse gas emissions or by preserving biological diversity and natural habitats. (Source: *Int. Solar Energy Intelligence Report*, June 1995)

OECD shipbuilding agreement

An agreement to safeguard competition in the shipbuilding sector was recently opened for signature at the OECD. It aims at establishing equitable conditions by introducing a legally binding discipline against government subsidies, or similar support, and setting up a legal instrument to deal with dumping by shipbuilding companies. The Agreement is scheduled to enter into force in January 1996.

The Agreement can be seen as a response to some characteristic features of shipbuilding: a tendency for Governments to assist their industries, and pronounced market cycles, which induces shipbuilding companies, in a recession, to cut their prices considerably, resulting in distortion of competition among countries and companies alike.

With regard to government subsidies, previous non-binding agreements have in the past been limited in their effectiveness. Because of the legally binding character of the new Agreement, because it deals with all kinds of state support, both direct and indirect, its coverage of dumping practices of shipyards, more hope is now evident. As it covers around 80 per cent of the world's shipbuilding market, the Agreement is expected to have a gravitational effect on those other shipbuilding countries so that they also accede to the Agreement in the future and to accept the discipline which the present participants in the Agreement will apply among themselves.

The functioning of the Agreement will be subject to close supervision by a group at the OECD. Regular consultations will be held together with permanent transparency in a number of subjects. Governments have to make information available on such subjects as ship prices, investment activity, provision of permitted assistance among others. A major review is planned to take place three years after the Agreement enters into force. It is expected that the Agreement will prove to be of sustained benefit to the international shipbuilding industry through eliminating government support and deterring dumping practices. This should, in turn, bring to light the competitive edge of countries in shipbuilding and reveal the true economic performance of individual shipbuilders. (Source: *OECD Observer No. 192*, February March 1995)

ISO 9000—To certify or not to certify

The ISO 9000 is a series of five quality system standards (two guidance and three contractual) developed by the International Organization for Standardization (ISO). The ISO 9000 series is not a total quality management system, but can be used to implement a good quality assurance system which can be used as a stepping stone towards a total quality management system.

Using the ISO 9000 to implement a basic quality system for internal improvement can improve the quality of operations and thus increase efficiency as well as decreasing the costs of manufacturing or production of products or services. An improvement in quality should result in an improvement in market share, which in turn should result in an increased return on investment and subsequently increased profits. The ISO 9000 certification is a method through which customers, and competitors, can be shown that an organization is committed to quality. The benefits of suppliers having certified quality systems are that the level of receiving inspection, source inspection and vendor qualification efforts can usually be reduced. These cost reductions should result in increased saving and thus increased profits. (Source: ISO; *Sea Technology*, January 1995)

New world ocean atlas

The National Oceanographic Data Center (NODC), Ocean Climate Laboratory, Washington DC, USA, has issued a multi-volume World Ocean Atlas which presents new climatologies of major ocean parameters and an associated atlas data set. Following the greater volume of data available for objective analyses, new gridded fields are enhanced. The atlas volumes and data sets present global, objectively analysed fields of ocean temperature, salinity, oxygen, oxygen saturation, apparent oxygen utilization, phosphate, nitrate and silicate on a one-degree latitude-longitude grid for selected depth levels from the sea surface to 55,500 metres depth. The data sets include ocean profile data sets from which the gridded fields were derived. The atlas volumes are divided into ocean nutrients (vol. 1), oxygen (vol. 2), salinity (vol. 3) and temperature (vol. 4). For further information, contact the US NODC, User Services Branch, NOAA NESDIS, E/OC21, Washington, DC 20235, USA. (Source: *IMS Newsletter*, No. 73/74, 1st Semester 1995)

General bathymetric chart of the oceans

The British Oceanographic Data Centre (BODC) has released the first seamless, high-quality, digital bathymetric contour chart of the oceans (GEBCO). The Atlas contains digitized bathymetric contours, coastlines and trackline control which are taken from the Fifth Edition of GEBCO. It is published as a CD-ROM with a software interface for PC use.

For more information, contact BODC, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA, UK. (Source: *IMS Newsletter*, No. 73/74, 1st Semester 1995)

Centre for interdisciplinary coastal research in Spain

The International Centre for Coastal Resources Research (CIRC) has been established in response to an awareness that coastal zone issues require an inter-disciplinary approach so that projects in this field are developed from a global perspective. The Autonomous Government of Catalonia, the Catalonian University of Technology and the International Federation of Institutes for Advanced Study (Canada) have created this new Centre with the support of the United Nations Environment Programme.

The objectives of the Centre include the initiation and coordination of study, international research projects, training programmes and international meetings. The fields covered are: coastal physics and ecosystem dynamics, coastal resources management, nearshore oceanography and coastal geology. One of the main tasks of the Centre will be to promote international cooperation with other public and private institutes and bodies working in these, and similar fields.

For further information, contact: CIRC, Gran Capita, s/n, Capus Nord-UPC, Modul D-1, 08034, Barcelona, Spain. (Source: *IMS Newsletter*, No. 73/74, 1st Semester, 1995)

UNESCO's TREDMAR project extended

After a decade of efforts, the UNESCO programme in Training and Education in Marine Sciences (TREDMAR) is entering into an extension phase (1995-1998) with the theme of "awareness- and capacity- building in coastal remote sensing for global-change studies". The project has previously been steadily building and expanding in the production and distribution of materials aiming towards world-wide sharing of applicable, multidisciplinary knowledge which is needed for sustainable coastal and marine development.

The project operates on the strategy of user-driven creation and distribution of computer-based applications of image data from a variety of sensors including satellite and airborne. The target user community comprises, among others, planners, scientists, teachers and decision-makers, who share their experiences and lessons learnt through interpreting environmental image data. The results have shown an improved understanding of common natural phenomena and environmental issues such as coastal habitat mapping, monitoring environmental impact, watershed management and river outflow, aquaculture siting, oil-slick detection, coastal currents, upwelling, productivity, meteorology, to name just a few.

So far, the main vehicle used for this learning has been a series of image-data applications which function primarily on the BILKO image-processing software toolkit, which is grouped into five modules. These modules are based on interactive applications from authors in fifteen countries. The project has a global network of users at over 500 institutions in 77 countries, including universities, research institutes, government services, and companies.

The project is open for new participants who can receive the material free of charge, with a condition and obligation to provide feedback and/or aiding further dissemination of the material for the benefit of other potential users.

Further information is available from: TREDMAR Programme, SC/IOC/MR1, 1 rue Miollis, 75732 Paris cedex 15, France. (Source: *IMS Newsletter*, No. 73/74, 1st Semester 1995)

Remote sensing techniques for tropical coastal zones

The UK Overseas Development Administration is funding a project entitled "Cost-effectiveness of remote sensing techniques for application to tropical coastal zone management", which is being carried out by the University of Sheffield (UK). The project will include comparison of aerial photography, Landsat TM and MSS, SPOT, ERS-1 and airborne thematic mapper data for the coasts of Belize and Turks and Caicos Islands. It is hoped that the project will result in practical guidelines on the use and cost-

effectiveness of these methods for dissemination to coastal managers world-wide and in addition contribute to UNESCO's TREDMAR and COMAR programmes.

Part of the project includes a brief questionnaire for coastal managers on remote sensing in tropical regions. If you would care to participate, or would like more information, contact: Department of Geography, University of Sheffield, Winter Street, Sheffield, S10 2TN, UK. (Source: *IMS Newsletter*, No. 73/74, 1st Semester 1995)

Protection and utilization of oceans training in Germany

The German Ministry for Economic Cooperation and Development is offering a 14-month advanced vocational training programme on "Protection and utilization of Oceans". This ocean environment programme is aimed at scientists, not older than 35 years of age, who are employed at research institutions and observation stations with a university degree in the fields of marine ecology, marine biology, marine chemistry, oceanography of geology, and whose professional activities focus on the environmental protection of the oceans. The course has a practical orientation without a formal final examination.

For more information, contact the local German embassy, preferably by May of each year (four months before the training should start). Scholarships may be available. (Source: *IMS Newsletter*, No. 73/74, 1st semester 1995)

Europe strengthens its links on marine and polar projects

Under the auspices of the European Science Foundation, Strasbourg, France, scientists from 30 institutes in 17 European countries have agreed to set up two new bodies aimed at improving the coordination of marine and polar research in Europe. The Boards have been established following a conclusion that large programmes lasting around ten years are needed in Europe. Until now, most marine and polar programmes tended to be national programmes lasting between one and three years; large programmes could not be afforded by one nation alone.

One programme that the Boards will cover is on climate change, others include a programme forecasting physical, chemical and biological processes in oceans and coastal seas over timescales ranging from seasons to decades, a project to map the Arctic Ocean and a study of the deep sea floor. The Boards plan to seek better use of Europe's existing research fleet of 20 large vessels, as well as costly facilities such as submersibles and satellites. Ultimately the goal is to provide Europe with a single voice for marine and polar science in international negotiations. (Source: *Nature*, Vol. 377, 12 October 1995)

H. SOFTWARE

DECKPLAN — Load planning

A new load planning software called DECKPLAN has been designed by British Maritime Technology Ltd., to help overcome various problems which can arise when an offshore supply vessel is loaded for different offshore installations with mixed cargoes, including hazardous materials. The software uses a graphical "windowing" user interface to provide a plan view of the vessel deck and a representation of the intended cargo on the quayside. Vessel loading is rehearsed by an operator "dragging" the cargo into position on deck to develop an efficient and safe loading plan for approval by the ship's Master before loading. The programme provides a warning during cargo planning if any loading constraint is likely to be broken, including the possible loading of hazardous material in contravention of IMO's International Maritime Dangerous Goods Code. The system also allows the pre-planning of bulk cargo in a manner which minimizes the need for tank cleaning and takes into account the urgency and intended destination of all cargo. (Source: *BMT News*, November 1994)

Graphical transmission via satellite

Opportunities and methods for transmitting complex graphical information via Inmarsat services are developing rapidly with satellite communications technology advancing as it is. Sending graphical information via Inmarsat-A is relatively easy with the process being similar to sending graphics files between two land-based computers via an analogue phone line. The same applies to Inmarsat-B, where the system is digital. The systems are now so far developed that it is possible to send video pictures across these services. However, some limitations still exist. The process is still costly when transmitting large graphics files.

A new technique has been developed that should overcome the problems of large files and the associated cost of transmission. This technique has a software allowing an on-board computer to interpret smaller, coded files as if they were graphics. Although the transmission may be smaller, the amount of useful information that can be interpreted and provided to the mariner is often greater than would be possible if an entire graphic image was sent. Perhaps the biggest advantage is that the data for updating images can be transmitted over Inmarsat-C. (Source: *Ocean Voice*, January 1995)

Advanced computer analysis

RIFLEX and SIMO represent the state of the art in advanced analytical tools for marine systems. MARINTEK plans to merge the two programmes into a single system for comprehensive analyses. As oil production goes into deeper water, the effects of interactions between slender elements (mooring system) and surface vessel increase in importance.

SIMO is a computer program for time-domain analysis of multi-body systems. It allows non-linear effects to be included in the wave-frequency range. It has been designed with a high degree of flexibility so that both simple and complex analyses of multibody systems can be carried out. Typical examples of scenarios which can be simulated by SIMO are: tension leg platforms, offshore crane operations, floating production platforms, dynamic positioning systems and moored ships. The program itself is undergoing continuous development—an interface to a 3D computer animation system has recently been introduced.

RIFLEX is a finite element program tailor-made for static and dynamic time-domain analysis of flexible risers. The program offers simplified input output specifications for standard riser systems as well as general modelling of complex 3D riser systems. Several alternatives are available for static and dynamic analysis from very simple methods to advanced non-linear analysis of 3D systems. Riser systems are exposed to external loading by currents, waves, and vessel motion. It is possible to include simultaneous excitation from several support vessels. RIFLEX has developed into a comprehensive tool for analysing slender marine structures in general. (Source: *MARINTEK Review*, March 1995)

New navigation software

Software packages are sometimes strange things, error prone and subject to sudden, unexplained failure that often results in long periods of down time and loss of productivity. Cochrane Technology, Lafayette, Louisana, USA, has written their own software for C-NAV, a DOS-based survey and navigation application for the marine industry. It is apparently stable, and virtually crash-proof. Any peripheral error that occurs is displayed and logged but does not lock the system out. Core functions remain continuously in operation, even though reduced capabilities are in effect. Corrections by an operator are possible while remaining on-line and the system will automatically recognize when the problem has been corrected. All survey parameters are stored when entered or changed so that if a power failure occurs these values are automatically recalled. The system can be back on-line in roughly 30 seconds from the time power is restored. (Source: *Offshore*, July 1995)

I. CALENDAR OF EVENTS

COSU '95

Coastal Ocean Space Utilization '95 was held in Yokohama, Japan from 29 May to 1 June 1995, followed by the Osaka Bay Symposium from 5 to 6 June 1995. Prevention of disasters was a major theme together with sustainable development for the region. Other topics covered included new technologies for coastal ocean space utilization; concepts, principles and methods of integrated coastal management; coastal management case studies; technology and the natural environment; and major coastal development projects around the world.

Of particular interest was the introduction to new technologies from Shunroku Kaneko of the Ports and Harbours Bureau (Japan) who described some of the technologies used to create new facilities in coastal areas. In Northern Honshu, Sakata Port, his agency is conducting field tests on a caisson breakwater using wave power to generate electricity. At Kumatmoto Port in Kyushu, they have constructed an economical, lightweight breakwater designed for use on soft seafloors. Tests are being carried out at Miyazaki Port of a semi-circular caisson breakwater which apparently reduces horizontal wave forces and increases resistance to sliding by downward wave forces.

On the same topic, Mr. Dale Berner of Ben C. Gerwick Inc. (USA) introduced new designs to construct concrete caissons capable of withstanding the large lateral inertial forces of earthquakes. He said that these designs were being employed for concrete oil platforms in the North Sea and eastern Canada, and that they can improve seismic stability, particularly shear resistance against sliding and resistance to overturning and uplift.

Researchers from Nihon University and Terrax Co. (Japan) presented their findings of a study showing that seaweed can be cultivated on concrete block coated with ferrous sulphate. Field surveys have proven the success of this technique in supporting seaweed growth, as well as expanding the population of fish and certain shellfish.

Coastal management studies were presented from all regions showing that there is a fairly consistent nature to the problems of coastal areas primarily related to population pressures and economic development. A common framework for integrated coastal management could become necessary so as to promote the concept as a basis for sound analyses of techniques, models and other approaches in implementing such a framework.

It was decided that COSU should become an annual symposium (previously bi-annual), the next will be held in Buenos Aires in November 1996. COSU '97 is planned to take place in Singapore in April 1997. (Source: *Sea Technology*, August 1995)

12th OFFSHORE EUROPE '95

The 12th OFFSHORE EUROPE '95 was held in Aberdeen, Scotland from 5 to 8 September 1995. It has been designed to generate interest from across the oil and gas industry. Sessions were held on all aspects of the oil and gas industry and organized under eight specific technical categories: drilling; exploration; management and economics; development and abandonment; well intervention; health, safety and environment; production; and reservoir management. One highlight was an open forum on cost reduction in a new era (CRINE), a joint industry and government intitiative to help companies reduce costs of development and production by 30 per cent or more.

More information can be obtained from: Offshore Europe Partnership, Ocean House, 50 Kingston Rd., New Malden, Surrey, KT3 3LZ, UK.

Past events

30th International Geological Congress, 4-14 August 1995, Beijing, China. Information: Secretariat Bureau, 30th International Geological Congress, P.O.Box 823, Beijing 100037, People's Republic of China.

IAPSO XXI General Assembly, 5-12 August 1995, Honolulu, Hawaii. The International Association for the Physical Sciences of the Oceans. Information: Robert E. Stevenson, Secretary-General, Box 1161, Del Mar, CA 92014-1161, USA.

MARTRANS 95—1st International Conference on Marine Transport in the 21st Century, 30 August - 1 September 1995, Plymouth, UK. Information: Wessex Institute of Technology, Ashurst, Southampton, UK.

Coastal'95 2nd International Conference on Computer Modelling of Seas & Coastal Regions, 6-8 September 1995, Cancun, Mexico. Information: Conference Secretariat, Wessex Institute of Technology, Ashurst, Southampton, UK.

World Environmental Congress: Promoting Environmental Science, Technology & Business, 17-22 September 1995, London, Ontario, Canada. Information: Conference Chairman, Science & Technology Integration Inc., U.W.O. Research Pk., 100 Collip Circle, Suite 110, London, Ontario, Canada.

3rd Thematic Conference: Remote Sensing for Marine & Coastal Environments, 18-20 September 1995, Seattle, USA. Information: ERIM/Marine Environmental Conference, P.O.Box 134001, Ann Arbor, Michigan 48113, USA.

MARIENV 95: International Conference on Technologies for Marine Environment Preservation, 24-29 September 1995, Kobe, Japan. Information: Secretariat MARIEN'95, c/o Congress Corp., Namiki Bldg., 5-3 Kamiyama-cho, Shibuya-ku, Tokyo 150, Japan.

Operational Oceanography and Satellite Observation, 16-20 October 1995, Biarritz, France. Information: METEO-FRANCE, 1 Quai Branly, 75340 Paris, cedex 07, France.

8th International Deep Offshore Technology Conference, 30 October - 1 November 1995, Rio de Janeiro, Brazil. Information: Deep Offshore Technology Secretariat, 45, rue Louis Blanc, La Defense 1, 92400 Courbevoie, Cedex 72, France.

UNEP--Intergovernmental Conference to adopt the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, 23 October - 3 November 1995, Washington D.C., USA.

Forthcoming events

Oceanology International '96 - The Global Ocean, 5-8 March 1996, Brighton, UK. Information: Spearhead Exhibitions Ltd., Ocean House, 50 Kingston Road, New Malden, Surrey, UK

8th International Coral Reef Symposium, 24-29 June 1996, Panama City, Panama. Information: ICRS Administrative Office, Republic of Panama mail service, P.O.Box 2072, Balboa, Panama.

11th International Harbour Congress, 17-21 June 1996, Antwerpen, Belgium. Information: Secretariat, 11th International Harbour Congress, c/o Ingenieurshuis, Desguinlei 214, B-2018, Antwerpen, Belgium.

International Symposium on Geology and Geophysics of the Indian Ocean, 21-24 October 1996, Goa, India. Information: Convenor, 1996 International Symposium, National Institute of Oceanography, Dona Paula, Goa 403004, India.

J. PUBLICATIONS

International Maritime Organization

The IMO has launched its third electronic title: The IMO Resolutions Database. This is available on CD in the form of a document delivery system and is an indexed database containing information on all the resolutions adopted by the Assembly from 1959 to 1993. Each resolution has its own record from which images of the resolution and its annexes and appendices can be viewed and printed.

The database will be updated every two years and requires an IBM-compatible PC running Windows 3.1, or above, a VGA monitor and an ISO 9660-compatible CD-ROM reader.

Also available are new versions of the Computerized IMDG Code which incorporates Amendment 27-94, adds a new INF Code and updates the BC Code. Further, the IMO-Vega Database of all major IMO conventions, codes and resolutions.

The 1994 SOLAS Amendments. The Conference of Contracting Governments to the 1974 SOLAS Convention (Safety of Life at Sea) held at the IMO in May 1994 adopted a number of resolutions affecting the Convention. These amendments, as well as others, were adopted by the Maritime Safety Committee and are included in the 1994 Solas Amendments. The amendments cover fire protection; safety of navigation; and the carriage of dangerous cargoes and dangerous goods.

The International Code of Safety for High-Speed Craft (HSC Code) has been expanded through the addition of a new chapter following a thorough revision of the Code of Safety for Dynamically supported Craft. This will be mandatory after 1 January 1996.

The Torremolinos Protocol of 1993 Torremolinos International Convention for the Safety of Fishing Vessels, 1977. A consolidated text of the regulations annexed to the 1977 Convention.

Comprehensive Manual on Port Reception Facilities. MARPOL 73/78 requires Governments to ensure the provision of adequate port reception facilities to receive shipboard residues and mixtures containing oil or noxious liquids. The new Manual updates and supersedes previous IMO guidelines on these topics and was adopted in March 1994.

Forthcoming publications from the IMO include: Amendments to the Code of Safe Practice for Cargo Stowage and Securing; new editions of the Recommendations on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas; the IMO/UNEP Guidelines on Oil Spill Dispersant Applicant and Environmental Considerations and a joint IMO/ICAO International Signs to Provide Guidance to Persons at Airports and Marine Terminals.

Further information on IMO publications can be obtained from IMO, Publications Section, 4 Albert Embankment, London SE1 7SR, United Kingdom.

Books

Design and Construction of Maritime Structures for Protection against Waves

Authors: Miguel Losada (University Cantabria, Spain) and Nobuhisa Kabayashi (University of Delaware, USA).

Contents: the book covers theoretical and practical aspects in the design and construction of maritime structures against waves.

It contains: a description of sea surface motion; harbour problems; wave-structure interaction; design and stability analysis of mound breakwaters and vertical walls; composite and other special breakwaters; structure on piles; breakwaters for very short waves; risk analysis; construction and maintenance of maritime works; site investigations and data acquisition.

It is aimed at civil and coastal engineers and contains approximately 400 pages. Planned Publication summer 1995.

Computational Geometry for Ships

Editors: H. Nowacki (Technical University, Berlin, Germany), M.I.G. Bloor (Leeds University, UK) and B. Oleksiewicz (Technical University, Gdansk, Poland)

Contents: the book offers an advanced course on computational geometry for ships taking into account the recent rapid progress in this field by adapting modern computational methodology to ship-geometric applications. Preliminary curve and surface techniques are included to educate engineers in the use of mathematical methods to assist in CAD and other design areas. There is a comprehensive study of interpolation and approximation techniques reinforced by direct application to ship curve design, ship curve facing techniques and other related disciplines. The design, evaluation and production of ship surface geometries are further demonstrated by including current and evolving CAD modelling systems.

It is aimed at ship design engineers, CAD; academic and industry and contains approximately 230 pages. Planned publication Spring 1995.

Country Boats of Bangladesh. Social and economic development and decision-making in inland water transport

Authors: Eirik G. Jansen, Antony J. Dolman, Alf Morten Jerve and Nazibor Rahman.

The book discusses decision-making in inland water transport focusing on official policies towards country boats. It describes the river system of Bangladesh and the constraints imposed by natural conditions and the operational environment. ISBN 1 85339 027 5. Paperback, 280 pages.

Sailing Against the Wind: Boats and Boatmen of Bangladesh

Authors: Eirik G. Jansen. Photography: Trygve Bolstad.

The book conveys the atmosphere of unspoiled shipping on the water routes of Bangladesh aiming to preserve the cultural heritage that the over 700,000 traditional country boats, which are home to millions during the monsoon, represent in Bangladesh. ISBN 1 85339 159 X. Hardback 160 pages.

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