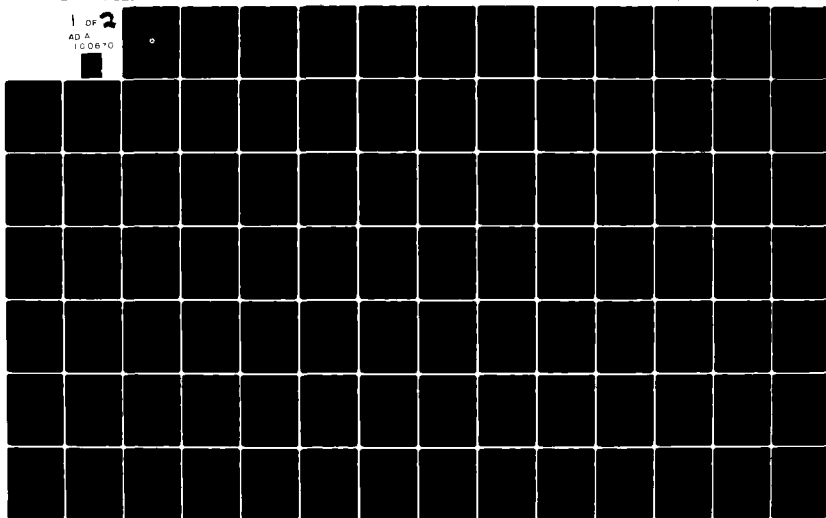


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Report No. CG-D-23-81

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OFFSHORE INSTALLATIONS AND THEIR RELEVANCE TO THE
COAST GUARD THROUGH THE NEXT TWENTY-FIVE YEARS

VOLUME I;
BASIC REPORT: FORECAST OF OFFSHORE INSTALLATIONS AND
THEIR IMPLICATIONS TO THE COAST GUARD

by:

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FINAL REPORT

November, 1980

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United States Coast Guard
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This three-volume study forecasts the universe of offshore installations (OSI) in waters proximate to U.S. territory out to the year 2005, and assesses the impact of the growth in numbers and types of these installations on the Coast Guard. Volume I describes the global, regional, national, and subnational forces operating to promote or inhibit the growth of the OSI universe; presents a forecast of the OSI universe resulting from the impact of these forces; describes the likely impact of this growth on the Coast Guard; suggests a set of alternative strategies that appear feasible and promising for the Coast Guard; and offers recommendations for the Coast Guard. Volume II presents detailed forecasts of a variety of categories of offshore installations related to energy, food, minerals, industrial expansion seaward, military and space, transportation, and science and technology. Volume III contains appendices for each of the key chapters of Volume II; the data and rationale supporting the forecasts of Volume II are presented. The conclusions of the study are summarized: - o By the year 2005 the population of oil and gas OSI will have expanded very significantly; OFEC installations will be a distant second; all other types of OSI will be a still farther distant third. - o The expansion of the OSI universe will increase the operating load on the Coast Guard enormously by the year 2005; there will be a strong need for decision to either expand Coast Guard capability or to reduce Coast Guard load. - o The study recommends that the Coast Guard opt to move in a direction that makes maximum use of its unique operational capability, if necessary at the expense of its regulatory and other nonoperational roles.				
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PREFACE

This report is submitted under provision of contract No. CG-916668-A with the U.S. Coast Guard to make a forecast of offshore installations to the year 2005. The study is one of several conducted or sponsored by the Coast Guard in an effort to ascertain the likely impact upon the Coast Guard of events between now and the end of the century.

The context of the study is the growing realization that the once abundant resources of our industrialized economy, including space, are becoming less available from their conventional sources on land. This is resulting in a seaward movement of our search for resources, which in turn is impacting upon the environment in which the Coast Guard has traditionally operated, with a significant increase in the demands being placed upon the Coast Guard.

Concurrently with this increased demand, the Coast Guard confronts a period of budget austerity, and in addition is experiencing the constraints of inflation that face all institutions dependent on federal appropriations.

The scope of the study is determined in large measure by the Coast Guard's definition of "offshore installation" to be a structure either fixed to the sea floor or capable of keeping station within a small radius.

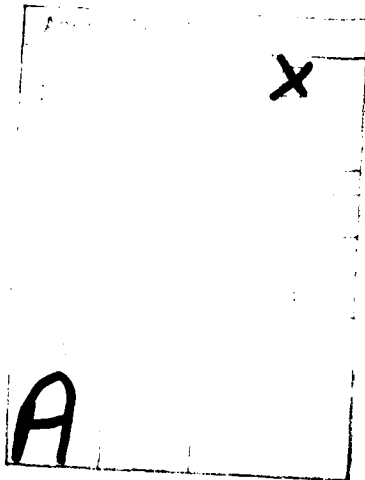
The report is in three volumes:

- o Volume I contains a description of the research process, forecasts of the macro and marine environments, forecasts of the offshore installations, implications to the Coast Guard, and the study team's recommendations.
- o Volume II contains detailed forecasts of offshore installations together with the basic data and rationale for their derivation.
- o Volume III consists of a set of appendices: one associated with each of Chapters 2 through 8 in Volume II, and a general appendix.

VOLUME I

TABLE OF CONTENTS

<u>Chapter</u>	<u>Title</u>
1	INTRODUCTION AND SUMMARY
2	METHODOLOGY
3	MACRO ENVIRONMENTAL FORECAST
4	MARINE ENVIRONMENTAL FORECAST
5	OFFSHORE INSTALLATIONS FORECAST
6	IMPLICATIONS TO COAST GUARD
7	ALTERNATIVES OPEN TO COAST GUARD
8	RECOMMENDATIONS



CHAPTER 1: INTRODUCTION AND SUMMARY

Until the beginning of the twentieth century the oceans had been used principally for navigation and fishing. About the turn of the century oil and gas recovery became economically feasible, and offshore wells were drilled and exploited. Within the last two decades a large number of other uses have either become a reality or have come to show promise. These include such activities as extraction of minerals, exploitation of renewable energy sources, development and exploitation of living resources for food (called aquaculture, fish farming, or other nomenclature), waste disposal, and space for the installation of industrial or commercial activities hitherto and traditionally confined to the land. One agency (NOAA) estimates that the value to the U.S. of accessible ocean resources will rise from about \$7.6 billion in 1972 to about \$40 billion (equivalent dollars) by the end of the century.

The facilities associated with this burgeoning growth in economic assets are variously labeled rigs, platforms, plant-ships, structures, artificial islands, etc. In a legal sense some of these installations are "vessels" while other are not, and some are "vessels" for some purposes but not for others.

The broad purpose of this report is to assess the nature of the universe of these offshore installations by the year 2005, and to evaluate the implications to the Coast Guard. Somewhat more specifically the objective of this study has been:

To conduct a forecast of offshore installations and to assess the relevance of that forecast to the U.S. Coast Guard over the next five to twenty-five years.

Scope:

The study was limited to installations designed to operate in or to transit the oceans. Buoys were excluded.

The term "installation" refers to structures whose mission requires them to

be fixed to the ocean floor or be capable of keeping station within a very small radius of tolerance.

Background:

Natural resources in great abundance exist in the oceans--energy, food, water, other minerals, and virtually limitless space. As the economies of the advanced industrialized countries have grown, they have begun to exploit these resources at an increasing rate. One of the vehicles of this exploitation has been the construction of offshore structures to use as bases of operation. To date drilling rigs and oil/gas extraction platforms for oil and gas recovery have been the dominant types of structure; however, a wide range of different types of structures is becoming a distinct possibility within the next two or three decades. In addition, these exploitation processes and their associated transportation activities are moving seaward into deeper waters. As the movement has gotten farther away from the traditional territorial waters of the U.S., the legal and political complexities have grown. Should the growth and expansion of the offshore environment continue, and should it be accompanied by significant increase in the number and variety of offshore installations, the demand for Coast Guard services would also increase markedly.

The Coast Guard has traditionally been a conservative service, reluctant to engage aggressively in bureaucratic competition for budget resources. At a time when the Coast Guard's domain of responsibility is increasing quite rapidly, this posture has caught the Coast Guard in a crunch between demand and capability. Inflation has been an aggravating factor.

SUMMARY OF STUDY RESULTS

Our study results are summarized in terms of conclusions, alternatives

open to the Coast Guard, and recommendations for action by the Coast Guard. By "conclusions" we mean our forecasts of the various dynamic and general circumstances with respect to offshore installations in which the Coast Guard is expected to find itself toward the end of the century and on to the year 2005. By "forecast" we mean a description of one condition, among many possible conditions along a spectrum of possibilities, that we judge to be more likely than any other single one condition. Thus we do not mean by "forecast" a prediction that one particular event and no other will occur. The "conditions" that we usually describe are more dynamic than static.

Summary of Conclusions:

Our conclusions are presented in four categories. Three of these categories represent the concentric environments out of which emerge the forces acting upon the Coast Guard--the macro environment, the marine environment, and the offshore installations. The fourth category is our assessment of the implications to the Coast Guard of the outcomes described in the other three categories.

Macro Forecast: The following characteristics are likely to prevail in the macro environment by the year 2005.

The nation-state will remain the basic element of the international community through the end of the century and well into the next century; regional alignments will grow in importance.

The UN will remain as the only viable international body of governance; its role will change only slightly through the time period of this project.

The economic and military "interdependence" among nations will continue to grow. Economic power centers will emerge with power to play havoc with the

international economic balance. The need for international coordination will grow.

"Acceleration" at an exponential rate will characterize a large share of the most relevant variables.

The economic gap between the developed and the developing nations will continue to widen exponentially.

World-wide resource shortages, now energy but later something else, will continue to be perceived as among the most crucial problems of world society.

Economic growth will continue to be a fundamental value of all nations.

The role of the U.S. in the international community will remain as a "great power", but this role will undergo at least slight modification in adaptation to the emerging power of other nations.

The U.S. economy will remain essentially welfare capitalism, with increasing portions of its annual output devoted to the "public" interest.

Environmental concerns will exert increasing weight in economic and political decisions within and among nations.

The probability of massive destruction by nuclear weapons is not zero, but is quite low; on the other hand, the probability of use by at least one nation is high.

The probability of violent conflict at lower levels of intensity is high; this conflict is likely to take on new forms, including economic forms as well as blackmail, terrorism, and biological weapons.

There are a number of "conditions" that may be categorized somewhat differently than the foregoing. We label these as "issues"--conditions that demand a decision, either by a decision making body or by societal consensus. We can forecast that the issue will arise with far more confidence than we can

forecast its outcome; and from the point of view of a decision maker likely to be involved in these issues, it is more important to be aware of the issue's imminence than to know of someone's guess as to its outcome. In order to distinguish our issues from our forecasts above, we list them below as questions that remain to be answered.

- o U.S. economy:- What direction will it take in terms of movement toward socialism, managed capitalism, welfare capitalism, free enterprise, other?
- o Inflation:- Will it be restrained? If not restrained, how will it be institutionalized in terms of the basic functions of our society? What will be the effect on government operations? Corporate operations? International trade?
- o Technology:- Has it reached a stage of diminishing returns? In what technical areas? Effect on the economy?
- o Productivity:- How can and will the "supply side" of our economy be managed? How effectively can it be managed?
- o Multinational Corporation's Role:- How will the MNC emerge as an international economic force?
- o Governance in the Marine Environment:- What form will it take? How soon will this form become manifest and how soon will it take shape sufficiently to be effective as a structural foundation for free enterprise initiatives in the ocean regions beyond territorial waters?
- o Sponsorship of oceanic investment:- What form will this take? When will it take form?
- o Regulatory function:- When if ever will this function become compatible with efficient free enterprise? How will its costs be allocated to promote rather than inhibit entrepreneurial initiatives? What is the probability that it will stifle U.S. industry further?
- o Energy:- How will this need be met? What will be the eventual effect on the U.S. economy? On the international economy?
- o Environment:- How will balance be struck between the need to preserve our environment and its resources and the growth needs of modern economies?

Marine Environment Forecast: Changes in the marine environment derive directly from those changes we have forecast for the macro environment in the

preceding subsection. The most salient of these marine environment forecasts are as follows.

Commercial operations will continue to move seaward and to increase in density.

Commercial traffic density will increase commensurately with this increase in commercial operations.

All oceanic activities will increase more rapidly than the going rate of economic expansion and growth throughout the remainder of the century; but the search for resources, particularly energy resources, will increase even in proportion to other oceanic activities.

For the next decade or more, oil and gas will continue to be the primary target of energy search and exploitation; offshore activities related to this exploitation will constitute a major portion of all offshore resource extraction activities.

The U.S. will continue to press its claims seaward somewhat in advance of sanctions by the UN; this will yield an atmosphere of uncertainty within which the free enterprise system may move with faltering steps.

As the U.S. economic activities move seaward, the probability of competition or conflict with other nations will increase.

As the activity offshore moves into deeper and more distant waters, the states will be pressed to assume responsibility for increasing shares of the action within the territorial limits; individual states will move in this direction with quite different motivations and at quite different speeds.

Regional administrative bodies and coalitions will further act more to slow than to accelerate the efficient development of the ocean's resources by some combination of government and private enterprise.

Offshore Installations Forecast: From the foregoing forecasts--as amplified in the body of this report--it is possible to derive an assessment of the

dominant pressures toward change in the offshore installations (OSI) universe whose sources lie external to that universe, the barriers to this change, and the uncertainties that appear to remain.

The energy shortage will dominate change in the OSI universe. The overriding pressure to build up the OSI universe is the world-wide energy shortage coupled with the perceived abundance of resources in the oceans. We forecast that for the duration of the century this will be the dominant force for OSI build-up; it will probably focus on oil and gas, but in any case it will dominate. Toward the end of the century we forecast that other forms of energy will have become significant and will have begun to supplant oil and gas extraction as an OCS activity, but in share of total magnitude of effort, this other activity will be miniscule.

Mineral shortages (other than energy-related) will emerge, probably before publicly anticipated, and become important factors toward ocean exploration and exploitation. The availability of metals and other minerals in sea water, on the seabed, and beneath the seabed constitute a second characteristic of the marine environment that, when coupled with shortages, leads to significant pressure toward industrial activity to extract these material from the seas. The barriers are formidable, however. Technologies of recovery are not well developed, and the environmental consequences are not well understood. So our forecast is that these developments are likely to be very slow in emerging, and will not compete for dominance with oil and gas recovery until well after the time period of this project.

Exploitation of living resources will press toward more than against development of the OSI universe, but will give rise to only small numbers of units. The pressures toward expansion of capabilities to extract living resources from the oceans will come from two sources; the world-wide food shortage

(that is being more talked about than experienced), and the realization that organic materials in the oceans have commercial and industrial potential, including but by no means confined to food or energy-related uses.

Transportation in all forms will increase in the offshore regions. In part this will derive from increased transoceanic traffic, but also in part it will derive from the traffic associated with the expansion of the OSI universe and the industrial complexes that will grow where there are concentrations of offshore installations--in effect embryonic offshore industrial complexes. The two basic characteristics "acceleration" and "interdependence" constitute increased pressure toward increased ocean traffic as international and intranational trade continue to expand in high-growth economies. As the OSI universe grows, this ocean traffic will begin to make use of it for logistic purposes, giving further impetus to its build-up.

Coastal crowding of the northeastern seaboard of the U.S., and to a lesser extent on the southwestern seaboard of California, may give rise to pressures toward construction of offshore facilities to accomodate this overflow. Such overcrowding has occurred in some places--e.g. Norway--and been found to be susceptible to compensation by displacing certain functions to offshore structures or to manmade islands. However, our forecast is that the economics of such a move are not yet even nearly feasible, and that although such activity may occur in the U.S. by the end of the century, the probability is very low. In conjunction with other forces, however, this one must be considered as important.

There are important barriers to the growth of the OSI universe. Many of these are not addressed in appropriate balance in much of the literature.

- o The oceans are inhospitable; only massive and sturdy structures survive. This means that only a high capital investment capability will permit OSI universe growth, and risks are significant.
- o Beyond the territorial waters of the U.S.--i.e. beyond 12 miles, and especially beyond 200 miles--these risks are magnified because

a mild form of international anarchy exists; a U.S. corporation could invest millions in an offshore installation tied to subsurface "real estate", and have this investment jeopardized by a foreign power because the governance of the region provides inadequate protection to the investor.

- o Decisions with respect to build-up along the U.S. coasts are subject to delay by adherence to pluralism--the institutionalized value of permitting all parties to participate--often interminably--in any decisions affecting them.
- o Regulatory action may slow build-up significantly--even at times stopping it completely.
- o It is entirely possible that the risks of heavy investment in OSI build-up are so great that this build-up will not occur without a well organized, centralized government-backed program such as put men on the moon. If such is the case, then the absence of such a program is now a barrier. We perceive that it now is a barrier, and that it will continue to be one for at least several years.

Growth of the OSI universe is shrouded in uncertainties. Together these uncertainties render the spectrum of possibilities of the future OSI universe extremely broad. Decision makers who depend upon any one estimate of that future should continue to monitor very closely these uncertainties and the precursors associated with them.

- o International tensions between the U.S. and the U.S.S.R., between the U.S. and OPEC, or between the U.S. and any other nation, can be enormously influential by impacting our determination to extract resources from the marine environment.
- o The state of the U.S. economy and the associated fiscal policy can accelerate or delay federal government action in support of OSI build-up. Business investment will be highly sensitive to business expectations of profit from offshore capital formation. Confidence or lack of it in U.S. technology as a source of continuing productivity increases will also weigh heavily in these business decisions.
- o The U.S. business community's perception of the cost of federal regulatory action on new capital formation will be highly influential in business decisions to invest in the OSI universe.
- o The overall energy strategy of the U.S. will be a crucial variable in determining the magnitude of U.S. effort to extract energy from the oceans, and to promote OSI build-up. If such a strategy continues to lag, as it has during the last years of the 1970s, the commitment of resources to the task will be minimal.
- o A concomitant of U.S. energy strategy is the emphasis that we as a nation place upon energy technology and on ocean technology. Obviously if this emphasis is heavy the OSI universe will expand.

- o Although the effect of UNCLOSS III deliberations may not be felt in significant degree for several years, the long term future of the OSI universe will be heavily affected by the UN decision as to what point on the spectrum between "Common Heritage of Mankind" and "Free Enterprise" is adopted. The closer the decision is to Common Heritage the less likely will be private investment in the OSI universe at any distance from what can be clearly identified as U.S. territorial waters.

Coast Guard Implications:

The implications to the Coast Guard may be summarized as follows:

Increased Size of Region to be Covered: On March 1, 1977, the area over which the Coast Guard has major responsibility increased from a region approximately 10-12 miles off the coast to an area extending 200 miles off the coast of the U.S. Toward the end of the time period of this study this area will extend even further to cover regions in which resources are being extracted from deep waters. These regions will move beyond what are now recognized as regions of even limited legitimate national cognizance. Obviously an increase in geographical area of responsibility will increase the burden of operations on the Coast Guard. Fortunately the rate of increase is likely to be slow, and only beginning to move beyond 200 miles by this time.

Changing Nature of the Legal/Political Framework: The U.S. has been moving its economic interests seaward for several years at a rate slightly in advance of international consensus in recognition of the legitimacy of U.S. movement. This means that the Coast Guard has had to operate in legal/political ambiguity for some time. This ambiguity is likely not only to continue but to increase as U.S. interests and capital ventures extend seaward beyond regions of established international protocol.

Increased Numbers of Offshore Installations: The sheer numbers of offshore installations will mean additional opportunities for personnel and property casualties and safety hazards. The increase in numbers will also

mean increased opportunities for illegal activities using the structures as cover or as hostage. Both the safety and the law enforcement elements of the increase in numbers of offshore installations will add to the demand for Coast Guard services.

Changing Technological Aspects of Offshore Installations: Offshore installations will reflect technological advances and thus impose a requirement on the Coast Guard to educate and train its personnel in the new technologies, to analyse the technologies to ascertain potential hazards and develop inspection procedures, and regulatory requirements.

Indirect Effects from Added Complexity: Direct effects on the Coast Guard from changes in the marine environment derive from a clear connection between the new characteristics of the marine environment and Coast Guard responsibility. In addition to these more obvious effects there are significant indirect effects that occur because the fundamental changes in the marine environment will lead inevitably to other changes. These include the additional logistic support that will be required for multiple complexes of offshore installations, the increased traffic density that will result from their presence, and the increased hazards to personnel and property. Another indirect effect will derive from the increased motivation of the federal government to have the individual states assume responsibility for ocean regions within territorial waters. All of the implications except this last will have the effect of increasing the work load on the Coast Guard.

Summary of Coast Guard Alternatives

In chapter 7 we address Coast Guard alternatives at two levels of generality. At the first level we assess that the Coast Guard has options in terms of intensity of effort to prepare for an exponentially expanding work load. The options at this level in general are:

- o To move ahead aggressively in competition with other agencies of the federal government for bureaucratic hegemony. This course of action would require that the Coast Guard "sell" to the Executive and Legislative Branches the indisputable fact that demands on the Coast Guard are highly likely to burgeon well beyond present levels and beyond the Coast Guard's planned capability to respond effectively.
- o To continue to plan in as complete a manner as possible for the foreseen heavy load, continue to make representation to the Executive and Legislative Branches for the resources to be required, and let the chips fall where they may in terms of having the capability required when the time comes.
- o Continue to plan as thoroughly as possible for the expected load, and concurrently bend an effort to divest the Coast Guard of responsibilities that contribute least toward the accomplishment of the Coast Guard's most important mission--the operational mission involving safety of life and property at sea. Concurrently develop plans and promote their institution to impose charges on members of the Coast Guard's constituency who benefit from Coast Guard services--i.e. establish user charges and value capture systems.

The second level of generality in chapter 7 provides specific details on how the Coast Guard may implement any one of these options or a combination of them.

Summary of Recommended Action

Our recommendations for Coast Guard action are set forth in Chapter 8 and are briefly summarized here. Note that our recommendations have little to do directly with offshore installations. This is because as we see it the increased load on Coast Guard operational forces by the year 2005 will be so enormously greater than at present, that without the kind of action we address here, any action by the Coast Guard directed specifically toward the offshore installations would be fruitless.

The action that we perceive to be in the long term best interests of both the U.S. and the Coast Guard would be for the Coast Guard to adopt a highly aggressive position with respect to the gap between the Coast Guard's future capability and the demand expected to be placed on it. This position would be anathema to the Coast Guard's traditionally conservative position, would risk

a change in the image of the Coast Guard as perceived by its constituencies, and would be politically difficult to accomplish.

More specific recommendations follow:

- o Establish a systematic process through which to monitor the forecast futures presented in this report, and then maintain an up-date process to keep the precursors identified and tracked as the future unfolds;
- o Adopt a policy to maintain the Coast Guard's principal asset--its operational capability at sea--by stressing preparedness for operational missions, if necessary at the expense of other missions;
- o Promote reduction of nonoperational demands on the Coast Guard.
- o Develop a force mix plan optimized for operations in polar waters, deeper waters, and more distant waters than the present force mix is designed to handle.
- o Promote transfer of Coast Guard responsibilities--both administrative and operational--within U.S. territorial waters to the states and local authorities.
- o Take the lead in establishing U.S. policies for handling international incidents involving foreign ships in waters claimed by the U.S. as sovereign, but not acknowledged to be by others.
- o Establish user charge and value capture systems through which to recover costs of operation to at least some minimum degree.

CHAPTER 2: METHODOLOGY

One of the purposes of this chapter is to provide sufficient information on the manner in which we arrived at our conclusions to permit the intelligent and informed reader to identify any assumptions or judgements with which he disagrees and then to trace through the effects of this difference in judgement on the conclusions.

The overall conceptual structure consists of four basic conceptual frameworks and one "model". The conceptual frameworks are generalized structures within which to view the world external to the offshore installations universe--called frequently hereafter "the OSI universe". The model is labeled differently merely to indicate a deeper level of detail. It represents a conceptual scheme of showing all the categories of offshore installations that the study team, including the Coast Guard COTR membership, could develop as possibly existing at some future date well beyond the time period of the study. The OSI universe model is shown in figure 2-1.

A brief description of the conceptual frameworks and model is:

- o Macro Framework: the entire universe external to the focus of study effort. It is the combination of scientific, technological, economic, political, and societal developments that set the overall patterns within which all institutions will operate. It provides the structure on which our forecast of global, regional, and national events is constructed. It identifies those variables in the macro environment that either drive or oppose changes in the offshore structures universe or in the Coast Guard--i.e. it defines the external forces that determine the future of the OSI universe and of the Coast Guard. Our Macro framework is especially tailored to suit the purposes of this study in that its fundamental structure was developed against the criterion of relevance to the growth of the OSI universe and its relationship to the Coast Guard.
- o Marine Environment Framework: that part of the universe within which the offshore installations are to be embedded and in which the Coast Guard performs its roles. It is the combination of natural and man-related characteristics of the marine environment which ultimately will determine the stage for future Coast Guard mission accomplishment. The structure of this framework was also developed against the criterion of relevance

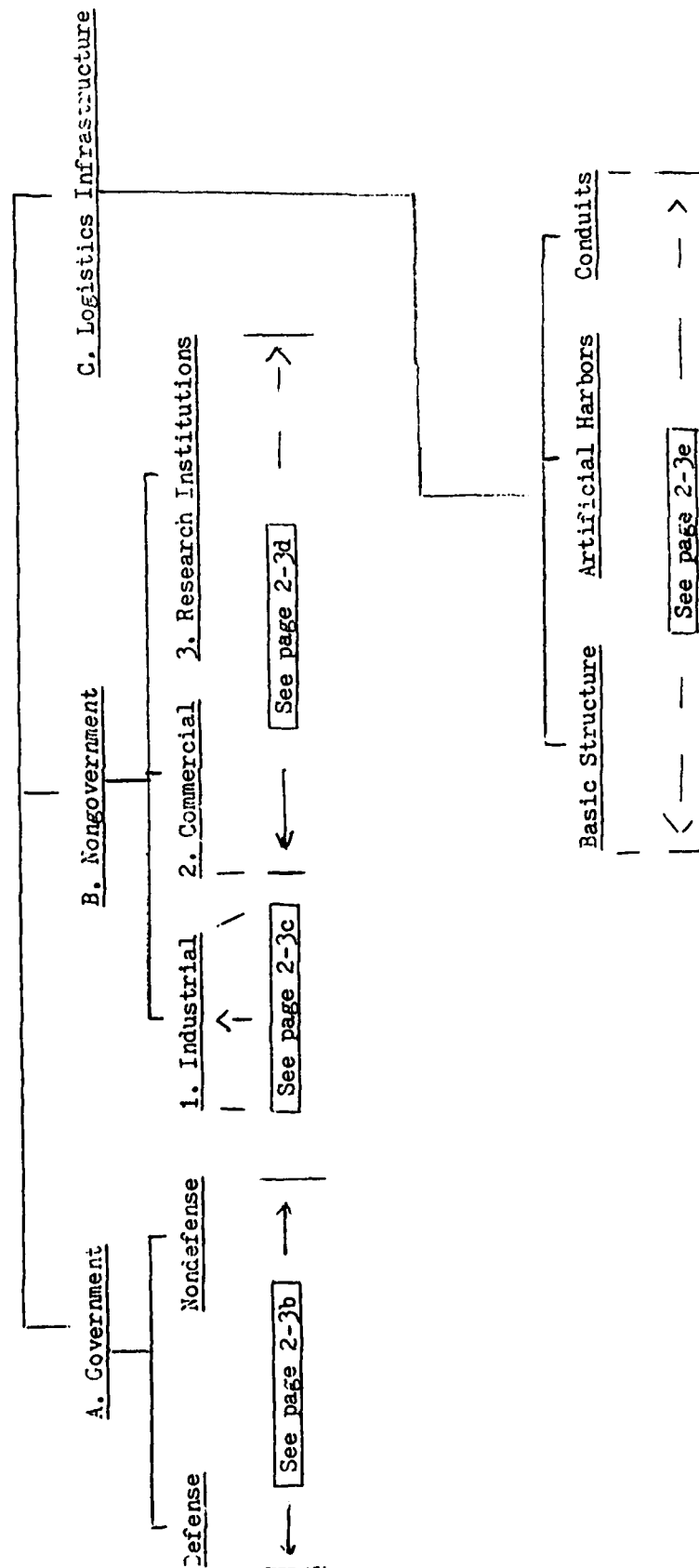
to the growth of the OSI universe and its relationship to Coast Guard mission accomplishment.

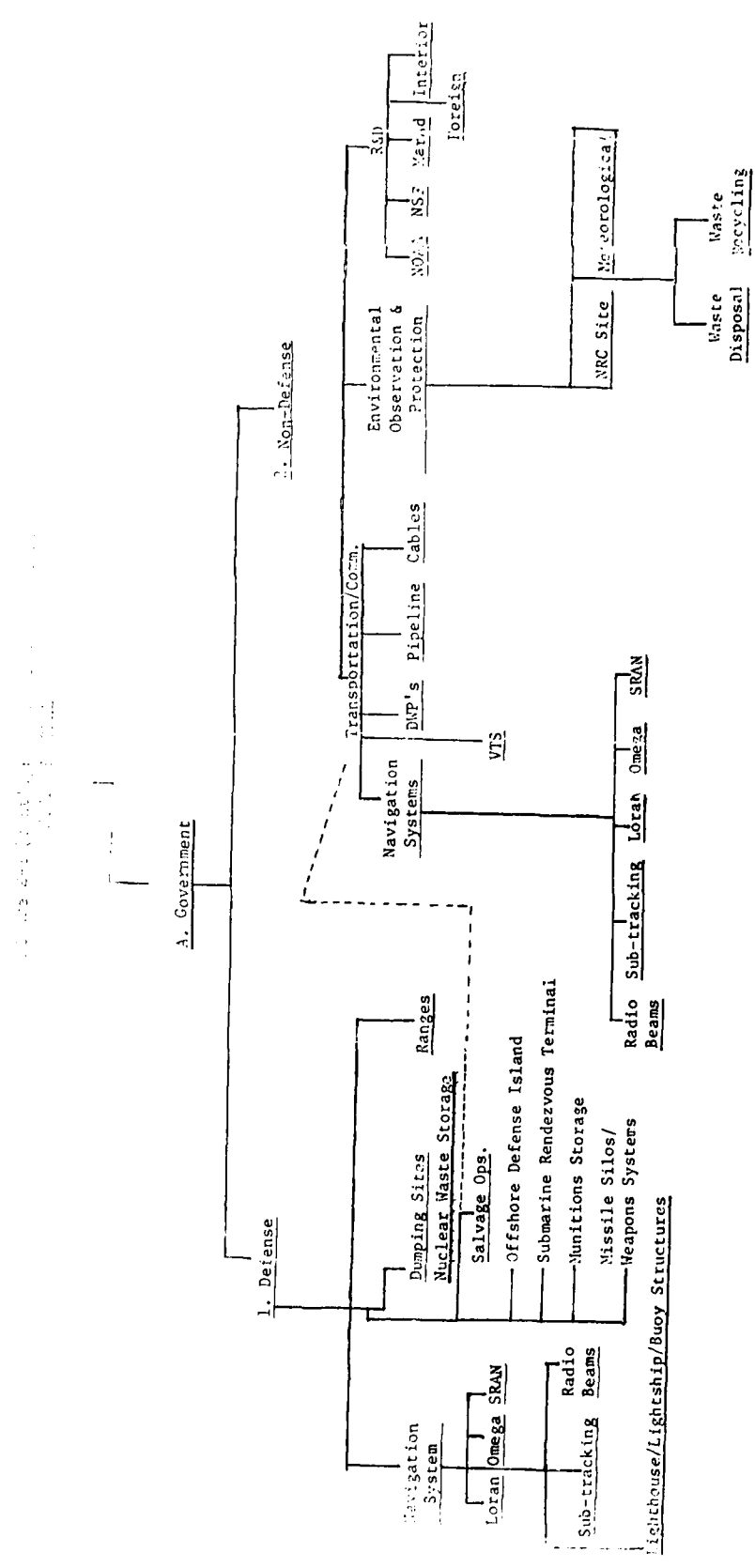
- o Coast Guard Framework: a general description of the roles and functions of the Coast Guard, with a special focus on their relationship to the OSI universe. This framework provides the foundation on which to assess changes in Coast Guard roles resulting from changes in the OSI universe. These roles are described in Chapter 10 of this volume.
- o Government Framework: the roles, purposes, and general organizational and structural relationships of world, international, national, and intranational institutions. It depicts the key elements of government that impact on the growth of the offshore installations universe or on the Coast Guard. This framework provides a description of the various actors and their functions that are most relevant to the focus of study. The Coast Guard functions as an integral unit within this framework. As described in this study, this framework focusses on the U.S. federal government, with a secondary focus on state governments.
- o Offshore Installations Operations Systems Model: an inventory of current and potential offshore installations. It represents the structure of the present and imaginable future offshore installations universe. This structure describes the entire range of types of offshore installations that the study team and its Coast Guard associate members were able to conceive could possibly exist in the time frame of the study. It provides a guide to the creative imagination of team members, and stimulates examination of types of structures that could otherwise be

FIGURE 2-1: BASIC STRUCTURE OF THE FOUR CONCEPTUAL FRAMEWORKS

MACRO ENVIRONMENTAL FRAMEWORK	MARINE ENVIRONMENTAL FRAMEWORK	GOVERNMENT FRAMEWORK	COAST GUARD FRAMEWORK
Political	Political	Regulation	Safety of life & property
Economic	Economic	Law enforcement	
Social	Physical/geo- logical	Research	Environmental preservation
Physical re- sources	Living resources	Services	Law enforcement
Technological	Military	Resource develop- ment	Defense of U.S.
Environmental	Science & technology	Operations	Regulation
	Environmental	National security	Research
		Legislative/judicial	Navigation systems

Figure 2-2: OFFSHORE INSTALLATIONS OPERATIONAL SYSTEMS MODEL

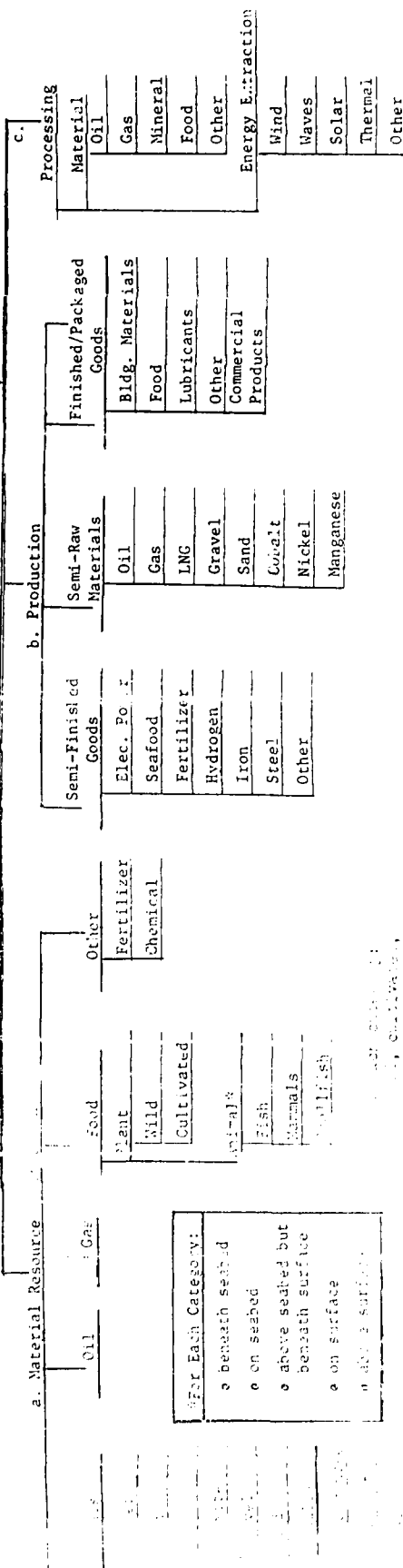




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INDUSTRIAL

1. Industrial

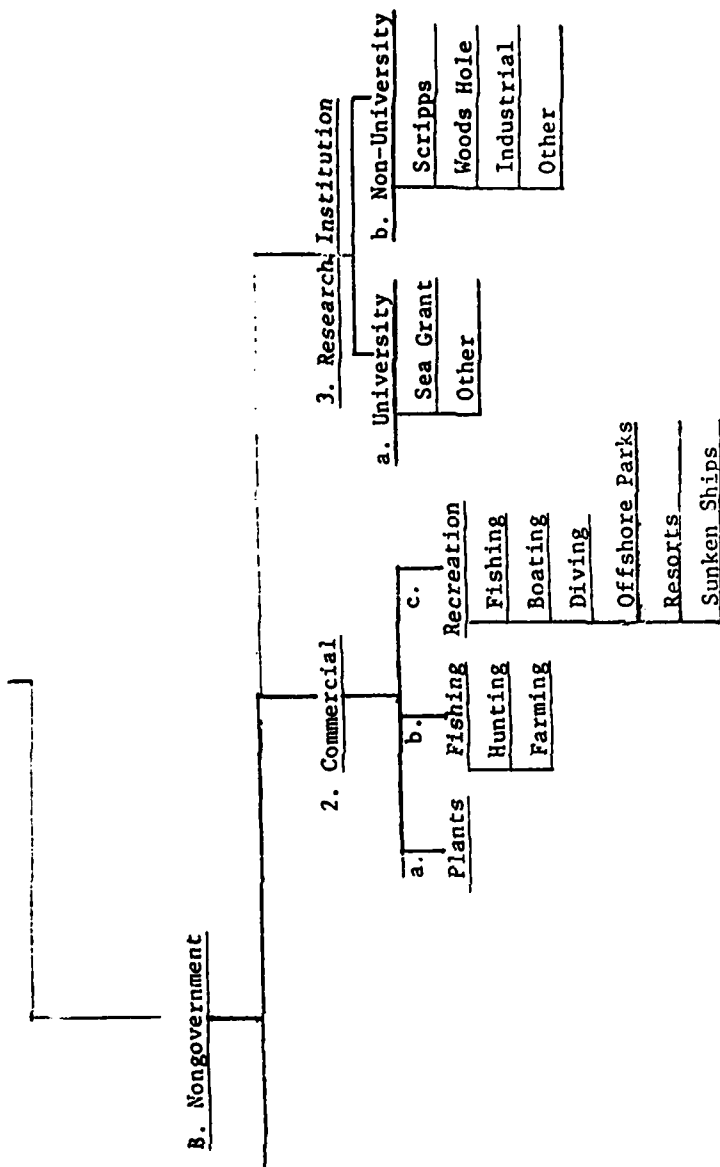


For Each Category:

- o beneath seabed
- o on seabed
- o above seabed but beneath surface
- o on surface
- o above surface

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WASHINGTON, D.C. 20540

FIGURE 2-2 (cont'd): OFFSHORE INSTALLATIONS
SYSTEMS MODEL



1. Basic Structure

C. Logistics Infrastructure

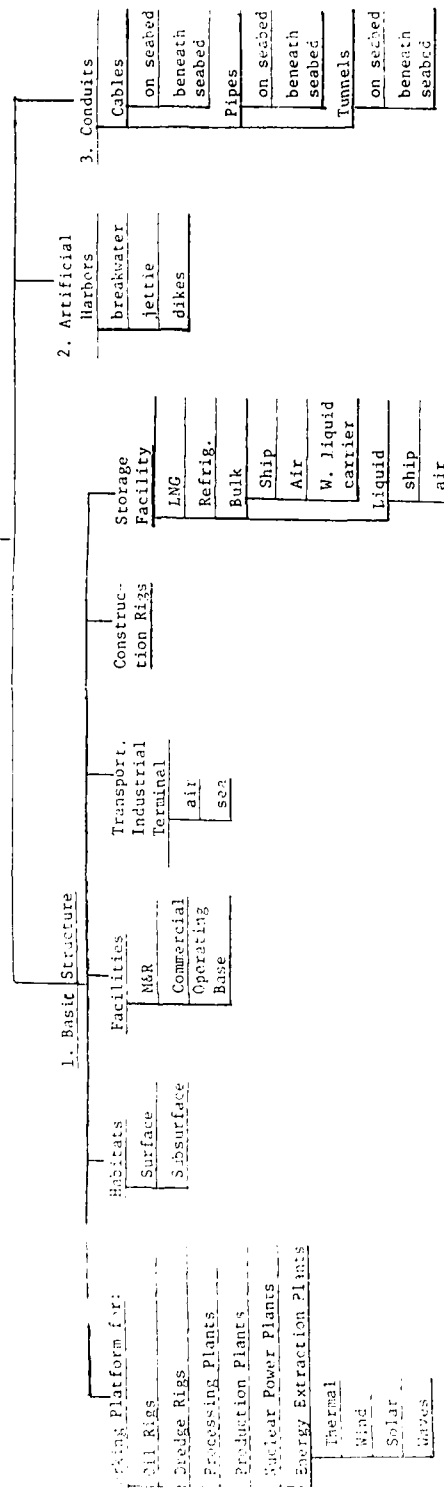
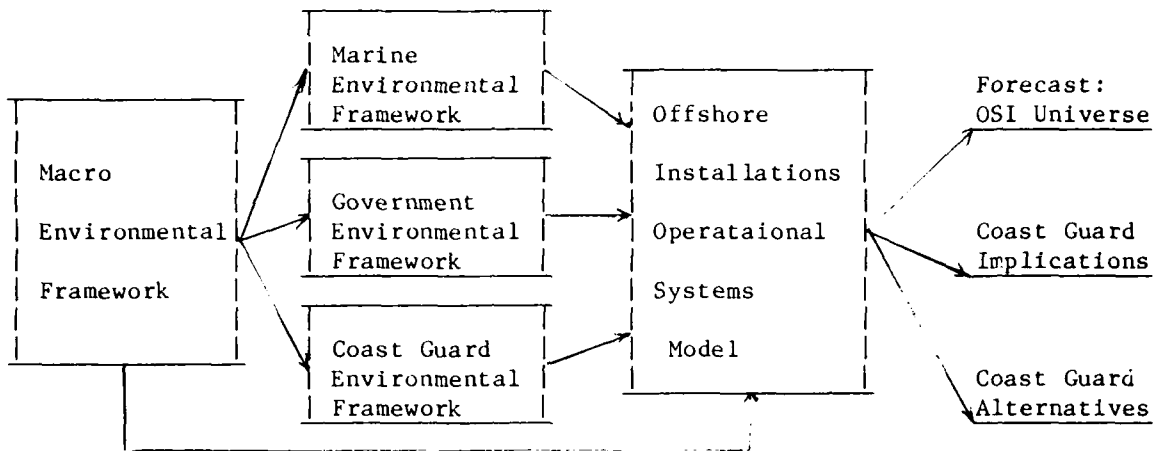


FIGURE 2-3: SIMPLIFIED LOGIC FLOW DIAGRAM



overlooked. The interested reader may perceive the possibility of some form of offshore installation not mentioned in the report except in this model. He may then conclude that we have examined the possibility and, rightly or wrongly, decided that it is so unlikely as to warrant no further discussion.

Figure 2-1 represents the basic structure of the four frameworks and figure 2-2 depicts the structure of the Offshore Installations Operational Systems Model in some detail.

The dynamics of the relationships among these conceptual frameworks, and between them and the OSI Operational Systems Model is depicted in figure 2-3. Each framework and the model represents a segment of reality in which both endogenous and exogenous forces act to produce change within and without the entity itself. Each interacts with all the others, and the sequence of interactions of interest to this study are represented in figure 2-3. Obviously our representation is an oversimplification, but it serves as general guidance to the reader seeking to understand not only what this report says but the rationale behind it.

In its most fundamental sense, our approach is to think of every organic entity--from an entire society down to a single cell--as having several characteristics:

- o It is embedded in a matrix of other organic and inorganic entities that contain forces and pressures acting upon it.
- o It has endogenous forces and pressures of its own that operate against the forces and pressures external to it.
- o The key to full understanding of how an organic entity may move in the future is to understand the nature of these endogenous and exogenous forces and pressures and the relationships between and among them.

Our approach, then, is to order our thinking about both the entity--in this case first the OSI universe, and then the Coast Guard--and its external matrix in such a way that the relationships among and between the various elements of both the entity and its external matrix are brought out in the clearest possible fashion.

Figure 2-4 is a more detailed description of our methodology and relates our methodological steps to the various chapters in Volumes I and II.

In our approach we attribute specific meaning to several terms:

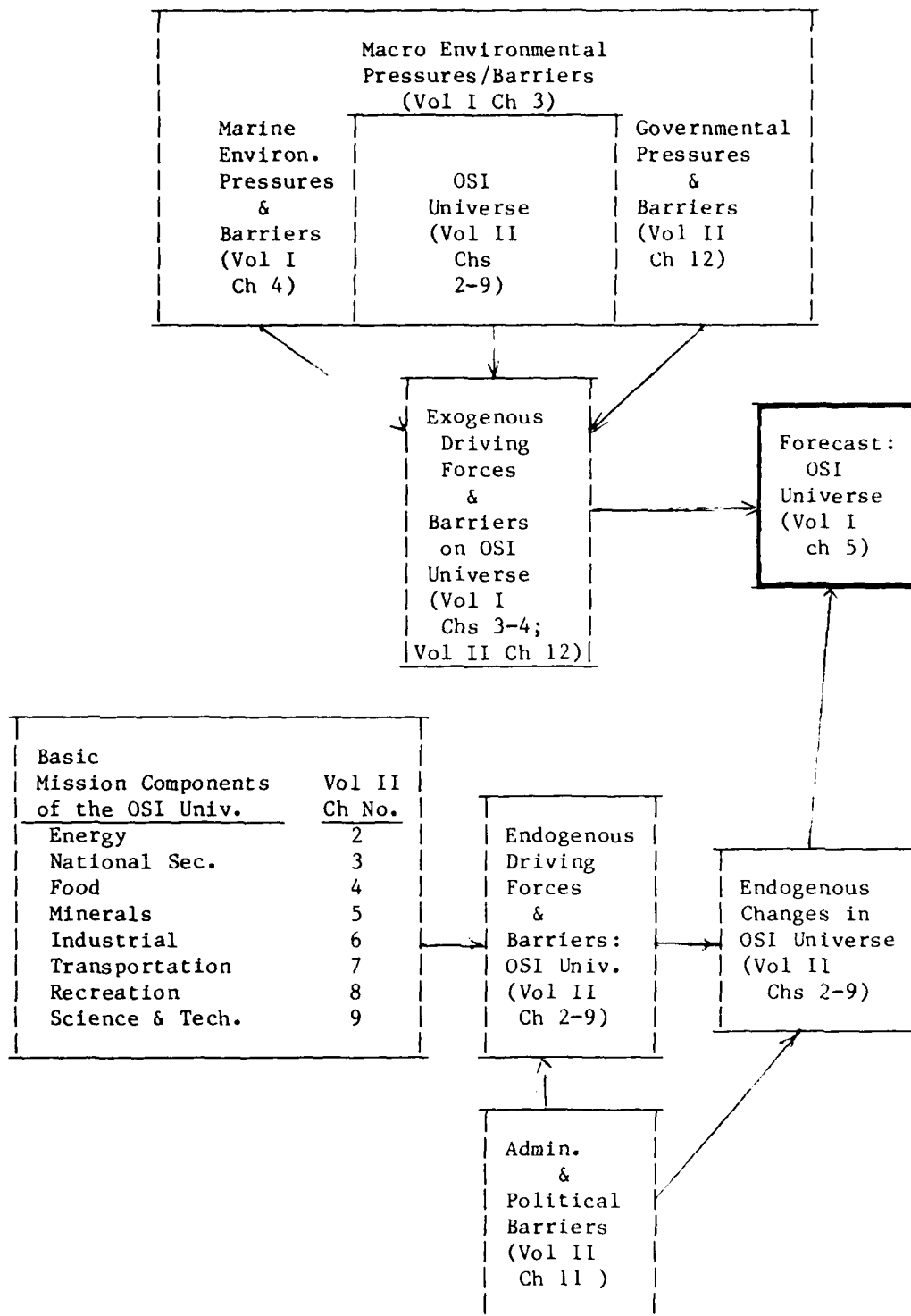
- o Issue: a circumstance that leads to a decision or outcome. This may be either an explicit decision of a policy making body, an explicit decision of an aggregated consensual public, an implicit decision of either; or it may be an implicit decision that evolves from the confluence of conflicting trends in nature, but which a society decides implicitly or explicitly not to do anything about--e.g. the approach of a hurricane, or the confluence of population growth and food shortage. The techniques of forecasting are more successful in predicting trends and issues than in forecasting issue outcomes. This is because trends and their confluence are more likely to be visible early on than are the outcomes of issues. So in a study of this nature, it is useful to distinguish between trends and issues in order to permit later use of the study as the outcomes of issues become visible.
- o Prediction: a description of a possible future state perceived to be more likely than any other one state, but not necessarily highly likely. For example, a particular issue may have five possible outcomes which together have probability of 100%. But the outcomes may not be highly different in their respective probabilities of occurrence. One may be 19% probable, one 18%, a third 14%, a fourth 24%, and a fifth 25%. A forecast that simply states that the fifth is the most

likely state of the future would be true, but would be misleading, since the fifth is far less likely than some one of the other four--i.e. the fifth has only one chance in four of occurring, while it is 75% probable that some outcome other than the fifth will occur.

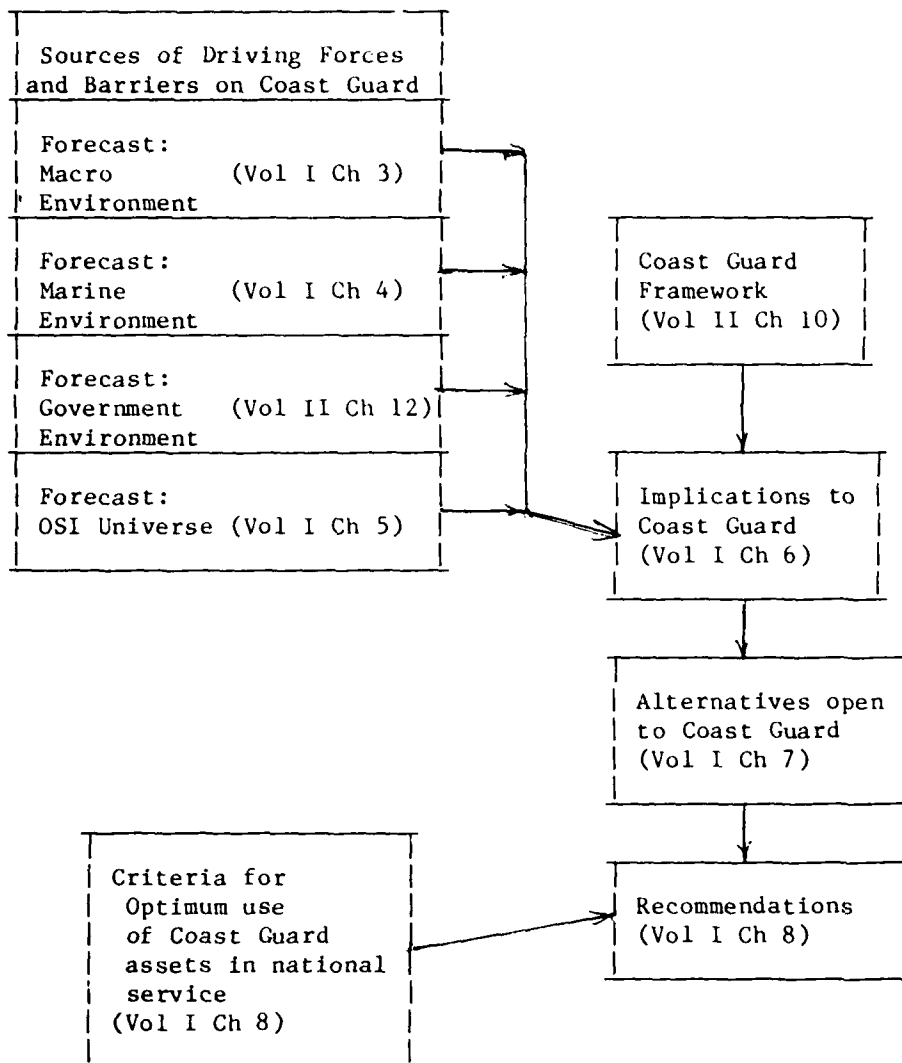
- o Forecast: a description of the spectrum of possible outcomes of a set of trends and issues. This definition recognizes the limitations of estimating probabilities of issue outcomes, as described above under "Prediction", and recognizes that in order to be useful a forecast must present the spectrum of possibilities rather than merely the most probable outcome among several of near-equal probability.
- o Precursors: an event whose occurrence changes a previous estimate of an outcome probability. A study such as this one attributes probabilities to a number of futures, but the unfolding of events invariably changes these probabilities, and the user of a study such as this one, can make optimum use of it only if he continues to inject into it, and carries through its logic process, the new information from unfolding events. Precursors themselves are often not clearly identifiable until issue outcomes begin to take form.
- o Implication: the effect of an event on a mission capability. In this study the "implication" of a particular future event in the OSI universe on the Coast Guard consists of an estimate of how that event will directly or indirectly affect the Coast Guard's mission capability.

A brief description of the flow of logic represented by figures 2-4a and 2-4b provides the basis for understanding the rationale of the study, and for tying the material of each of the chapters into the rationale of the study.

- o The Macro, Marine, and Governmental Environments are the sources of external pressures toward change in the OSI universe and the repositories of barriers opposing change. Our description of these forces, the pressures and the barriers, is contained in Volume I Chapters 3 and 4. Some of the material on which this description is based is also contained in Volume II Chapter 12.
- o Each offshore installation mission contains within itself endogenous forces toward and resistant to change. These are described broadly in Volume II Chapters 2-9.



SCHEMATIC DIAGRAM OF ANALYSIS PROCESS: PHASE I
Figure 2-4a



SCHEMATIC DIAGRAM OF ANALYSIS PROCESS: PHASE II

Figure 2-4b

- o We make no claim for preciseness in discriminating between endogenous and exogenous forces; they are in reality so intertwined that description of one necessarily brings in the other. But in a general sense, the chapters of Volume I focus on exogenous and those of Volume II focus on endogenous forces operating on the OSI universe.
- o The aggregated assessment of driving forces and barriers from both Volumes is concentrated into our assessment of the OSI universe forecast in Chapter 5 of Volume I. Although we did not divide the study process into phases, for purposes of this description we have labeled the process to this point Phase I and show it in Figure 2-4a.
- o Chapter 11 of Volume II is presented because we have become aware of the strong barriers to change existing in the pluralistic political and administrative processes that must be gotten through before an offshore installation may be completed.
- o The next step is to assess how all the changes, all the driving forces, and all the barriers are likely to impact on the Coast Guard. We show this process in Figure 2-4b and have labeled it Phase II. We note that the impact upon the Coast Guard is not simply the impact of a future OSI universe on the Coast Guard as we know it today; the same driving forces and barriers that operate on the OSI universe will also be operating on the Coast Guard during the period to 2005. So our assessment must take this into account. We present the results of this analysis in Volume I Chapter 6.
- o Development of sets of alternatives open to the Coast Guard derives from the nature of the impact on the Coast Guard, developed to this point, and upon the missions placed upon the Coast Guard. We present our assessment of these alternatives in Volume I chapter 7.
- o The final task was to develop recommendations for Coast Guard action. This required the development of criteria against which to judge the relative value of the alternatives. The scope of the study did not call for detailed recommendations, so our presentation on this subject in Volume I chapter 8 is very broad, and based upon very broad criteria.

CHAPTER 3: MACRO FORECASTS AND THEIR SIGNIFICANCE

The purpose of this chapter is to present our forecasts of the macro environment and our assessments of the corresponding effects that the forecast conditions are likely to have on the marine environment and on the offshore installations (OSI) universe. The chapter has two major sections. The first presents our macro forecasts and their significance. The second presents our assessments of "issues"--decision points arising because of the convergence of two or more trends. As pointed out previously in Chapter 2, issues can be forecast with greater confidence than their outcomes (see page 2-5).

MACRO FORECASTS

This section is derived from an application of the methodology described in Chapter 2 to the "Macro Framework" presented in the appendix to this chapter. The contents of the section are presented under four headings: General, Political/Military, Economic, and Science and Technology. In each of these subsections we present a "Forecast" and follow it with its "Effect".

General

Forecast 1. Exponential acceleration will continue to characterize a large share of the most relevant variables. Since the early twentieth century population growth has maintained a significantly greater rate than at any time in previous history, and promises to continue to do so. This rate is greater in the less developed countries (LDCs) than it is in the Advanced Industrialized Countries (AICs). The constant acceleration of population drives a large number of other dependent variables to follow suit, including economic growth. The high value placed upon economic growth, independent of population growth,

especially in the West, will encourage "exponential acceleration" as a characteristic of the macro environment through the time period of this study.

Effect 1. Exponential acceleration leads toward a general raising of the level of activity in the marine environment, including increasing numbers of offshore installations and increasing traffic density.

Forecast 2. Interdependence is a second fundamental characteristic of the macro environment and will persist through the year 2005. It is the result of acceleration and is principally economic in nature. It results from (1) increasing specialization of production in advancing economies and (2) increasing relative scarcity of resources for use in that production. It results in sudden and unexpected emergence of economic power centers when one or more nations acquires control over a resource upon which others have developed a heavy dependency.

- o Economic and technological development has led to uses for most of the globe's resources; since many of these resources are found in nature in only a small number of specific locations, the "owners" of those locations have acquired power beyond any previously perceived level. Many of these "owners" are only now beginning to appreciate their power. As the century nears its end, they will put this power to use to their own advantage through price setting, coalitions, blackmail, and other pressure devices.
- o Multinational corporations (MNCs) will develop to the point of having power equivalent to that of some nations by virtue of their command of certain resources; the MNCs will use and be used by the LDCs in this pursuit of power.

Effect 2. Interdependence manifests itself in all nations having a high interest in all activities in the marine environment, including those associated with the OSI universe. It may result in sudden competition for an offshore resource and/or conflict over and offshore installation. Complexes of offshore installations are likely to be used either by nations or by MNCs as leverage points in this conflict.

Forecast 3. Societies tend to assign a high discount rate to potential crises or even catastrophes. Examples abound: the oil crisis was foreseen for many years; the overall energy shortage was foreseen; on a lower scale, aircraft hijacking had been clearly possible for many years before it was widespread; for the future, it is clear that nuclear weapon hostages are a likely possibility--though no precautionary action is visible.

Effect 3. A deliberate hostile act by one nation against another's OSI is highly feasible and therefore likely; but, until it occurs no nation--least of all the U.S.-- will prepare adequately for the event, and will be surprised when it finally occurs. Immediately thereafter there will be a scramble by all OSI owners to institute defensive systems. These systems may effect significant changes in the OSI universe and its operation.

Forecast 4. A phenomenon that might be called societal dynamism operates throughout our civilization. Spontaneous vitality appears in some nation, group within a nation, or group of nations that leads that assemblage to totally unexpected and unpredictable heights of power. In hindsight the conditions that led to the rise may be clear, but only in hindsight. Examples include Japan in the early part of this century, Bismark Germany, and at the present time perhaps Taiwan. The OPEC nations are in some ways an example also; they slumbered with their present power in only potential form for many years before they realized this potential and began to cherish it. During the period of this study societal dynamism is likely to emerge in some portions of the world, but no signs are yet available.

Effect 4. Sudden discovery and exploitation of offshore resources by an LDC may occur with the result that the discovering nation emerges as a significant

power, and a focal point for international competitive coalitions.

Political Military

Forecast 1. The nation-state will remain the basic element of the international community through the end of the century and well into the next century.

- o The number of nation-states will stabilize as former colonies become fully independent.
- o Regional alignments will grow in importance.
- o Functional alignments will also grow in importance, probably faster than regional alignments.

Effect 1. Management of OSI resources by regional alignments may occur. At the interface between U.S. and foreign domination of an ocean region--e.g., between U.S. and Mexico or a Latin American coalition in the Gulf--conflict of OSI operational matters may occur. Environmental protection, for example, could be an issue.

Forecast 2. With all its defects, the UN will remain as the principal viable international body of governance; other alignments will also assume governing functions (e.g., the EEC).

- o The role of the UN will change only slightly through the time period of this study, the year 2005.
- o Interaction between the UN and regional and functional bodies will increase, giving rise to the most important component of change in the UN role.

Effect 2. When conflict over any phase of OSI construction or operation occurs, the UN, and to an increasing degree regional bodies, will interject their respective influence to settle issues; the result is likely to be improved chances of peaceful settlement, but the result is also likely to be increased time lag and administrative energy in OSI development.

Forecast 3. The "super-power" concept will remain viable, with the U.S. maintaining its "great power" role, but significantly mitigated as other nations'

power--particularly economic power--increase.

- o Use of one or more nuclear weapons by an otherwise nonpowerful state will occur, leading to a quantum increase in public awareness of the fragility of civilization's survivability.
- o Terrorist and/or other nonconventional antisocial action against "great powers" will increase, further altering public awareness of the helplessness of any one power center or bloc to control events, and the concomitant power of any state to disrupt.
- o The probability of violent conflict between nations at lower levels of intensity is high; this conflict is likely to take on new forms, including economic forms as well as blackmail, terrorist, and biological.
- o U.S. military preparedness will both increase in absolute terms, and will change its complexion toward rapid reaction capability with increased precision of application.
- o Toward the end of the century the rich-poor gap will increasingly be correctly perceived to be the cause of international conflict, directly or indirectly.

Effect 3. The U.S., will continue its present policy to move cautiously in assuming cognizance of resource-rich oceanic regions, and in enactment of legislation to promote and protect capital investments in the marine environment. Sooner or later an OSI will be erected by private enterprise, challenged by a foreign power or coalition, and the U.S. government will feel compelled to come to the rescue of the entrepreneur--thereby taking one additional step toward government "planning" of private enterprise. Thereafter additional OSI erection will be under increased supervision by the federal government.

- o An antisocial act against an OSI will eventually be executed revealing the vulnerability of the OSI universe to terrorist, nuclear, blackmail, biological and other ingenious acts of violence. This one act will stimulate the U.S. military into development of defensive measures to protect the OSI universe. It is likely also to introduce significant changes in the physical configurations of the OSI universe to render it less vulnerable.

- o The defense of the OSI universe will consist of naval and Coast Guard forces.
- o The defense forces will develop the capability for rapid reaction to surprise action as a necessary component of effective defense.
- o OSI operations are likely to be the focal point of conflict between the AIC's and the LDC's in regions where geographical cognizance is adjacent.

Economic

Forecast 1. Growth will remain the dominant value among the world's economies; it will be increasingly perceived that in a world approaching resource limits in many areas, growth may become an archaic value, but this perception will not develop into inhibiting action before the end of the time period of this study.

- o The economic gap between the rich and poor nations will continue to widen; "dualism" will persist both within and among nations. A similar gap will develop between the resource-have and resource-have-not poor nations.
- o Population growth rates in the developed nations will continue to slow, while the higher rates in the developing nations will continue.
- o Communications technology and education will render more visible and more intelligible the disparity between the material well-being of the developed vs. the developing nations; this will be a stimulant to global unrest.
- o Macro economic concepts for managing the global economy will be sought, but with only limited success; global economies will present increasingly troublesome problems:
 - No international monetary system will be established that offers significant improvement over the present system.
 - Protectionism will continue to thwart efforts toward a stable world economy.
 - Immigration, both legal and illegal, will continue to increase, with mixed effects on the economies of developed and developing nations.

Effect 1. The value "economic growth" will be a major driving force toward growth of the OSI universe.

- o Probably not in the time frame of this study, but at some future time the rich-poor gap tension is likely to manifest itself in the OSI universe in the form of conflict over who owns the ocean resources beyond 200 miles, and to what degree do the products of the OSI accrue to the resource-have-not poor nations. Such conflict may take the form of physical interruption of OSI operation by a resource-poor nation as leverage on OSI ownership to share the benefits of ownership.
- o Ebb and flow cycles of protectionism are likely to exacerbate the rich-poor gap and alternately offer and withdraw sharing of benefits by rich with poor.
- o The OSI universe will develop physically to the point that OSI's will constitute safe havens for illegal immigration, and secure caches for contraband goods, especially drugs.

Forecast 2. World-wide resource shortages, particularly energy shortages, will be increasingly perceived as one of the most crucial problems of world society.

- o The motivation to discover new sources of nonrenewable and renewable energy resources will continue to increase on a global scale.
- o At a lesser level of intensity, the motivation to discover new sources of nonenergy resources will also continue to increase.
- o Land will grow in importance as a limited resource; desertification, urban growth, and soil damage will be perceived with increasing concern; this in turn will lead to changes in institutions of land ownership by individuals, institutions, and nations.
- o The perceived resource abundance of the oceans will lead to rapidly increasing action to develop and extract both energy and nonenergy resources from the oceans.

Effect 2. Resource shortages will stimulate growth of the OSI universe.

- o The energy shortage is the single most important driving force toward growth of the OSI universe. The relative strength of this driving force leads to the conclusion that the dominant activity in the OSI universe through the end of the century will be oil and gas extraction and production. Other energy-related activities will increase significantly in the marine environment, and will probably out-distance other OSI growth patterns, but through the end of the time period of this study only OTEC will develop significantly, and OTEC will not begin to compare with oil and gas extraction as an activity of the OSI universe.

- o Other resource shortages--e.g., metallic minerals, sand and gravel, fresh water, etc.--will stimulate development of activities in the marine environment, but none will stimulate developments on the scale of energy-related activities.
- o Land in the vicinity of congested urban areas will grow in importance as a limited resource. For example, the northeast corridor of the U.S. is characterized by urban industrialization over large contiguous areas. This industrialization has grown spontaneously and therefore without plan; which means that as modernization occurs, the allocation of space becomes less and less efficient for new purposes and new modes of operation. For example, in large areas of old cities the shopping areas are devoid of parking spaces; to go back and remodel the structural configuration of the city to accommodate this need would be extremely expensive. Therefore new ways to accommodate to the transportation needs of shoppers must be devised. Urban mass transit systems are one result. Another possible accommodation to the industrial congestion of urban industrial areas is to make use of the space and material resources of contiguous ocean areas; as the cost of land-based accommodations increases with the increased congestion, this option becomes more feasible economically.
- o Many of these urban industrial areas contain the focal points for a number of business interests. This means that there is a motivation to reduce the geographical distance between these focal points and emerging new business activities, and a perceived need to place new activities close to the focal points. But in the older cities there is no space left; so there is motivation for OSI developments.
- o The argument (e.g., Costeau) that there will always be sufficient space on land for the world's population may be valid; but it does not take into account that some space is more economically valuable than other; that proximity to focal points is likely to lead to making nearby space economically of great value. Thus a move seaward by economic units may occur despite high cost and despite the availability of far less expensive space in other places.
- o The added factor of environmental hazard in congested areas will lead to movement of nuclear power plants to sea. The number of plants in operation by the end of the century is likely to be small, but growing.
- o A countervailing force could emerge in the form of emigration of eastern seaboard urban industry away from present locations and toward the more attractive sunbelt regions.

Forecast 3. The U.S. economy will remain essentially welfare capitalism, but will undergo gradual shift toward a "planned" economy; this shift will be embedded in an increasingly bitter debate between "left" and "right" views.

- o "Free enterprise" will remain a value, but large corporations will increasingly be subject to governmental constraints, thus mitigating their power. Planned incentivization of entrepreneurship will prove to be extremely difficult.
- o The importance of the "public interest" as an economic value will continue to increase in the U.S.
- o Macro economic concepts for managing mature national economies will be urgently sought, but with only limited success in the absence of aggregate self-discipline.

Effect 3. Interest of the federal government in OSI development will lead to attempts by the federal government to incentivize investment in the OSI universe. The result of this governmental effort on the growth of the OSI universe is highly uncertain; some corporate strategy makers will see the government's interest as opportunity while others see it as interference. The rate of growth of the OSI universe will depend upon how effectively the government manages this problem of incentivization. We may be entering a major turning point in the relationship between democratic government and free enterprise. Inept management could lead to incentivization of highly undersirable OSI components, concurrently with little or no growth of more desirable components.

Forecast 4. Concern for this environment will weight increasingly in economic (and also political) decisions, especially in the U.S.

- o One effect of this concern for the environment will be to exert a pressure against growth--both growth of profits and growth in production of goods and services, including energy-related goods and services.
- o This concern for the environment will be exercised almost exclusively through governmental rather than private-action--thus fostering governmental intrusion into private enterprise.

o The objects of concern will include:

- Land--desertification, effects of mining, water supplies, soil depletion and erosion, scenic beauty.
- Air--climate, air quality, ozone layer, global temperature stability.
- Sea--water, seabed, living resources and other organic substances, dynamic stability.

Effect 4. A principal barrier to growth of the OSI universe, especially as it relates to oil and gas extraction, will be concern for the environment. This barrier will act upon any OSI's that extract, process, produce, handle or transport polluting or hazardous substances. A by-product of this concern will be that it can be expressed only through governmental action, thereby creating a secondary barrier--"government interference". Since different nations have widely different values and standards with respect to the environment, and since the envelop of effects of many of the OSI operations are extremely broad geographically, conflict over environmental protection policies and practices is highly likely; the OSI's of one nation are likely to conform to a totally different set of specifications with respect to environmental protection than are those of an adjacent nation. These types of conflict may be resolved by the UN or regional bodies, but are likely to be long and tedious processes of negotiation.

Forecast 5. The world-wide food shortage has begun to enter the consciousness of many and will become a matter of great concern as the century nears its close.

This concern will result in:

- o Increased extraction of food products from the oceans by developing countries for their own use and by the developed countries for export; and
- o Increased effort by the developed countries to broaden culture-limited appetites for some of the more plentiful varieties of nutrition that could be readily available.
- o Controversy in the developed nations over limiting the traditional over-nutritious and inefficient food system--e.g., grain-fed beef instead of grain.

Effect 5. The world-wide food shortage will be a driving force toward OSI related to ocean food production. At the moment these structures are not perceived to be extensive; however, if fish farming evolves then the OSI universe will include the artificial barriers that may be required to delimit the farms. This component of the OSI universe is unlikely to be extensive by the end of the period of this study, but may be a rapid growth mode by that time.

Science and Technology

Forecast 1. The technical capability to control, monitor, model, and resuscitate the environment will increase.

- o Computer models of the environment will be developed that focus more precisely our present knowledge of cause-effect relationships in the air, water, sea and land environment.
- o Our knowledge of natural resuscitating mechanisms of the environment will be increased; as a result our ability to catalyze such natural action will be increased.
- o Techniques and technologies for remedying environmental damage--particularly oil spills--will be developed.
- o Weather prediction and weather modification technology will be developed to provide slightly more accurate forecasting than we have at present, and a small degree of control over extreme weather conditions--like the development and tracks of violent storms.
- o The problem of coastal erosion will become somewhat more tractable.
- o The desertification problem--the encroachment of desert regions into formerly arable regions--will become at least theoretically tractable.

Effect 1. Increase in our ability to manage the environment is unlikely to lead to development of significant components of the OSI universe.

Forecast 2. The technologies of discovery, inventory, extraction, and processing of living and mineral resources--energy and non-energy--will be refined.

- o Our capability to inventory nonrenewable resources will be increased perhaps to the point that an order of magni-

tude higher confidence level can be attributed to estimates of reserves.

- o Particular emphasis will be placed upon advancing the technologies of ocean resources; space-based surveillance of ocean areas will be developed and contribute to increased knowledge of the ocean's living and nonliving resources.
- o Technologies for exploiting the oceans' resources will develop, including the living and non-living.
- o Ocean chemistry will develop to permit production of new synthetic materials from ocean resources.
- o Extremely large scale, heavy duty structure and equipment technologies will develop and permit economical and secure installation for survival and operation in extreme weather conditions.

Effect 2. Advances in processing technologies are likely to lead to increase in the amount of resource processing that takes place in situ within the OSI universe. All-weather platforms and processing units are likely to become part of the OSI universe in arctic and antarctic regions. Entirely new products will likely be successfully developed directly from ocean-contained materials; this will permit processing units on the same platforms with extraction units.

Forecast 3. Transportation technology will advance in terms of ocean surface and subsurface modes.

- o Water vehicle speeds will increase through use of special effects vehicles--surface-effect ships, hydrofoils, etc.
- o Subsurface modes of transport will become somewhat more feasible economically; these will include a variety of short range local vehicles.
- o Supersized ships will become increasingly operational.
- o Automated cargo handling will permit cargo transfers and storage under adverse ocean conditions.

Effect 3. OSI units will be required to conform to certain specifications dictated by navigation safety of advanced water vehicles. This means special

lights, radar, and sonar devices to aid vessels in transit through regions of high OSI density. Increased traffic density will lead to the need for a high degree of coordination in the location of OSIs, and restrictions on these locations to permit seaways and fareways to be established for commercial traffic. OSIs will be equipped with advanced cargo and substance handling equipment to promote both safety and efficiency in all weather conditions.

Forecast 4. Ocean engineering will advance in highly significant ways; technologies will be developed that reveal human capability to explore, develop, and operate in the ocean environment that have heretofore been unimagined.

- o Ocean "growing" of structures will prove highly feasible at reasonable costs; these growth techniques will make use of electrolytic, chemical, and hydrodynamic phenomena already in use but whose application to the ocean environment has only been slightly appreciated.
- o Construction of the massive structures and equipment that are the only types survivable and operable under the heavy seas and weather conditions of the oceans will prove entirely feasible.
- o Technologies will be found for the natural physics and chemistry of the oceans to promote human uses; what has heretofore been a transfer of land engineering into the oceans will slowly translate into a true ocean engineering.

Effect 4. Advances in ocean engineering will lead to the feasibility of "growing" structures at reasonable cost, and construction of massive structures to withstand the most severe weather conditions. Remote control devices will permit operation of unmanned platforms in a variety of modes; these devices will also permit security measures to be installed that provide warning of intrusion of unauthorized persons. Engineering advances will be made in exploiting the chemistry, physics, and biology of the oceans in support of various functions performed on the OSIs.

Forecast 5. The greatest advances will be made in the information processing technologies.

- o Microminiaturization will continue to advance, bringing sophisticated sensing communications and computing devices within reach of individual citizens--both in their homes and on their persons.
- o Cybernetics will permit automated control of highly complex operations from remote locations in places that have hitherto proved too dangerous or otherwise inaccessible to humans.
- o Photographic technologies, including holography, will further enhance the sensing communications and computational capabilities of all aspects of human activity.
- o The opacity of sea water will be reduced, but only slightly.
- o Satellite technology will also enhance our capability for sensing, communicating, and computing.

Effect 5. Television and holographic techniques will permit surveillance of OSI's on a continuing basis from long distances. These techniques coupled with computer technology will enable OSI operations from remote distances, under adverse weather conditions, and controlled by a small number of personnel. Satellite communications and surveillance will augment the foregoing in systems of broad geographic dispersion.

Forecast 6. Bioengineering will increase human capabilities to operate under the pressures and through the pressure gradients characteristic of ocean living.

Effect 6. Some OSI will be equipped for human submergence to extreme depths through advances in bioengineering.

Forecast 7. The science and technology of energy will undergo almost drastic changes, exemplified in the following areas:

- o Effective and efficient energy storage
- o Fusion power

- o Energy from--sun, wind, thermal gradients in the oceans, geothermal, current, tides, salinity gradients, waves, tectonic plate movement, photosynthesis, hydrogen, superconductivity.

Effect 7. Advances in energy extraction technology will render many new forms of energy sources economically feasible soon after the end of the time period of this study; however, the major focus of energy extraction for the time period of this study will continue to be oil and gas, with OTEC moving up from behind. By the end of the century we may expect new forms to have advanced to the point that OTEC is now: fusion power; solar energy in all its various forms; geothermal; current; tide; salinity gradients; wave motion; tectonic plate movement; hydrogen; superconductivity. By the year 2005 devices for commercialization of many of these forms will be in the conceptual development phase.

MACRO ISSUES

The issues described in this section are presented under the two headings Political and Economic. The general format is the same as in the immediately preceding section.

The preceding section, MACRO FORECASTS, presents a set of reliable statements about the future of certain key elements of the macro environment; we perceive these elements to be key forces shaping and constraining the OSI universe during the remainder of the century. There are other important shaping and constraining forces acting upon the OSI universe from the macro environments, but statements about their future can be made only with great uncertainty. We identify these as "issues". An "issue" is a culmination of matters or trends that demands decision whose outcome is uncertain; the "decision" may be made by one or more formally constituted decision making bodies or it may be made by society in the aggregate. In the discussion below we describe the range

of likely outcomes for each of the issues identified. Each issue represents a variable of significant relevance to the OSI universe and we forecast that its importance will continue, but the direction and rate of its future movement are highly uncertain and subject to yet-to-be-made decisions by a variety of persons. Most of these issues have their basis in the Macro Forecasts.

This section also itemizes our assessment of the possible effects of each of the "Macro Issues" on the marine environment in general and on the OSS universe in particular.

Since the outcomes of issues are by definition uncertain, we present in this section the spectra of effects that we perceive to be reasonably likely, depending upon the spectra of issue outcomes.

Political

Issue 1. The direction of evolution of the international law of the sea will determine the umbrella of governance under which the OSI universe will operate. This issue will not constrain the U.S. in close-in waters, but as the OSI universe moves seaward it will become more important. The basic question is which of the two concepts will dominate UNCLOSS III: The "common heritage of mankind" or free enterprise. At one extreme, forces are in motion to insure countries with no access to ocean resources a "fair share" of those resources, independent of their capability to extract these resources; at the other extreme are the forces that seek to guarantee private enterprise the protection of a governing institution over their property rights, which are analogous to property rights within the U.S.

The probability of the different outcomes along this spectrum of possibilities varies from one UNCLOSS III session to the next, and even from time to time during each session. At the moment the most likely outcome is a reasonable balance that assures developed countries protection to their entrepreneurs who

invest in OSI development. A somewhat less likely, but not to be overlooked, outcome is prolonged and fruitless UNCLOSS III to the point that U.S. urgency to proceed leads to unilateral U.S. decision to either invest with a government or quasi-government corporation, or to offer safeguards to private industry in the form of guaranteed protection of assets and profits.

Our forecast is that once an aggressive U.S. policy has been decided upon, the lack of UN decision will not delay or inhibit investment. Further, since significant increases in the OSI complex are likely to emerge clearer inshore than further out, we forecast that any impediment created by UN delay will have its major effect only late in the time period of this study.

Effect 1. The uncertainty in the effect on the OSI universe of the uncertainty in the outcome of the governance issue increases. Within the territorial waters of the U.S. the uncertainty is negligible; over the OCS the uncertainty is not negligible, but nearly so; beyond 200 miles the uncertainty is great. Our forecast is that U.S. official concern for the energy shortage will express itself independent of the governance issue in ocean areas where U.S. de facto or de jure jurisdiction has been reasonably established. This extends at this time to the region over the OCS and to some extent to 200 miles; and legislative and executive action continues to take place which gradually expands the de facto jurisdiction.

Beyond the OCS and 200 miles, however, the absence of institutionalized governance is likely to inhibit U.S. exploration and exploitation of resources--notable the deep-sea modules. Further, toward the end of the time period of this study we forecast that the potential of new forms of energy extraction/exploitation will have become sufficiently evident to reveal opportunities farther out that are not now apparent--and therefore not likely to become issues.

We also forecast that in certain regions--e.g., the Caribbean--the ambiguity

of governance may lead to international conflict over resources well within the 200 mile limit.

Issue 2. The legal structure of enterprise behind OSI investment may vary from full investment by private enterprise to full cognizance by a federal agency. At some point between these two extremes would be the corporation owned by the federal government or by a state. Other combinations of private, federal, or state ownership/sponsorship are possible. The underlying characteristic of the OSI universe is that major units must be of such physical size and toughness that large capital investment is required; the small business cannot compete.

The regulatory burden on private enterprise constitutes an inhibition to investment; thus our forecast is that as the OSI universe expands, and as federal regulatory activity continues to increase, private enterprise will not have incentives to invest. The most probable action to promote such investment will be that the federal and state governments take the initiative and create the necessary institutional arrangements. At somewhat lower probability will be investment by private enterprise.

Effect 2. The newer forms of OSI--deepwater port, offshore nuclear power plant, OTEC--are likely to be created under the aegis of a governmental or quasi-governmental corporate body. Whereas oil and gas exploration and extraction appear at this time to be sufficiently attractive to private enterprise to foster investment, no other OSI activity appears so attractive. It is likely that growth of these other forms will occur only with government incentivization--subsidy and/or protection of risk. This governmental intervention is likely to be some federal and state combination, with the DOE playing a major role. The success of these ventures will be highly dependent upon the regulatory competence with which the ventures are promoted and guided.

Economic

Issue 1. One of the most important economic issues for this study is the question of what policies will be adopted by the U.S. to deal with the resource shortage, particularly the energy shortage? Several forecasts are relevant to this issue, but do not dictate its outcome.

- o Significant increase in the reliability of estimates of the raw material reserves, particularly oil, gas, and coal reserves as the century nears its end will lead to a clearer definition of energy and other shortage problems confronting the developed economies. Our forecast is that this clearer definition will not alleviate the urgency of the energy problem, but that by reducing its uncertainty it will provide an underpinning of confidence to the policies decided upon. It will also define the nature of shortages in other raw materials and lead to somewhat more effective handling of these future shortage problems than we have experienced with energy.
- o The search for "soft" alternatives to the energy shortage will continue, and may promise solutions by the end of the century, but will not alleviate the shortages before that time. Coal may become a partial substitute for oil, but the urgency of developing the offshore oil and gas reserves will not diminish significantly before the end of the century. Only a program with the urgency of the "man-to-the-moon" program of the 1960's could do that, and our forecast is that this will not occur.
- o The foregoing forecast could be negated almost completely by an early break-through in fusion power development. Our forecast is that this is highly unlikely, but not in any sense impossible; and should there be high emphasis placed upon this development by the President its probability would be significantly enhanced.
- o The foregoing forecast could also be altered by an increase in international tensions giving rise to U.S. belief that our oil supply was in serious and immediate jeopardy; our forecast is that this is moderately likely at some time before the end of the time period of this study. If the belief lasts over several years, or if it becomes reality, then the offshore oil and gas development effort would increase in intensity many times over.
- o The probability of the U.S. becoming energy independent by the end of the century is very low, but not zero; should there be sufficient warning of a related crisis, and

should there be highly effective and efficient management of a program on a national scale, and should there be "good luck" in technological developments, then this could come about. If it does in fact come about, then offshore oil and gas would probably play a major role in the late 1980's and early 1990's, and a diminishing role thereafter.

- o The conflict between "energists" and "environmentalists" will persist through the time period of this study, shifting favor to first one side then the other depending upon the short-term urgency of shortages.
- o A shift in institutionalized values away from the "more" goods and services toward "higher" human values--i.e., self-actualization, spiritual values--is highly unlikely; but if it occurs and is accompanied by an international environment of peace, then the urgency of offshore oil and gas development would increase at a slower rate, but is unlikely to be reduced, and is certain not to be eliminated.
- o U.S. dependence upon nonenergy raw materials will continue to come into focus as the century nears its close. Oil and gas are in the light now, but as "interdependence" takes its effect other materials' importance will be accentuated. Our forecast, however, is that unless there is a major international conflict, this shortage will not reach the magnitude of the oil and gas shortage, unless it is caused by gross mismanagement--a non-zero but low probability.

Effect 1. A clearly defined and credible policy on materials shortages--particularly energy shortages--is likely to lead to a more rapid expansion of the OSI universe than a vacillating or ambiguous policy; if that clearly defined policy is also aggressive then this expansion is likely to be even more rapid. If the energy shortage continues to be the dominant shortage--as we forecast that it will--then the expansion is likely to be centered on oil and gas extraction plus modest emphasis on OTEC. Under these circumstances continued through the end of the century, other forms of energy will begin to promise economic feasibility--e.g., salinity gradient, wind, waves, current, etc. But none of these forms is likely to prove economically feasible to the point of operational use before the year 2005.

- o An increased capability to inventory the earth's resources, particularly in the oceans, will lead

to increased likelihood that federal government policy will be well defined and unambiguous. We forecast that this inventory capability will in fact occur by the early to mid 1990's. To the degree that a federal administration is willing to commit itself to firm and unambiguous policies in the absence of this inventory capability, so will policy be firm and consequently OSI universe expansion will be promoted. On the other hand, should successive federal administrations be reluctant to commit to any firm policy in the absence of the improved inventory capability, so will OSI universe expansion be uncertain and equivocal.

- o A drastic increase in the emphasis by the federal government in the search for "soft" energy sources is likely to lead toward firmness and clarity in the U.S. policies underpinning the OSI universe expansion. Such an increased emphasis is likely to lead to clear and emphatic policies in support of oil and gas exploitation offshore as a hedge, followed by gradually diminished emphasis as the "soft" sources prove out. This proving out is likely to consume most of the time remaining in the century and beyond, so the search for soft sources is not likely to diminish the need for ocean energy sources before the end of the study time frame. Even an increase in reliance on coal as a source is not likely to change this forecast; and even a "man-on-the-moon" priority to develop soft sources is not likely to have much effect during the time period of the study (though such a priority would certainly be likely to have significant effects on policy by the end of this time period).
- o Operational fusion power plants are highly unlikely by the end of the time period of this study; however, should the President decide to allocate maximum R&D effort to this area, a breakthrough would be possible. Even with such a breakthrough an operational plant at sea by the year 2005 is unlikely; however, this would not be impossible. If Presidential high priority is given to fusion power development it will be very important to monitor its progress closely; in the event of unexpected success, the expansion of oil and gas, OTEC, and other sources of energy would suddenly decelerate rapidly, and fusion power plants at sea would be likely.
- o An all-out effort by the U.S. to become energy-independent over the next two decades could, with good fortune, lead to success within two or three decades. Such an effort undoubtedly would involve a major thrust in oil

and gas exploitation offshore. This effort would be of maximum intensity over the next 5 to 15 years, then stabilize at near maximum production levels. Thus, the oil and gas components of the OSI universe would peak as a proportion as well as in absolute terms by about 1995, then level off in absolute terms and decline in relative terms thereafter.

- o The "environmentalist" vs. "energist" conflict will continue and result in slight reduction in the rate of expansion of the OSI universe; the overall result will be acceptance of more stringent criteria to be met by the OSIs for the protection of the environment. This result may be reached only after considerable international debate and controversy on a regional basis, e.g. between the U.S. and Mexico. The leverage power attributable to the environmentalists will depend upon the urgency with which energy development is pursued.
- o International tensions or conflict that place marine environment contiguous with the U.S. in jeopardy, i.e., posed such a threat in the near ocean areas as to render offshore development a high risk venture, could immediately and drastically slow OSI universe buildup. The vulnerability of OSIs to anti-social action has not been assessed except hypothetically; should this vulnerability prove to be high--despite the many cogent arguments to the contrary--the effect on OSI universe buildup would be catastrophic.
- o International peace and harmony, coupled with spread of the "small is beautiful" value system, would be likely to lull the U.S. into complacent acceptance of slow growth of the energy exploitation of the oceans. This is unlikely, but possible. Should it occur, the OSI universe would grow extremely slowly, incentivized principally by the profit motive of the oil and gas industry.
- o The international "interdependence" previously alluded to could conceivably result in one nation or a coalition of nations cornering the supply of a critical material, as yet unidentified, and to emerge as a surprise, in such a manner as to alter the balance of relative importance in the ocean's resources. In other words, it is possible, though not highly likely, that some ocean resource, not now even imagined to be important, overnight could become of crucial importance. This eventuality would result in a surge of growth in some yet-to-be determined OSI component.

Issue 2. The effectiveness with which inflation is handled by the U.S. will

affect the attractiveness to private enterprise of investment in the OSI universe. Ineffective inflation management is almost certain to disincentivize such investment almost completely, resulting in the federal government being the only U.S. source of this investment. In this event there would be some probability that foreign investors would be attracted, thereby giving rise to conflict over OSI rights and responsibilities.

Our forecast is that U.S. inflation will be managed only partially effectively, and that the incentive to private enterprise to invest in the OSI universe will decline at least in the early and mid-1980s. Should the management of inflation become more effective in later years, it will be too late to incentivize private industry. The inertia already extant by that time will keep the federal government in the role of initiator and operator of offshore installations.

Effect 2. If inflation is not well managed by the U.S., either the federal government or a foreign power is likely to be the sponsor of OSI investment; this will give rise to conflict and probably slow-down in OSI build-up. The most likely forecast is partial success in managing inflation, accompanied by heavy U.S. government involvement in OSI build-up beyond oil and gas units. The problem of incentivization will be long lasting and controversial between government, industry, and the many special interest groups involved.

Issue 3. The effectiveness with which the U.S. productivity decline is managed also will determine how well the productivity of U.S. labor recovers from its decline. This "supply side" dilemma of the U.S. as described by our economists has only a modest probability of being resolved; if it is not resolved, inflation will be almost impossible to slow, and the entire conceptual basis for private enterprise motivation will collapse. Our forecast is that this productivity dilemma will be only partially resolved, and that private

investment in the offshore universe will not be adequate to national needs through the end of the century. Thus, another factor pressing toward federal intervention will be manifested, modulated only slightly by the following:

- o The average age of the U.S. labor force is increasing; this is likely to be a factor favoring resumption of increasing productivity.
- o There is some evidence that the average work week will be slightly shorter than 40 hours; this is also likely to favor resumption of increasing productivity.
- o The next slowing of the economy is likely to lead further toward an "incomes policy" of some sort in the U.S. Under such a policy the U.S. government will be the employer of last resort, thus making the less productive segments of the labor force readily available to any federal industrial programs in operation e.g., operation of OSI's.
- o The U.S. labor force will be increasingly composed of women; until these new entrants become proficient with the training, their productivity may be lower than the labor force average on the whole.
- o The concept of job "ownership" will become increasingly institutionalized through the next decades. Productivity is unlikely to be increased as a result of the increased job security.
- o If, as forecast above, investment incentives decline, the U.S. economy will shift away from being capital intensive toward being labor intensive, further pressing productivity downward.

Effect 3. A continued downward movement in productivity of the U.S. labor force will persist amidst momentary improvements through the time period of this study. This will further complicate the government's initiatives in attempting to promote OSI universe growth. In short, low or marginal productivity rise will introduce further uncertainty in the future of the OSI universe.

Issue 4. Toward the end of the time period of this study the MNC is likely to emerge as a major international political as well as economic force. The intensity of this threat will depend upon how well U.S. capitalism supports itself

through the remaining years of the century, as well as the effectiveness with which foreign MNC's develop their own strength. Our forecast is that there is at least a low probability that foreign MNC's will threaten our offshore resources by the end of the century.

Effect 4. The uncertainty and ambiguity surrounding U.S. policy in OSI development will create fertile ground for intrusion by foreign dominated MNC's.

Issue 5. During the last two decades the regulatory activity of the federal government has virtually exploded. The result has been strident claims by industry that it is being smothered out of existence by regulations. The evidence supports at least portions of these claims. Most of the regulations that are under attack are procedural rather than substantive, and hence do in fact require extensive detailed attention to implementation and enforcement. Media accounts of some of the most flagrant examples do in fact reflect absurdities. This burden on industry can be reduced if regulatory bodies shift away from procedural and move toward substantive regulations that impose significant penalties on violators, but based only upon adverse results--rather than on procedural violations. Our forecast is that there will be a move in this direction, but that it will be extremely difficult to implement because of the vested interest that regulatory personnel have in massive amounts of detail which add to job expansion and security. A large opportunity exists for regulatory bodies covering the OSI universe to contribute to the desirable shift; if they are effective the incentive for private industry to invest will be increased.

Effect 5. A countervailing force to the above could be improved regulatory processes by the federal government--to the point of improvement in the effectiveness vs. efficiency balance. Should this occur, it would tend to promote healthy expansion of the OSI universe.

Issue 6. One of the most fundamental issues of relevance is the direction that U.S. capitalism is to take during the remainder of the century. A direction toward increased centralized government-assisted planning will mean one thing to the OSI universe, while a direction toward accountability and renewed independence and strength of the private sector will mean quite another thing. The nature of the emerging OSI universe will be different and the management of it will be different, depending upon the direction taken. The conflict is fundamentally between the basic values of efficiency vs. equality in American production systems. The outcome of this issue appears now to be more dependent upon the aggregate U.S. population than on governmental decisions. Our forecast is that the dominance of "equality" will diminish, but not sufficiently to avoid institutionalizing the planned capitalism that represents a step toward a socialistic society. At the same time we recognize that the values of private enterprise capitalism are deeply rooted in U.S. philosophy, history and institutions and may not be altered beyond small deviations. Certainly significant alteration will occur only through vigorous debate. The future of offshore development will hinge upon the outcome of this issue.

Effect 6. A second countervailing force could be reaffirmation of the independent role of private enterprise in the U.S. economy. In the absence of established systems of governance in the marine environment this is not likely to occur to the degree necessary for significant impact on the growth of the OSI universe.

Issue 7. Environmental quality will continue to be an issue throughout the period of this study. Toward the end of the century protective measures will become considerably more institutionalized than they have been in the last two decades; however, a three-way conflict will continue to rage between environmentalists, and the producers, and the energists. Our forecast is that although

the environmentalists represent the pro-planning forces, by themselves the environmentalists will not be decisive; the outcome will depend more on the outcome of the issue described in paragraph 6 above than specifically on the environmental issue.

Effect 7. The environmentalists will slow but not stop OSI universe growth; as the technology of environmental protection and restoration improves, the slowing effect of the environmentalists will diminish.

APPENDIX TO CHAPTER 3, VOL 1

MACRO FRAMEWORK TAILORED TO COAST GUARD FUTURE

This appendix forms the structure for collection of data on the macro environment; it constitutes a structuring of the universe external to the Coast Guard in such a way as to render data collection on that universe most relevant to the Coast Guard.

Military

• Global/Regional/National

- Structure of global military alignments by region and country
- Structure of regional military alignments by country
- Networks of military assistance:
 - Sources and beneficiaries
 - In-country force deployments
 - Advice/materials only
- Trends and developments

• Capability*

- Strategic offensive
 - ICBM
 - SLBM
 - Aircraft borne
 - Space borne
- Strategic defensive
 - Anti-ICBM
 - Aircraft interceptor
 - Anti-air missile
 - ASW
 - Antisatellite
 - PBW
- General purpose
 - Ground
 - Air
 - Naval
- Support
 - Logistics (incl. non-mil. transp.)
 - Transportation - military
 - Command and control
 - Mobilization, reserve
 - Stockpile
 - Communications and EW
 - Civil defense
- Unconventional warfare
 - ABC
 - Terrorism
 - Paramilitary

- Research and development

By above categories of capability

Plant and equipment

Relationship to:

government
industry
universities

State of the art in military technology

• Role of Military in Government Society

- Structural relationship
- Political relationship
- Societal/social relationship
- Relationship to industry
- Military budget

• Resource Base

- Material

Fuel
Non-fuel mineral
Building materials
Food
National infrastructure

- Personnel

Education/skill/competence
Morale/esprit/patriotism
Sources

- Availability of substitutes

• Intentions

- National military policy-- operational vs rhetorical
- Alliances/alignments/adversaries
- Use of force, direct & indirect
- Avoidance of use of force

*This and subsequent headings are by country, with occasional regional descriptions as appropriate.

Military (cont'd)

- Specific orientation to U.S., U.S.' allies, and UN
- Military strategy
 - offensive
 - defensive
- As perceived by adversaries/allies
- Geographical Environment
 - Sources of military resources
 - Topography
 - Urban/rural complexion
- Current Deployment/Operations/Posture
 - Same categories as "Capability" above
 - As perceived by adversaries/allies
- Biographic Data
- Data/Information Sources
 - Overt
 - Clandestine

Political

- Global/Regional/Country
 - Political alignments/conflicts/strengths
 - Economic
 - Geographic
 - Continental
 - Seas and bodies of water
 - Atmospheric
 - Space
 - Special Issues (see p.)
- Ideologies*
 - Consensus
 - Conflicting
 - Operational/rhetorical
 - Party systems/factions
 - Human rights
- Government
 - Structure/form: national, intermediate, local
 - Executive form
 - Legislative form
 - Judicial form

- Public structure vs effective structure, i.e., actual vs ostensible power sources

Motivation
Balance/durability
Instabilities
Special interest groups
identity/size
power effectiveness
motivation

- Role in economy management

• National Security

- Policy
- Arms control
- Nuclear proliferation

• Foreign Policy: operational/rhetorical

- Region } alliances/alignments
- Country }
- Relation to: U.S./West/UN/USSR/PRC

• Roles of Military

- In policy formulation
- In structure
- In party/special interest group system
- Ostensible/actual
- Stability/volatility
- Position inre ideologies: conformity/conflict

• Current Posture, Trends and Issues

- Internal
- External
- Drug traffic

• Biographic Data

• Data/Information Sources

- Overt
- Clandestine

*This and subsequent headings are by country, with occasional regional descriptions as appropriate.

Economic

- Global/Regional/Country
 - Trade and finance patterns
 - Interdependencies
 - Special issues (see p.)
- System Characteristics
 - Free enterprise
 - Socialist
 - Tradition
 - Command
 - Mix
 - Military system
- GNP
 - By components: C, I, G, FE
 - By industry: agriculture, manufacturing, retail, ...
 - By value added: raw, ...retail
 - By income recipient: wages, interest, profit
 - Trends in above: capacity, utility, business
- Industrial and Business Complex and Activities
 - Raw material process
 - Manufacturing
 - Commerce
 - Agriculture
 - Services
 - Retail
 - Transport/communications
 - Patterns of concentration
 - Geographic distribution
 - Relation to government-regulations, etc.
 - Multinational corporations
- Indications of Economic Well Being
 - Price stability
 - Labor force/productivity
 - Employment/unemployment rates
 - Growth rates
 - Income distribution
 - Investment rates
 - Poverty
 - Dependence/Interdependence
 - Trade/markets
 - Resources
 - Economic aid

- Relation to Military Capability
 - Weapons production/support
 - Capability
 - Practice
 - R&D
- Foreign
 - Policy
 - B O P; trade balance
 - Trade partners
 - Availability of exchange
- Economic Policies
 - Policy making machinery/structure
 - Policies: operational/rhetorical
 - Foreign
 - Domestic
 - Policy makers: identity, motivation, effectiveness
- Current Issues and Trends
- Biographic Data
- Data/Information Sources
 - Overt
 - Clandestine

*This and subsequent headings are by country, with occasional regional descriptions as appropriate.

Physical Resources

● General

- Efficiency of usage
- Location/distribution (indigenous, foreign sources)
- Reliability of access
- Essentiality
- Substitutability
- Demand/Supply
- Chemical/physical/climatic properties and characteristics
- Acquisition characteristics/means
 - Cost
 - Technology
 - Natural/synthetic
 - Lag/lead times
 - Renewability/exhaustibility
 - Recycling/conservation
 - Capital investment
- Environmental effects

- Energy - Coal, shale, tar sands, crude oil, natural gas, fissionable materials, solar, wind, geothermal, tidal/hydroelectric, marine thermal gradients, fusion
- Raw Materials - Minerals, fertilizers, construction materials, other
- Land - Cropland (food, fiber), grazeland, urban/transportation land, park land
- Water - sources (rain, surface, ground, saline)
 - Agricultural uses
 - Industrial uses
 - Municipal uses
 - Fisheries (fishing and aquaculture)

Climatological/Geological

● Autonomous Climate Trends

- Moisture
- Sunspots
- Natural catastrophies incidence
 - Precipitation (flood/blizzard)
 - Wind
 - Lightning

● Autonomous Geological Trends

- Tectonics
- Coastal erosion
- Earthquake/tidal
- Volcanic eruptions
- Rising/sinking islands

● Climatic and Geological Prediction

- Technological development
- Resource allocation
- Short run/long run

● Geologic Manipulation/Disruption

- Technological development
- Resource allocation
- Short run/long run

Environment

• General

- Disruptive events
- Manipulative events
- Unexpected events/knowledge trends
- Externalities
- Relation to economic growth
- Man's welfare
- Pollution characteristics

Radioactive
Thermal
Toxic
Contaminant
Long run/short run
Lagged effect

• Air

- Ozone depletion
- Emissions: carbon, oxide, particulate
- Direct and indirect radioactivity
- Water-to-air transfer

• Land

- Waste disposal and sewage
- Wasteland developments
- Introduction of chemicals & other materials

• Water

- Air-to-water transfer
- Solid waste and sewage
- Chemicals
- Special materials
- Accidental infusion
- Thermal

• Esthetic Impairment

- Structures
- Vessels
- Activity

• Topography

- Elevation profiles
- Hydrography
- Vegetation profiles
- Land use profiles
- Infrastructures
- Resource distribution
- Political subdivisions
- Demographic distribution
- Urban/suburban/rural

Population

• Number

- Economic State
- Age Distribution
- Sex Ratio
- Labor Force

- Nature and number
- Participation rate
- Productivity rate
- Sex distribution

• By Country

• Structure

- Stratification

by nationality/ethnic group
by profession
by income
by heritage
by position
other

- Mobility -- among strata

-- Relation to

economy
political structure

• Culture

- Beliefs

political-economic
religious
values
moves
role-defined
tradition-effect
structure of loyalties

- Institutions (noneconomic, nonpolitical)

religious
educational
social
recreational
health
criminal
altruistic

• Education

- Philosophy
- Institutions
- Relation to state
- Relation to religion
- Relation to private enterprise

(continued)

- Standards of accomplishment
- By discipline, by population, by employment
- Imported/exported
- Cohesiveness of Society
 - Social structure vs political structure
 - Intrastate conflicts
 - Disparity of ideologies
 - General esprit, patriotism
- Current trends and issues
- Biographic Data
- Data/information sources
 - overt
 - clandestine

Science and Technology

- Science activity
 - By subject and phase (basic/applied)
 - nuclear
 - nonnuclear
 - Lasers
 - By technology
 - Relation to industrial base
 - Relation to military
 - By source of funding
 - government
 - industry
 - university
 - By source of effort
 - government lab/office
 - industrial lab/office
 - university lab/office
- Extant Technology
 - Industrial by topic
 - nuclear
 - nonnuclear
 - Lasers
 - Military by topic
 - nuclear
 - nonnuclear
 - Lasers
 - Nonmilitary government by topic
 - nuclear
 - nonnuclear
 - Lasers

- Commerce by topic
- Communications by type
- Investment in Technological Development
 - Government/military by topic & source
 - Government/nonmilitary by topic & source
- Role of S&T in culture
 - Philosophy/ideology/values
 - Relation to institutions
 - Conflicts
- S&T Policies--Operational/Rhetorical
 - Government
 - Industrial
 - University
- University Base
 - Number and type
 - Committed to S&T
 - Graduate profile
 - by discipline
 - by employment
 - relation to job market
- Technology Transfer
 - Within country between elements
 - Export
 - Import
 - Efficiency
- Biographic Data
- Data/Information Sources
 - Overt
 - Clandestine

Worldwide/International and Special Issues

- Nuclear proliferation
 - Selected nations' capability
 - Pressures to export nuclear technology
 - Barriers to export
 - Incentives to import
 - Barriers to import
 - Possible consequences of import/export
- Terrorism
 - Proclivity (historical)
 - Capability: by type
 - Intentions: by type
 - Possible consequences

- International Trade & Balance of Payments
- Ethnic Conflict
- Religious Conflict
- Rich vs Poor Stress Points
- Drugs
- Arms Limitation
- Ocean Use and Exploitation
- Raw Materials
 - Fuel
 - Nonfuel mineral
 - Food
- Demography Stress Points
- Multinational Corporations
- Worldwide Technology Stress Points and Issues
- Biographic Data

CHAPTER 4: MARINE ENVIRONMENTAL FORECAST

This chapter identifies the long-term issues likely to arise in the marine environment from the conditions forecast in the preceding chapter, and then identifies the key variables in the marine environment that are most likely to experience change. The chapter's major sections are "Long-Term Issues in the Marine Environment" and "Key Dimensions of Change in the Marine Environment". The contents of the chapter derive from the methodology, presented in Chapter 2, operating on the "Marine Environment Framework", presented in this chapter's appendix.

LONG-TERM ISSUES IN THE MARINE ENVIRONMENT

The long term issues likely to emerge in the marine environment may be categorized as legal/regulatory, socio/economic, and physical/environmental. These are the subheadings that follow.

Legal/Regulatory

Three sorts of issues are likely to dominate the legal and regulatory aspects of the growth of the offshore installations universe. Questions of jurisdiction and governance in the regions of the oceans now governed almost exclusively by traditional concepts, such as "freedom of the seas", may not be settled for many decades, but will intensify with considerable acceleration within the next one or two decades. The growing ambiguity and conflict between public interest and special interest in the power distribution and assimilation processes of government in the U.S. will emerge with poignant effect as the allocation of the ocean's resources becomes an increasingly important public issue. The debate on the social value of the overhead costs of regulation will lead toward

Jurisdiction and Governance

- o Capital investment on a massive scale will be required to exploit the resources of the marine environment; only the very large corporation or government commands aggregates of capital of this magnitude.
- o No nation-state or private corporation is likely to make investments of the required magnitude without the protective umbrella of a system of governance.
- o The concept of "governing" the marine environment is new; to this point "freedom of the seas" has been the principal governing concept and has not required a highly active governing body; the marine environment has served its users adequately under a degree of anarchy--anarchy in the sense of absence of rulers, though not in the sense of absence of rules.
- o Only in the last decade has an inroad been made into establishing some form of dynamic governance in the marine environment; this has been in the action to establish fishery conservation zones. The only other serious attempt has been in connection with deep-sea mining of nodules; and here UNCLOSS III has become enmeshed in controversy to the point of severely inhibiting growth of any form of governance. The drive to extend a system of governance into the marine environment originates in three sources--the UN, the U.S. federal government, and the individual states of the U.S.
- o One of the principal barriers to extension of governance into the marine environment has been adherence to "pluralism" in the U.S.--the concept that all groups and parties to a decision must have a say, and as it works out in practice, any one party has power of veto.
- o As it appears to be emerging at the present time, governance in the marine environment may be categorized along three different lines--geographic, functional, and by actor
 - Geographic: states have jurisdiction out to three miles, the federal government from three miles to 200, and ambiguity governs beyond that.
 - Functional: the U.S. and other maritime nations have asserted right of jurisdiction out to 200 miles, specifically for fisheries, and to a lesser extent for "economic" activities. International law seems to remain accepted in the dimension of transportation--i.e., freedom to transit the seas for commercial purpose is not yet in jeopardy.

- By actor: The U.S. and certain other nations have agreed on certain roles for implementation in a number of the world's fisheries--not confined to waters adjacent to the parties
- o Although for decades the "3-mile limit" was considered sacrosanct and unlikely to change, four basic zones that have emerged in recent years appear to be defined for the present, but appear likely to extend seaward with time. These zones at present are: 0-3 miles; 3-12 miles; 12-200 miles; and beyond 200 miles.
- o The oil companies have been building and operating off-shore structures for the last 25 years, and corporation law has kept pace in terms of covering issues that have arisen. However, most of the rigs have been within the 3-mile limit, have involved only small numbers of personnel, and have in the aggregate represented a very simple off-shore economic complex. Complicated issues of human rights, crime, tort, mutual interference among economic interests, anti-trust, or even environmental matters have infrequently arisen. Coordination between private enterprise, state and federal government has been required, but in a relatively simple context. Virtually no issues have arisen in terms of major conflicts; and those that have (e.g., the recent Mexican well blow-out) have not been fully resolved.
- o Only preliminary considerations have been given to the problem of zoning; and without some form of governing system this issue cannot be addressed in any substantive way.

Public Interest vs. Special Interest

- o The U.S. economy and democratic systems have matured to the point that "public interest" includes pluralistic concern for certain private interests. Public interest connotes the greatest good for the greatest number; private interest connotes a minority interest which could be harmed by a public interest--e.g., such an interest may be narrowly defined but relate directly to the public well-being. This concern for the legitimacy of private interests is a factor in many political decision. Blurring the issue has been the extremely rapid growth of "special interests"--the exclusive interests of certain groups, usually economic, whose interests are satisfied only at public expense in some form. These special interests are often served by masking the distinction between public, private and special interests; and such masking may lead to decisions that are in neither public nor private interest and to extraordinary delays while unmasking takes place.

Regulatory Effectiveness Criteria

- o The increasing importance placed upon commutative and distributive justice in the U.S. has led to the explosion of regulatory activity. The pendulum has swung in many instances past the point reasonableness, from the point of view of venture capital. A new order of regulatory effectiveness and efficiency may emerge in which balance is struck between achieving "fairness" and protecting the unwary on the one hand and freedom from unnecessary restraints and hobbles on the other. Declining productivity in the U.S. may foster this new order. If this new order of regulatory effectiveness does not emerge, the growth of economic activity in the marine environment may be slowed significantly.
- o Concurrent with slowing of economic growth in the marine environment due to regulatory impediments, may arise an increase in government initiatives in the marine environment to exploit its resources.
- o Concurrent with increased government activity in the marine environment--whether regulatory or in economic initiatives--will be an increase in interagency competition for cognizance. This competition is likely to be to the disadvantage of the overall U.S. economy, the consumer, the private enterprise system, and to the government as a whole.
- o A "lead agency" concept is becoming increasingly important to implement.

Socio/Economic

Issues of equity in the sharing of offshore benefits, and of the onshore effects of offshore developments will be the major socio/economic issues raised by the conditions forecast for the end of the century and slightly beyond.

Equity

- o Space allocation. Already conflict has arisen between oil interests and environmentalists with regard to equitable allocation of space. If the economic activities of the marine environment expand rapidly, the controversy is likely to take on proportions of an order of magnitude higher than we have experienced to date. One of the functions of governance will be to make space allocations against criteria of equity, and benefit to the economy as a whole. The Coast Guard's sea zoning study is a preliminary address of this issue.

- o Value capture and user charges. As the economic activity in the marine environment grows, the issue of payment proportionate to benefit will arise, and may stimulate action to attribute charges to beneficiaries. These beneficiaries will fall into two categories, the actual users of the output of the activity and those who benefit only indirectly from the activity--e.g., businesses that accrue increased sales revenues from the activity, businesses whose sales are enhanced from secondary activity, etc. Should tax dollars play a large role in this capital investment, these issues are likely to loom large.
- o Shared security responsibility. Whereas the Coast Guard is charged with insuring the safety of personnel embarked in vessels, and some of the offshore structures may fall into the category of "commercial vessel" for this function, if the offshore structure universe expands by integral factors, the sheer weight of work load on the Coast Guard will become prohibitive; a means of sharing responsibility will be a necessity.
- o Shared navigation/communications support. The Coast Guard again will experience overload under conditions of drastic expansion of economic activity in the marine environment. The overload will be far less than that in the security function, but is likely to be sufficiently high that some sharing of work and costs will be required. This will be particularly so with respect to local communications and local navigation aids.
- o Balance: benefit vs. investment. Whatever rules are evolved by the governing activity, growth of the economic component will be sensitive to how well these rules incentivize investment. Inadequate incentive will lead to the need for gradual government usurpation of the private enterprise function. Tax policies will be crucially important.

Onshore Effects

- o Employment. The primary effect of build-up of the offshore structures will of course be an increase in employment opportunities in adjacent on-shore areas. In addition we may expect secondary effects in terms of a change in the complexion of the local labor force. The newly employed workers may be expected to be higher paid, transient, and less susceptible to integration into the local community than the local people would prefer. Their presence may push up the wage rate among other local workers. The period of construction of an offshore complex may be months long, leading to an influx of workers for that purpose alone. These will be transient and from the point of view of the local populace less stable than would be desirable. Where the local area was initially sparsely populated, the influx of workers will create new towns

and centers of population, possibly disrupting local small townships and rural or fishing village settlement.

- o Business stimulation. The stimulation of local business is likely to derive more from the increased support activity of off-shore structures than from the direct use of the output of these structures. For example, an oil rig complex may pump oil directly out of the area of pipelines, with little or none of it having any impact upon the local area. However, the increased activity in support of the rigs is highly likely to lend to heavy business stimulation locally.
- o Facility support. Each off-shore complex will require an on-shore facility to support it. These will vary with the nature of the off-shore functions, but may be expected to be largely energy related for the remainder of the century.
- o Community development. As the density of off-shore complexes increases, the effect on the on-shore components may develop to the point that the off-shore industry dominates the community. Over a time period of several years or decades this will lead to entire communities oriented to the off-shore industry. They will develop their own social and economic characteristics and come to be identified as distinctly as the various industrial urban metropolitan areas are today.

Physical/Environmental

The physical/environmental effects of offshore build-up will be both direct and indirect, or primary and secondary. The direct effects will be the changes in the physical characteristics of the region brought about by the physical developments offshore. The indirect or secondary effects may be even more important than the primary effects, but will not be as evident and will take longer to manifest their significance.

Primary Effects

- o Extensive build-up of offshore installations will bring about significant changes in regional geography. The operating structures themselves will be only a part of this change; ancillary structures will be constructed,

traffic bearing conduits will be built, and support facilities of a variety of types will emerge including breakwaters and artificial harbors, etc.

- o Traffic patterns will change both from the effects of the installations on in-transit traffic, and from the build-up of local traffic associated with the installations complexes.
- o Industries involved in extraction of living resources will also be affected. These will include fishing, crabbing, and all the other types of living resource extraction activities. Fishing grounds will be altered in location and often in their fundamental nature; new and different species will be fostered, while other species will find the new environment less supportive than previously and will diminish in population. Environmentalists, fishermen and other special interest groups will raise strident objections, and will predict extreme and adverse effects from the new installations, most of which will not be born out in subsequent experience. On the contrary, a number of new and potentially exploitable types of living resources will be found to thrive, giving rise to new and unpredicted business opportunities.
- o The natural environment will be changed, but not necessarily adversely. The intrusion of man-made structures into the environment will be damaging to some elements of the environment, but stimulating to others.

- Construction activity and its debris:

This will cause a temporary disruption to balance in nature:

Some species of fish will be driven away, and their predators with them;

Some scavengers will be attracted, and their predators with them;

Some plant life will be temporarily destroyed, while other forms of plant life will be stimulated by the absence of some of the fish life that has previously kept it in balance;

As time approaches the end of the century, pollution is likely to be reduced; this will result from increased pressures from environmentalists, from increased understanding of the mechanisms of the oceans' self-healing and self-restoration characteristics, and from advances in environmental technology.

- New types of underwater construction processes will be developed that make use of the natural organic activities of the oceans to contribute to the construction process itself--e.g., the use of low voltage electrolytic techniques to fill in structure frameworks, once the basic network of the structure has been deposited.
- Operational activity and its debris will make necessary a readjustment in nature's balance in most of the dimension described above; this readjustment will involve transient changes at first followed by gradual adjustment to steady state conditions.
- The presence of foreign bodies in the oceans will also be a source of alteration in the balance of nature. Marine growth has always been a problem for ships and harbor facilities and it will continue to so. However, it is likely to become susceptible to control and redirection in constructive ways by the end of the century.
- o The changes just over the horizon and described here will lead to vociferous objections from a variety of special interest groups, including but by no means dominated by the environmentalists, as these changes emerge and appear to give advantage first to one then to another of these groups. These conflicts will present a demand for attention and resolution by whatever body of governance may be emerging in the marine environment.

Secondary Effects

- o The maintenance and hygiene of the marine environment will become a major activity in itself, involving heavy concentration of attention from both governing bodies and private enterprise.
- o Developments and extensions in marine science and engineering will emerge that yield opportunities to exploit the oceans' self-resuscitating capability; these developments will have by-products in other applications and are likely to stimulate the development of new business activities.

KEY DIMENSIONS OF CHANGE IN THE MARINE ENVIRONMENT

The focus of the changes in the marine environment being driven by the forces described to this point are along the dimensions of economic, political/military, environment (including waste disposal), and science/technology. Each of these is discussed below.

Economic

Transocean and coastal shipping will increase, with a relatively larger increase in foreign ships than in U.S. ships.

Increased traffic density, especially near port entrances, will require improved forms of traffic control; much of this control will be automated, along the lines of air traffic control, but only after litigation over ship captains' rights and responsibilities.

The number of specialized craft will increase. Surface-effect ships, hydrofoils, etc., will come into increased usage. Specially designed craft for processing extracted resources will appear. For example, ships with capability to receive oil and/or gas directly from wells are foreseen; ships with capability to "double" as offshore structures and to weather conditions that would be too hazardous for personnel exposure; containerization will increase.

The number of Deep Water Ports will increase as the administrative complexity of licensing, leasing, and regulation is gotten through.

Commercial submarine craft may become useful, although significant numbers are not forecast before the end of this century.

U.S. ship-building capability is likely to increase, but only slightly, unless productivity in the industry improves.

Political/Military

Traditional concepts of political/military relationships in the marine environment are rapidly becoming archaic.

Freedom of the seas as a fundamental principle of international law has already become modified through both international agreement and through unilateral action by maritime nations, including the U.S. As the resources of the oceans

have become more clearly accessible on economically acceptable terms, the nations with capability to exploit these resources have asserted claim to jurisdiction of regions adjacent to their coasts, in order to acquire exclusive or near-exclusive access. This has occurred with respect to both living and non-living resources. A competing concept, that of "common heritage of mankind", has been set forth which claims that all nations, not just those with access and/or capability, should be allowed to share the benefits of these resources. We are thus entering an era in which we may expect that the claims of many nations will be heard for the resources of the oceans, and during which the issue is not likely to be settled without extensive controversy and conflict.

Whatever form of governance emerges, it appears clear that one of its consequences will be increased constraints on all forms of action in the marine environment. This will include military action; what has been perceived to be military action in the past may well become purely police action in the future. As such, the agent of its execution may shift away from military forces to police forces. On the other hand, international aggression in new forms, such as sabotage of structures, capture of personnel, etc., may be clearly military in nature, but not susceptible to being controlled by conventional military forces; antisocial action of this nature may, however, be susceptible to control by the Coast Guard.

Concepts of "ownership" are likely to emerge which are quite different from those established over many years of usage in the land environment. In order to incentivize private investment in developing marine resources, it will be necessary that some form of governance be established that forms the basis for a clear and well understood concept of the rights and responsibilities of investors whose risk leads to capital formation of the massive sort needed

to exploit resources in the oceans.

The governance function that is ultimately established in the marine environment will be required to provide for zoning of regions in order to minimize mutual interference and conflicting claims. Before a system of zoning can become institutionalized on a large scale it is highly likely that a great deal of time and administrative effort will be required. Our adherence to "pluralism" will demand that all parties be heard; this process may become interminable, and will surely be at least time consuming.

The individual states will take on increasing jurisdiction of that part of the marine environment within the 3-mile limit. This will relieve the federal government of significant amounts of administrative details, but will require coordinative action by either regional bodies or the federal government.

The fundamental role of the oceans as barriers between nations is changing into a more complex role of combination barrier and conduit. The oceans are becoming focal points for international cooperation and simultaneously for international conflict. New forms of conflict will be made possible by the mere presence of the valuable capital of individual nations. Piracy, terrorism, and sabotage are examples at the more conventional level of international conflict; seabed ICBM launchers are examples at the higher level.

On balance U.S. vulnerability to hostile action by a foreign power will be increased as the U.S. becomes increasingly successful in injecting major units of its economy into the marine environment.

A requirement concomitant with this increased vulnerability of the U.S. will be significantly improved surveillance of the marine environment, together with the capability to respond to when this surveillance indicates that trouble is brewing.

The role of conventional naval forces is declining.

Environment and Waste Disposal

Environmental consciousness is likely to protect the ocean environment from excessive harm, but only at the expense of considerable time and effort devoted to deliberation and litigation. This latter will involve intra- and international negotiations and conflict. Out of it will emerge institutionalized ways of preserving the environment.

A major issue will be the dumping of nuclear waste products. Safe, but expensive ways will be found to effect this dumping but only after considerable time.

Interest in environmental protection will stimulate technical advances in surveillance capabilities.

Science and Technology

The science and technology of the ocean is likely to experience a quantum increase in attention and effectiveness. Rather than being an extension of the science and technology of the land environment, the oceans will begin to be viewed as systems in themselves. This activity will lead to new and unforeseen ways of making use of the oceans and their resources. For example, an aspect already alluded to is the capability of the oceans to resuscitate themselves after environmental damage has been sustained.

Technological capabilities in communications, surveillance, and navigation will be improved very significantly. This will include satellite technology and photographic technology.

The areas of most emphasis will be those related to resource extraction, particularly energy extraction. In the early years oil and gas will receive the predominant emphasis, the OTEC, and possibly solar/wind systems, wave, current, geothermal and even fusion power systems will be given attention.

APPENDIX TO CHAPTER 4, VOL I

MARINE ENVIRONMENT FRAMEWORK TAILORED TO COAST GUARD FUTURE

This appendix forms the structure for collection of data on the marine environment-- the universe in which the Coast Guard conducts its operations.

o Economics

- Transportation

Transport modes

Surface waterways
Subsurface waterways
Bridges and causeways
Tunnels

Types and number of vessels/vehicles employed

Over surface
On surface
Beneath surface

Location and volume of vessel activity

Open seas (beyond 200 miles)

International waters
Multinational waters
National waters
Within 200 miles of coast

U.S.

Pacific
Atlantic
Gulf of Mexico
Gulf of Alaska

Other nations

Within 3 mile limit

Ports/harbors/marinas

Inland waterways

Purposes of vessels' activity

Transport industrial materials

Transport passengers

Recreational leisure vessel: Public
Personal

Political

Military/warfare

Other

Materials carried (types and volumes)

Legal cargoes

Hazardous
Nonhazardous

Illegal cargos

Hazardous
Nonhazardous

Packaging/containers employed

- Communications

Safe navigation

Dialogue and messages

Traffic management

Emergency assistance

- Industrial processing

- Recreational

Water sports

Involving vessels
Not involving vessels

Water hobbies

Involving vessels
Not involving vessels

A "spiritual" retreat/renewal

Involving vessels
Not involving vessels

Marine entertainment functions/
industry

Underseas visitation centers
Underseas restaurants, etc.
Underseas resorts

- Waste management

Processor to collect, decompose
or absorb waste

Carrier of waste to planned
destination

Residual depository

o Political/Legal

- International

Convention/tradition

LOS

Controversies

Individual issues

- National

LOS

S&L

Coastal zone specifics

Jurisdictional issues

APPENDIX A TO CHAPTER 4, VOL I

MARINE ENVIRONMENT FRAMEWORK

• Political/Legal (cont'd)

- Demarcation territorial sovereignty
 - Within nations (subnational boundaries)
 - Between nations (national boundaries)
 - Among nations
 - Multinational
 - International
- Barrier/Integrator
 - Separator land to land
 - Commerce
 - Personnel movement
 - Among nations
- Marine logistics as national economic base
 - Shipbuilding and maintenance
 - By vessel type
 - Marine equipment and maintenance
 - Including ship components
 - By equipment
 - By volume and industry
 - Employment of vessel operators
 - By vessel type
- Marine resources as a source of economic wealth and development
- Main relationships to national growth and development patterns
 - Irrigation and land agricultural productivity
 - Transportation network for Ind./Comm. development
 - Water supply/functions for community service/utilities for economic base
- Marine environment as "an economic unit" of diversified potentials
- Marine law/legal system
 - Component of sovereign territory
 - International "commons" or "shared resources"
 - Multinational "commons" or "shared resources"
 - National "commons" or "shared resources"

U.S. States "commons" or "shared resources"

Local jurisdiction "commons" or "shared resources"

Vessels as sovereign territory

Ownership of resources

Rights of Use

For resource exploitation

For passage

For waste disposal

For experimentation/research

For development of military (naval) capability

For other "occupational" purposes

• Military

- "Moat" against military aggression
- "Avenue" of military aggression
- "Avenue" of national power
- Provides a "cover" for attack

• Science and Technology

- Basic science and knowledge
- Marine resource management and development
- Marine support systems management and development
- "Frontier" expansion

APPENDIX A TO CHAPTER 4, VOL 1

MARINE ENVIRONMENT FRAMEWORK

• Oceanography

- Seas
- Atmosphere
- Shelf
- Slope
- Rise
- Seabed
- Water cycles/precipitation
- Tides
- Currents
- Life systems
- Resources
- Water

Various uses and volumes

- Marine life organisms

Noncultivated

Animal } Classes/types and/or
Plant } functional uses

Cultivated

Animal } Classes/types and/or
Plant } functional uses

Materials harvested

In directly usable form
Inputs to further processing

Minerals/ores mined

From water
On beach
Beneath floor

Energy Generation system

Tidal forces and dams
Wind/solar collection and
conversion system
Thermal gradient system
Hydrolysis

Alternative land siting

Habitation

Housing
Communities

Plant location

Plant location

Floating nuclear or energy plants
Floating industrial plants

Landfills/dumps for solid waste

• Geographic

- Boundaries
- Geography-specifics
- Coastal dynamics

CHAPTER 5: OFFSHORE INSTALLATIONS FORECAST

This chapter presents our assessment of the future of the offshore installations universe in four sections. Section I is a discussion of the principal change agents operating on the OSI. Section II describes the long term issues raised through these change agents. Section III presents the dimensions of change likely to be operative throughout the time period of this study--an envelope within which change is likely. Section IV offers our specific and conditional forecast for the OSI universe; this forecast is conditional on (1) no highly unexpected resolution of any of the issues described in Section II, and on (2) none of the outcomes of the uncertainties or critical events described in Section III occurring at the extreme ends of their probability spectra.

This chapter is complex; figures 5-1 and 5-2 constitute a "roadmap" through which the logic flow of the chapter is explicated, and the relationships of the various parts of the chapter to each other are explained. Figure 5-1 is a more detailed overview; figure 5-2 shows, by page numbers, how to find interrelated portions.

I. OSI UNIVERSE CHANGE AGENTS

From the foregoing forecasts and issues it is possible to derive an assessment of the dominant pressures toward change in the OSI universe whose sources lie external to that universe, the barriers to this change, and the uncertainties that appear to remain.

Dominance of the Energy Shortage

The over-riding pressure to build up the OSI universe is the worldwide energy shortage coupled with the perceived abundance of resources in the marine environment. We forecast that for the duration of the century this will be a strong force whether is it toward oil and gas extraction from the OSI or from extraction of other energy related resources from the sea. Toward the end of the century we forecast that other forms have become significant and will have

Figure 5-1: BASIC LOGIC FLOW, CHAPTER 5

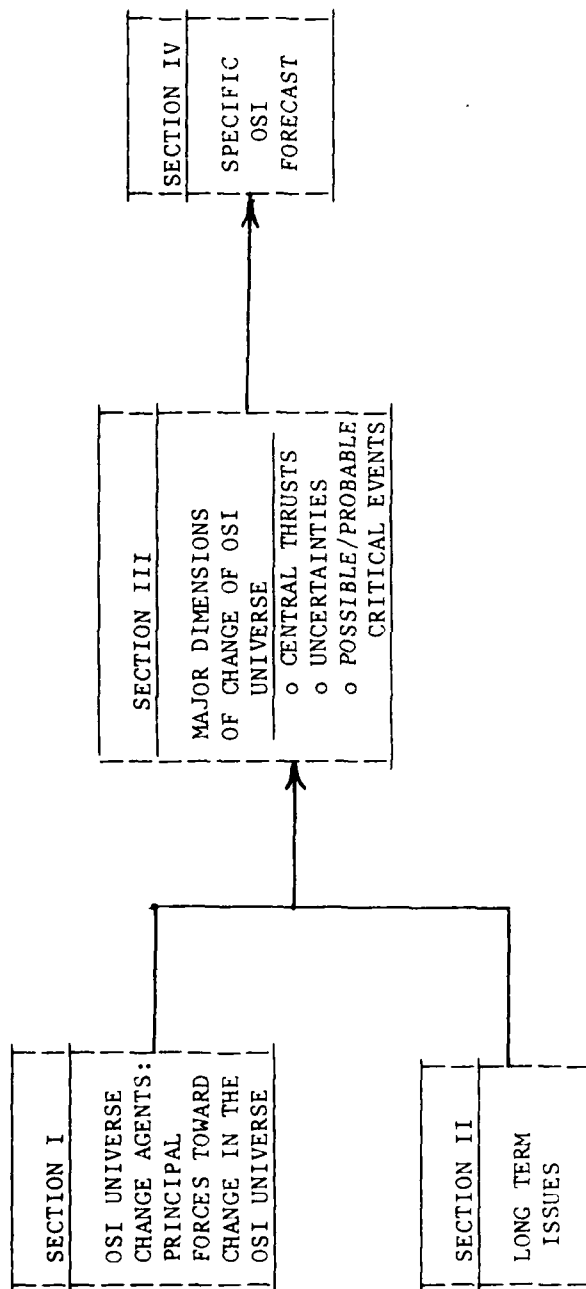
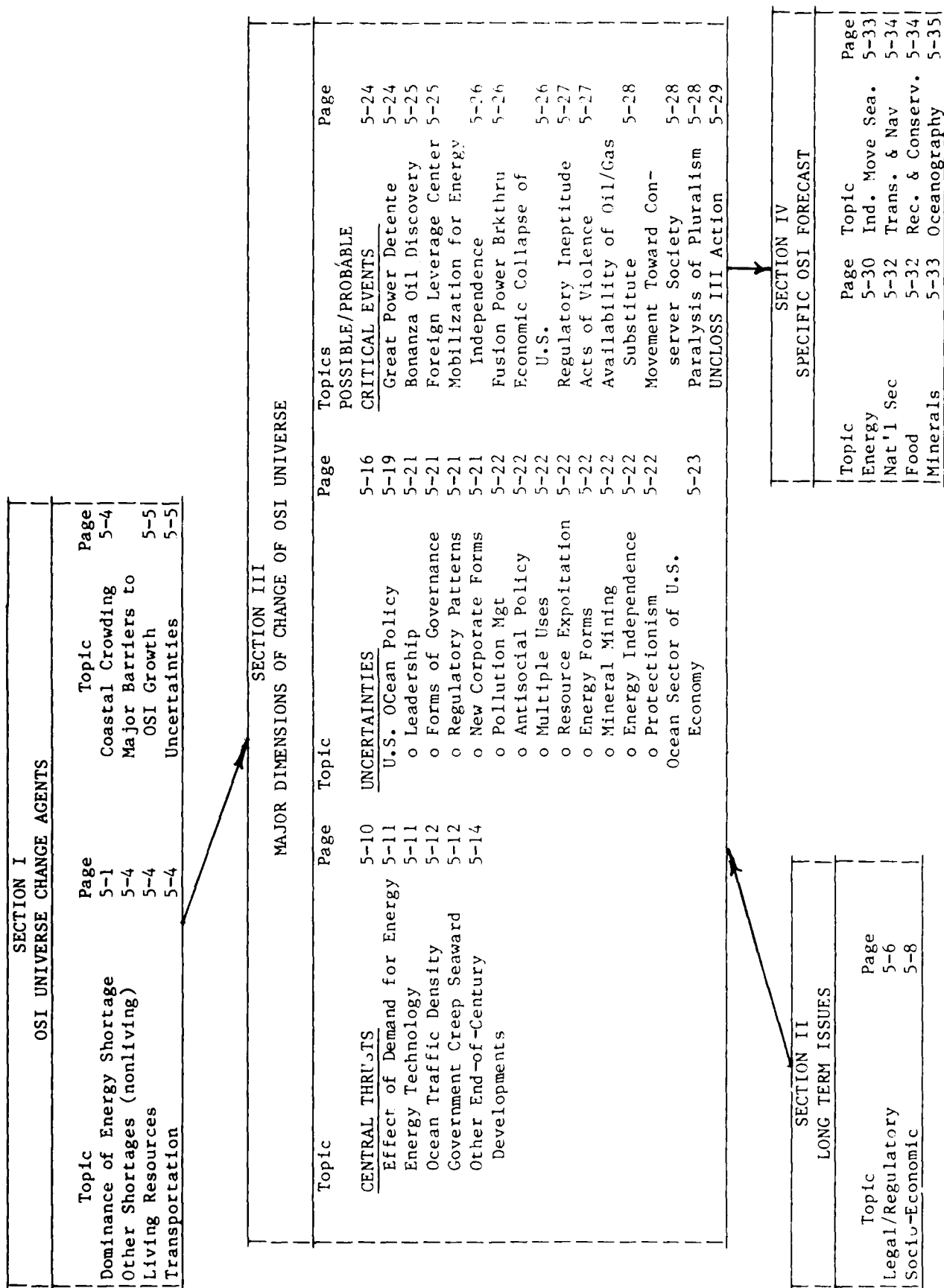


Figure 5-2: DETAILED OVERVIEW OF BASIC LOGIC FLOW, CHAPTER 5



begun to supplant oil and gas extraction as an OSI activity. Even in the event of a breakthrough in fusion power the principal pressure for OSI buildup will be for energy.

Other Shortages (nonliving)

The availability of metals and other minerals in sea water, on the sea bed, and beneath the sea bed constitute a second characteristic of the marine environment that when coupled with shortages leads to significant pressure toward industrial activity to extract these materials from the seas.

Living Resources

The pressure toward expansion of capabilities to extract living resources from the oceans will come from two sources: the worldwide food shortage that is developing; and the realization that organic materials in the oceans have commercial and industrial potential, including energy-related uses.

Transportation

The two basic characteristics "acceleration" and "interdependence" cited earlier constitute pressures toward increased ocean traffic as international trade continues to expand in high-growth economies. As the OSI universe is built up this ocean traffic will begin to make use of it for logistic purposes, giving further impetus to its buildup.

Coastal Crowding

Metropolitan areas on the U.S. east and west coasts are not crowded to the point that it would be economically feasible to construct offshore islands of any sort to accommodate spillover; however, such crowding has occurred in some instances, e.g., Norway--and they have found that displacing certain functions to man-made islands is a viable solution. Our forecast is that the U.S. by the end of the century, but the probability of crowding in combination with other pressures toward industrial activity will be significant.

Major Barriers to Growth of OSI Universe

A number of factors together constitute a force slowing the buildup of the OSI universe.

- o The oceans are inhospitable; only massive and sturdy structures survive. This means that only a high capital investment capability will permit OSI universe growth, and risks are significant.
- o Beyond the territorial waters of the U.S.--beyond 12 miles and especially beyond 200 miles--these risks are magnified because international anarchy exists.
- o Decisions with respect to buildup along the U.S. coasts are subject to delay by adherence to pluralism--the institutionalized value to permit all parties to participate--often interminably--in any decision affecting them.
- o Regulatory action may slow buildup significantly--even at times stopping it completely.
- o It is possible that the risks of heavy investment in OSI buildup are so great that this buildup will not occur without a well organized, centralized government backed program such as put men on the moon; if such is the case, then the absence of such a program is now a barrier, and we forecast it will continue to be for at least several years.

Uncertainties

The following uncertainties emerge from the ISSUES described above. Together these uncertainties render the future possibilities of the OSI universe highly varied. Decisions that depend upon any one estimate of that future should continue to monitor very closely these uncertainties and the precursors associated with them.

- o International tensions (between the U.S. and the USSR or between the U.S. and OPEC, for example) can be enormously influential in their impact upon the determination to extract resource from the marine environment.
- o The state of the U.S. economy and the associated fiscal policy can accelerate or delay federal government action in support of OSI buildup. Business investment will be highly sensitive to expectations of

profit from offshore capital formation. Confidence or lack of it in U.S. technology as a source of continuing productivity increases will also weigh heavily in these business decisions.

- o The U.S. business community's perception of the cost of federal regulatory action on new capital formation will be highly influential in business decisions to invest in the OSI universe.
- o The overall energy strategy of the U.S. will be a crucial variable in determining the magnitude of U.S. effort to extract energy from the oceans, and to promote OSI buildup. If such a strategy continues to lag, as it has during the last years of the 1970's, the commitment of resources to the task will be minimal.
- o A concomitant of U.S. energy strategy is the emphasis that we as a nation place upon energy technology and on ocean technology. Obviously if this emphasis is heavy the OSI universe will expand.
- o Although the effect of UNCLOSS III deliberations may not be felt in significant degree for several years, the long term future of the OSI universe will be heavily affected by the UN decision as to what point on the spectrum between "Common Heritage of Mankind" and "Free Enterprise" is adopted. The closer the decision is to Common Heritage the less likely will be private investment in the OSI universe at any distance from what can be clearly identified as U.S. territorial waters.

II. LONG TERM ISSUES

The organization of this section parallels the corresponding section of Chapter 4 in order to facilitate tracing the rationale of our analysis. The term "issue" has the same meaning here that it does there--a confluence of trends producing a need for some form of decision.

Legal/Regulatory

Jurisdiction and Governance

- o Assuming that components of American enterprise are at least partners in the investment to build offshore structures, the equitable determination of the rights and responsibilities of

private "ownership" of these assets will be a long and ambiguous process during which a number of conflicts will require resolution.

- The present arrangement in which the federal government awards lease-holds to bidders from private enterprise for oil exploration and extraction appears to offer a model which is adequate for the more complex, more extensive, and further distant off-shore structures forecast to be constructed by the end of the century.
- o The relative roles of different federal agencies in the above determinations has not yet been institutionalized; this institutionalization process will take considerable time and will be extremely important for the future viability of the economic components of the off-shore universe. If the issue is decided predominantly by the criterion of effectiveness in bureaucratic competition the result is likely to be less beneficial for all concerned than if it is decided by criteria of efficiency, effectiveness and equity.
- o In almost all the interaction that occurs between the federal government and private enterprise at the present time each state has a major role. As the off-shore universe moves out beyond the 3-mile limit, the states' role will be eliminated abruptly unless state jurisdiction is extended beyond this limit. So the issue will need to be addressed as to how the government-enterprise relationships will respond to the absence of state participation.
- o If the concept of "functional" jurisdiction grows, issues relating to the manner in which geographic criteria will be established and applied will arise.
- o The question as to division of responsibility for the security of material assets between government and private enterprise is likely to require considerable time and administrative energy.
- o The jurisdiction of the federal government over personnel on off-shore structures beyond the 3-mile and 12-mile limits will also require extensive consideration. The major problem of law enforcement including drug and other smuggling activities will hinge upon this issue.

Public Interest vs. Private Interest

- o This issue is likely to constitute a major barrier to the installation of off-shore structures. Each structure will be massive in size by land structure standards, and will have the potential to intrude upon a large number of on-going activities of a business and recreational nature. Each structure itself will represent a potential issue, and as the complexes increase in size and complexity the facilities

that connect structures will provide additional points of controversy. The principal issues are likely to be other business, ecological, and recreational activities.

- o Since each private interest may be represented by special interest groups of varying degrees of influence, and since each special interest is likely to be in some measure at least a public interest, the determination of equitable adjustments may be long and demanding. For example, a particularly promising oil field whose exploitation is clearly in the national interest may conflict with a local commercial and recreational fishing areas that is of virtually no importance on a national scale, but is of high significance on a local scale. The process by which this issue is adjudicated is only partially established at the present time, and will require extensive development in the future.

Regulatory Effectiveness Criteria

The many substantive matters subject to regulation by a number of federal agencies will come to focus on the off-shore structure itself. If the agencies concerned do not sort out their respective roles and responsibilities clearly, the victim is likely to be the operator of the off-shore structure. Further, if the regulatory process is not in some way streamlined to balance regulatory effectiveness against operational freedom, the investment incentive will decline and perhaps become a disincentive. This issue will arise in both the construction and in the operation of the structures. For example, in order to protect the environment a regulation may require a set of complex procedures in the actual drilling process; on the other hand the same objective may be realized with equivalent probability by incentivizing the desired results in combination with penalizing the undesired results. A company whose management is virtually certain that an oil spill is likely to cost near-bankruptcy may be more effective in averting a spill than a company whose procedures are being closely monitored with a likely minor penalty for a violation.

Socio-Economic

Equity

- o Space allocation. For each function that is performed from offshore structures, a field of influence must

be established in terms of other functions that may or may not be pursued. The governing body will have the task of establishing the ground rules for initial installation and for maintaining complex operations in which mutual interference is minimized. In this space allocation process it will be important that spontaneous cooperation among actors be allowed to contribute to the maximum; it will be easy for regulatory agents to assume their determinations are required in circumstances where in point of fact permitting the actors to work out the processes will maximize utility to all. In the other cases final decision authority will have to exist.

- o Value capture and user charge. Value capture may be implemented through some form of tax upon beneficiaries of a complex of off-shore installations. This tax would need to be commensurate with public funds allocated to the investment and/or the operation. In other words, a government subsidy of private enterprise may be justified in terms of equitable sharing of costs and benefits if that enterprise pays back to the public treasury portions of its profits commensurate with public contribution; similarly those other business operations that also benefit, though indirectly, would also return to the public treasury a share of their profit commensurate with the public's contribution. For example in the case of an oil rig complex the indirect beneficiaries might include: local boat rental companies, boat maintenance and repair facilities, equipment maintenance and repair facilities, etc. In the case of an OTEC structure on-shore maintenance and repair facilities, etc. User charges are payments exacted from the beneficiaries of facilities installed or instigated by government at public expense which offer benefits to particular segments of private enterprise or to the general public. Equitable sharing of these public expenses demands that these beneficiaries make some form of payment commensurate with the benefit they receive from the use of the facilities. An oil rig installation might benefit from government-installed pipelines, or from a communications system that facilitates the business operation.
- o Shared security responsibility. As the OSI universe builds, the burden of responsibility for security will become insupportable without some form of legitimized assignment of responsibility to the owners of assets; up until recently, "ownership" in the marine environment had only ambiguous meaning, but the rights and responsibilities of ownership will be clarified in some fashion as the OSI universe grows, and a decision of sorts will be made with respect to responsibility for asset security.
- o Shared navigation/communication support. A similar argument may be made for forecasting that a decision will be made on allocation of responsibility for communications and navigation support. As the OSI grows, this responsibility will be assigned to "owners" of assets more than it is now. The issue is how this will take place.

- o Balance: benefit vs. investment. Whether private enterprise can be incentivized to invest heavily in the oceans is a moot point; but the decision will be made within the time period of this study. The issue is: toward which end of the socialism/free enterprise spectrum will this decision go?

III. MAJOR DIMENSIONS: FORECAST OF OFFSHORE STRUCTURES

This section presents an envelope of futures of offshore structures. This envelope constitutes the broad scope within which to present in Section IV the more detailed forecasts of individual OSI categories and components. The conclusions presented in this section derive from thorough consideration of the forces at work in the macro environment, the marine environment, and the governmental environment.

We describe here three categories of influence. There are a number of Central Thrusts that are discernible in or around the OSI universe; there are also a number of Uncertainties that will bear heavily on the OSI's future, but whose future state is unknowable now and needs to be watched carefully; finally there are some possible Critical Events that are not necessarily probable, but which could occur, and if they did would have very heavy impact on the OSI universe.

CENTRAL THRUSTS

Energy considerations will dominate the future of the OSI universe through the year 2005. Other factors will be important, but will be dwarfed by actual numbers of energy installations at sea. For example crucial shortages of particular minerals are likely to erupt into the public consciousness at any time, and gradual reduction of the relative costs of recovering the more abundant materials from the shallower portions of the ocean floor will take place. But none of these is likely to be of magnitude comparable to energy.

Effect of Demand for Energy

The voracious appetite of the U.S. for increased energy resources will lead to significant expansion of activity related to exploration for oil and gas resources. This drive will express itself in increased numbers of drill rigs and wells in the Gulf of Mexico, off the Atlantic and Pacific coasts of the U.S., and off Alaska. The near-shore regions will be covered first, followed by the regions farther out on the shelf, and then by the regions of the continental slope. The high cost and technological difficulty of drilling at great depths and under ice will slow the move into deeper water and into arctic regions, but toward the end of the century these costs and difficulties will be reduced.

Other forms of energy extraction from the sea will be given attention throughout the period, but only OTEC is likely to realize commercial applicability. Commercial OTEC units will be appearing in all the tropical and subtropical waters of the U.S. by the end of the period. They will provide populated areas in their vicinity with significant portions (10-15%) of their energy requirements. A small number of OTEC units will be combined with energy-intensive processing plants, integral with the OTEC units at sea.

Energy from salinity gradients, wind, sun, current, and tides will be under study and experimentation throughout this period, and by the end of the period one or more of these forms may have evolved to the point of commercial promise, but none is likely to evolve into commercial operation.

Energy Technology

Federal government sponsorship will insure that research and development effort in energy exploitation from the oceans will proceed at a moderate to high intensity throughout the period. Where the incentives to private industry fail to stimulate this research and development, the federal government will leave

R & D related specifically to oil and gas extraction is likely to proceed from the initiatives of the oil industry alone, and this area of R & D is likely to be the most intense and also the most productive, in terms of both exploration and extraction. Advances will be made in deep water drilling and environmental protection against oil spills from blow-outs, etc. Advances will also be made in surveillance of large geographical regions to assess oil and gas potential, before exploration starts.

Ocean Traffic Density

Continued economic growth of the U.S. and its principal trading partners, Western Europe and Japan, will lead to continuing increases in ocean-going commercial traffic. This will not lead directly to increases in the OSI universe, but will have the indirect effect of creating mutual interference between traffic and offshore structures. Like commercial traffic patterns in the Gulf of Mexico, the sea routes along the U.S. coasts will be constrained by the presence of oil and gas rigs. Some measure of zoning restrictions are likely to be imposed. These will restrict the location of the rigs, and will channel traffic safely with minimum interference with the oil and gas rigs. The fairways in the Gulf are not likely to be exactly replicated, but some form of channeling is likely beyond the safe access routes that are now required. Decisions to erect oil platforms will be constrained by requirements to conform to these routes. The first major accident involving collision of a ULCC with a rig will lead to restrictions that further constrain the freedom of navigation of ocean traffic.

Governmental Creep Seaward

In the last twenty-five years government action has established various forms of jurisdiction over the oceans to develop the ocean's resources for

the benefit of the U.S. economy. This governmental action accelerated in the 70's to the point that to some the 70's are known as "The Decade of the Oceans". In 1953 the Outer Continental Shelf (OCS) Lands Act established offshore oil and gas leasing rules--and incidentally established a precedent toward U.S. jurisdiction of ocean spaces contiguous to the U.S. The Marine Resources and Engineering Development Act of 1966 created the Commission on Marine Science, Engineering and Resources to survey marine affairs and recommend action to Congress. The National Oceans Policy Study, established in the middle seventies, carried the Stratton Commissions' work further in recommending policies for resource development and establishment of national/international jurisdiction over the oceans. The Coastal Zone Management Act of 1976 further refined jurisdictional issues between federal, state, and local authorities. The Fisheries Conservation and Management Act of 1976 set a precedent in establishing federal jurisdiction for living resources out to 200 miles. At this time international consensus appeared to sanction, for each coastal country, an "Exclusive Economic Zone" in some form out to 200 miles. Two Acts in 1978 further solidified the jurisdiction of the U.S. federal government over contiguous ocean regions; one was the OCS Lands Act Amendments that specified state participation in oil and gas leasing arrangements, and the other was the Ports and Waterways Safety Act that established "safe access routes" for ocean traffic approaching U.S. ports. The Third Law of the Sea Conference (UNCLOSS III) appears at the moment to be further reinforcing the right of a coastal nation to the powers of governance over adjacent sea regions.

Passage of the OCS Lands Act Amendments in 1978 set the stage for further developments of offshore oil and gas assets. By the terms of this act the broad responsibilities of federal agencies for this development were established as follows:

- o The Department of Energy is to establish production goals over a time period of several years.

- o The Department of Interior is to establish offshore lease schedules to be compatible with DOE's production goals.
- o The President's Energy Program, previously published by the White House, was incorporated into legislative policy.

Our forecast is that this "creep" of governmental jurisdiction seaward will continue, moving cautiously but inexorably toward extension of national sovereignty. As safety and security issues arise with the increased numbers of assets in the region, they will be resolved in favor of federal government responsibility and jurisdiction.

Other End-of-Century Developments

Exploitation of oil and gas resources will dominate the time period of this study, followed in a distant second place by OTEC in the energy field and by mineral dredging in the non-energy field. But there are a number of other potential developments that must be considered candidates of rising importance as the time period nears its close, and these candidates could rise up earlier.

- o Food Shortage. General perception of an impending worldwide food shortage will become an issue of ocean policy. Widespread starvation will make people aware that the resources of the oceans could alleviate the problem, but for reasons of cultural inertia these resources will be slow in developing. Soon after the end of the time period, but not in time to be of significance within it, major efforts will be devoted toward harvesting the food potential of the oceans, using whatever technologies are available at the time. Some form of structures are likely, but their nature is obscure at this time.
- o Energy Forms. One or more of the ocean energy forms previously alluded to is likely to have become promising. Whichever form it is will be likely to require structures either floating or bottom-mounted to support it. By the end of the time period it will be possible to forecast the nature of this development.
- o Other Minerals. Already coastal crowding in the northeast corridor of the U.S. has rendered the cost of building minerals high. In the very near future it may be economically feasible to dredge significant amounts of sand and gravel from the sea bottom in areas close to shore. By the end of the time period this cost factor will be significantly more important, and will result in growth in the numbers of offshore sand and gravel dredges. These numbers will be small compared with

the numbers of oil and gas rigs, but will continue to grow. In addition, mining of placer deposits is likely to become important at some time after the end of the time period. The technologies to be used are only vaguely perceived at this time, and are confined to shallow water.

- o Waste Disposal. Waste processing technologies are likely to advance by the end of the period such that it will be feasible to erect a waste processing plant on an offshore structure for massive disposal of waste carried to sea in barges. The technologies may reach the point that waste may be used to enhance the water quality, not merely be acceptable to it. Here again the number of units is likely to be small, with the growth in numbers just beginning at the end of the time period.
- o Processing Plants (Including Nuclear Power). The pressure among the environmentalists has already been felt to remove nuclear power plants from proximity to populations. By the end of the time period the issue is likely to be resolved in favor of locating a small number of nuclear plants in floating platforms at sea. Concurrently with the growth of these plants will be growth of energy-intensive processing plants of varied sorts to capitalize on the availability of OTEC energy. In addition there will be chemical processing plants in an expanding chemical industry whose waste products generate environmental controversy. Technologies to treat a variety of waste products for safe and clean discharge into the ocean will be developed and be ready for commercial use. None of these plants, however, will be developed in more than token numbers, and the number in operation will be extremely small.
- o Nodules. UNCLOSS III will lead to reasonable international agreement and a small beginning toward nodule mining will be made. By the end of the time period this will be only a beginning, and the units in operation will be only prototype units.
- o Beyond 200 Miles. Only the beginning of operations involving structures out beyond 200 miles--other than nodule mining--will have been conceptualized by the end of the period. However, by this time controversies will have begun to emerge concerning jurisdiction beyond 200 miles for operations not involving structures--e.g. fishing, aquaculture, etc. These controversies will presage those to come when structures become feasible at these depths.
- o Environmentalism/Energist Balance. The environmental and conservationist concerns of the '70's led to an operational policy by which decisions are delayed pending impact assessment, impact particularly on the environment, but also on other issues. This trend, coupled with general extension of regulatory processes, could extend to paralysis. This trend will have to slow if oceanic resource development is to proceed; in other words, significant resource development will require an increase in environmental risk. During the time period of this study the environmentalist vs. energist controversy will have shifted in balance from one side to the other and back several times, each time diminishing in amplitude. Optimistically the balance will have been nearly reached by the end of the time period.

- o Coastal City Crowding vs. Emigration of Industries. The current opposing trends involving increased crowding of cities on the one hand, and emigration of urban industries away from the eastern seaboard and toward the sunbelt on the other hand, may be resolved in either direction. Whatever its resolution, the issue will result in at least some movement seaward of urban activities now taking place in metropolitan areas of the eastern seaboard. Here again, the nature of this move and the technologies involved are unclear at this time.

UNCERTAINTIES

We have just described the "Central Thrusts" of our forecast. These central thrusts represent what we believe to be the center of the spectra of possible futures of the OSI universe, the most likely futures as viewed from our present vantage point. We now in this section present what we believe to be a variety of possible ways that this future may be altered by decisions of either political bodies or by societal consensus. Our contention is that to make forecasts of what these decisions will be would be hazardous to the point of being irresponsible. We believe that this study's utility will be served by identifying the issues and by describing the precursors that we perceive to be likely indicators of the direction the issue resolution is taking. In this way the reader has the capability to track events as they unfold, thereby updating his assessment of the future with more reliable information than we have available to us now.

The backdrop against which our forecast is being developed has one salient feature that dominates a forecaster's position. This is the much-discussed and analysed "interdependence" among nations.

An example of dramatically increasing dependence is that of the U.S. In the last decade the U.S. has become significantly more dependent on foreign economic ties than ever before. The kinds of linkages between the U.S. and other nations include trade in goods and services as the most visible; in 1977 and 1978 for the first time since World War II the U.S. current account was in deficit by large amounts. Many analysts attributed this deficit

to gradual deterioration in the competitive position of the U.S. in the international market place. But the importance of other linkages has increased at least as much as that of trade. Since World War II the foreign debt held by U.S. citizens has been in approximate balance with foreign claims on U.S. assets, but the ratio of both to the total financial assets of the U.S. private sector has more than doubled. The increasing use of the dollar as a unit of international currency has also led to increase in the foreign demand to denominate assets and liabilities in dollars; the result is that foreign forces constitute an important input to changes in the value of the dollar--i.e. to the behavior of U.S. inflation. (This effect is most dramatically evident in the case of OPEC price rises, but is highly operative in many other areas as well; the volatile demand for grain and its effect on U.S. price of grain is another visible example.) When the value of the dollar on foreign markets increases the price of imports goes down and of exports goes up, and of course vice versa. U.S. foreign trade has reached sufficiently high volume that changes in the price of goods traded on foreign markets leads to change in demand for these goods on domestic markets--demand moving toward traded goods when their international price goes down and away from them when the price goes up--the more frequent occurrence.

The important point from all of the above is that the U.S. cannot control its economy independent of foreign economic activity. As a result the constraints deriving from this foreign interdependence will be important inputs to the evolution of the U.S. economy in the foreseeable future. Or more importantly, the future of the U.S. economy is becoming more "policy dependent" and therefore less forecastable; that is, a long term forecast of the U.S. economy must increasingly take into account policy decisions as

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OFFSHORE INSTALLATIONS AND THEIR RELEVANCE TO THE COAST GUARD T--ETC(U)

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opposed to more or less "natural" trends. In other words, a forecaster must assess the spectrum of likely decisions to be made either by a policy making body or by a societal consensus in order to acquire a portrayal of the future; to a lesser and lesser extent can he depend on forecasting more "basic" trends like population, economic growth, etc. Since human decisions are far less predictable than are long term secular trends, a future that is policy dependent is significantly less reliably forecast than one that is dependent on secular trends for its reliability.

To further complicate the forecaster's job, the policy decisions do not constitute the only or even the major uncertainty; policy competence is an even less reliable factor in forecasting. Given that a certain policy has been adopted, the probability that its purpose will be effectively accomplished depends upon the administrative competence of the responsible executive body--a factor involving major uncertainties.

There are two technological areas in which a breakthrough in either one, and especially in both, could have very significant impact on the offshore universe expansion. One of these is photovoltaic technology--i.e. the technology of converting solar energy directly into electrical energy. The other is the technology of energy storage--especially the storage of electrical energy in some form of battery. Should significant breakthroughs occur in both of these technologies simultaneously, and become commercialized in short times, the pressure for expansion of the offshore universe would change.

Toward the end of the time period of this study the end of oil resources is likely to be in sight. This will lead to heavy emphasis on some other, yet-to-be-identified technology of energy development. The price of oil in particular, and of energy in general, will rise severely, inhibiting economic activities in many countries, and will lead to adoption of whatever energy-producing

proceseses have earned the highest respect from the decision makers during the time period. Direct application of solar energy is a top candidate, followed by coal, hydrogen (fusion), and biomass.

The central role played by oil in the world economy will change drastically by the end of the time period, and the alternative directions that this economy will take are highly uncertain, depending upon what replaces oil as the world's main energy source.

The current thinking of our leading economists is clouded with uncertainty with respect to the cause and effect relationships of economics. It is possible that a slow energy growth coupled with conservation would be compatible with healthy economic growth. Should this turn out to be demonstrated in one of the world's leading economies, the end of the oil resources would have a more gradual effect on economies, permitting gradual transition to another energy base.

U.S. Ocean Policy

The decades of the 70's was a transition from an aura of resource abundance to an aura of resource exhaustion. Confidence--even complacency--began to be replaced by anxiety. Economic growth lost its lofty position on the pedestal of economic and social values; it is being replaced, or at least placed in partnership with, conservation in our scale of public values. In harmony with this change in our structure of values is a change in our attitude toward government; we are beginning to place limits and constraints on growth in the size of government, and in its freedom to allocate resources. At the moment, this change of attitude is more evident at the state and local levels of government than at the national level.

Paradoxically, the very circumstance--resource scarcity--that is leading toward the conservative society is also opening up the resource abundance of the oceans to our visibility. And this in turn poses a dilemma for us: how to

stimulate the exploitation of these resources through investment, while at the same time giving expression to our conservation values. The resources of the oceans cannot be made available to us without the creative initiatives of government--i.e. without the allocation of further resources. The broad question that we face is: do we have the self discipline to withhold from present consumption sufficient resources to permit exploitation of the oceans?

A complicating factor is the secular trend toward increasing inflation that appears to require us to accept a higher and higher discount rate for future benefits whenever we invest.

Should the conservation mode dominate the 80's the effect will be to slow all programs and all initiatives toward oceanic resource exploitation--oil and gas exploration, coastal zone development, the fishing industry, deep sea mining, other oceanic energy development, other mineral mining, and science and technology in general.

So the big question for the decades ahead is how are to handle this dilemma? Will government provide less? If so the oceans will offer less also. Or will the government move aggressively toward oceanic development? If so will the major realignments be made in federal programs and agency domination that efficiency and effectiveness demands? For example, the balance in budget allocations among the federal agencies does not now accomodate this realignment; the change that will be required will increase allocations to those agencies concerned with oceanic development at the expense of other agencies. The former will accomodate easily; the latter will not. Special interest groups will be activated in the defense of the allocations to those newly denied. The political process will be in full swing, and it will be anyone's guess where the swing stops.

So the political and societal strain of accomodating to exploitation of ocean resources in a period of resource allocation conservatism will be severe.

This is the major dilemma whose resolution will determine the outcomes of resource allocation decisions to oceanic development in the decades ahead.

The decade of the 70's was only the leading edge of an acceleration of U.S. interest in the oceans; the next several decades will be marked by increase in the rate of this acceleration. Some of the areas of interest will include:

- o Leadership in Ocean Affairs and Policy. The identity of the leading actors in the execution of ocean policy, and the nature of this leadership will be decided upon within the next decade. This decision will be made through a process of balancing off in the strength of initiatives from among the various actors who now are expressing ambitions. This leadership is likely to be from a complex of actors including federal government, state governments, regional authorities, international bodies, foreign governments, private enterprise, and multinational corporations. Before the identity of actors and the form of leadership become well established, there is likely to be dominance of first one then another of the many actors on the scene, and associated with this uncertain movement there is likely to be considerable ambiguity in the form and content of leadership.
- o Forms of Governance. Accompanying the uncertainty in the leadership will be considerable vacillation and uncertainty in the forms of governance to be established in the regions extending from the coasts to beyond the 200 mile limit. This form will be largely determined by the nature of the actors who eventually emerge in leadership roles; but within certain limits the form may vary depending upon the dominance of such concepts as "freedom of the seas", "common heritage of mankind", etc.
- o Regulatory Patterns. It has become widely accepted that burgeoning regulatory activity has created far reaching economic and administrative burdens. In addition, a "layering effect" has accrued so that new regulations may not always be consistent with each other or with previously enacted regulations. Some rather drastic reforms in the legislative/regulatory process are likely to take place within the next decade, and to have significant impact on operations in the marine environment through the end of the time period. Some form of "performance regulation" that imposes penalties on violators, but minimizes procedural requirements is likely. This would have the further implication that financial resources would be required through which insured violators could be protected from financial disaster.
- o New Corporate Forms. An evolutionary development that could emerge from the pressures toward serving the public interest through governmental sponsorship of offshore developments on the one hand and toward maintaining the free enterprise system on the other--currently observed in the "deregulation" movement--could be significant growth in the use of the government enterprise.

- o Pollution Management. A subset of regulatory reform is likely to be new forms of pollution management through which the technology of environmental protection is advanced in major ways, and is applied through regulatory and enforcement action.
- o Antisocial Policy. At some time during the period a major antisocial act is likely to occur which inflicts heavy damage on an offshore asset. When this occurs--but not before--the policy makers will come to grips with the problem of how to handle the security of offshore assets against terrorist or other antisocial action.
- o Multiple Uses. A major policy decision will evolve with respect to allocation of space to multiple users of the oceans. This decision is likely to evolve over considerable time, and will depend in its substance on the order in which issues over space allocation arise.
- o Resource Exploitation/Conservation. A second major policy decision will be made concerning sustained, efficient, and conserving development of the ocean's resources. At some point it will be recognized that both renewable and nonrenewable resources can be extracted in varying degrees of balance with resource conservation and protection. Policies will emerge to promote such efficiency, conservation, and protection.
- o Energy Forms. At some time after OTEC has become commercially feasible, other forms of energy will become promising--e.g. wind, tide, current, fusion, etc. Future trends in policy establishment will be governed significantly by the nature of those forms that emerge as most promising. Precedents set in allocating space and in otherwise regulating these new developments will carry over into those that come later.
- o Mineral Mining. Policies on how, when, and where nonenergy minerals may be extracted, from near coastline to regions beyond 200 miles, will be established depending upon which minerals emerge as most economically desirable and where they are. Regions close to shore--and therefore under state jurisdiction--will be exploited first.
- o Energy Independence. A major policy to increase the U.S.'s independence from foreign energy may be established suddenly at any time during the time period; it is likely to be triggered by a political event perceived to threaten our energy availability. Such a policy could drastically change the rate at which developments in the marine environment accelerate, and the rate at which the OSI universe grows.
- o Protectionism. The short term interests of many U.S. economic blocs would be served by a policy of protection against foreign competition. Depending upon the driving forces behind such a move, this policy could either promote or inhibit growth of the OSI universe.

Ocean Sector of the U.S. Economy.

The contribution of the ocean sector to the U.S. economy--as reflected in the national income and product accounts--has become significant in the last decade and will become more so in the years to come. But the manner in which this sector fits into the economy has not yet settled into a pattern, and probably will not do so for some time. Relationships between elements of this sector and elements of the land economy, and relationships among the elements of this sector are likely to be established in different ways than those currently existing in the more "conventional" sectors. At least one key element of difference is that federal government regulation dominates the ocean sector. Thus to a degree far greater than in any other sector, government planning controls the economic activity of the ocean sector. But the details of how this is likely to mature are cloudy at this juncture. One of the principal dilemmas that the federal government will face in this new milieu is how to maintain an atmosphere in which private enterprise continues to be incentivized to invest in the face of the risk inherent in the marine environment.

The administrative competence with which the federal government accomplishes this function will have a great effect on the rate at which the OSS universe expands and on its composition. And one of the cautions with which successive administrations will have to contend is what some have called the "principle of unintended consequence", by which is meant that under the degree of interdependence that we now operate, any major policy decision is virtually certain to have effects in areas and in ways that cannot be foreseen at the time of the decision. In order to minimize the adverse effects of this principle each major decision will need to be supported by extensive study beforehand. This in turn will delay more than accelerate OSI expansion, and introduce uncertainties into the decision process.

Another feature that can be expected to accrue to the governance of the ocean regions is a gradual shift of governmental cognizance as jurisdiction moves from the coastal regions seaward; within territorial limits the states will be heavily influential, while beyond 200 miles the governance will likely be heavily influenced by international bodies. So functions performed close to shore may be under one form of governance while similar functions performed far at sea may be under a quite different form.

POSSIBLE/PROBABLE CRITICAL EVENTS

There is a class of events which are individually not very likely to occur, but within the class the probability of at least one of the events is significant. The probability of each one of the following is assessed to be almost insignificantly low; but we assess that the probability of one or more occurring is moderate to high. Each of these events by itself would have sufficient impact that it would significantly affect the results of this study. Therefore it is important to include it here.

"Great Power" Detente.

The probability of either armed conflict between the U.S. and the USSR--to the point of the nuclear holocaust--is slight. So is the probability of the other extreme, complete harmony. Either eventuality would have a highly significant effect on the future of the OSI universe, but the nature of this effect is impossible to foretell; it would depend, for example, on how fast the arms build-up were to occur. If, as is most likely, it occurred very rapidly, there would probably be no time for any effect whatever to take place in the OSS universe until the conflict had escalated to holocaust level. In that case, whatever was left of civilization after the holocaust is unlikely to be capable of offshore industrial activity. On the other hand, should the build-up take several years, and should the offshore regions be perceived to be somewhat

safe from destruction, there could well be an intensive effort to accelerate offshore energy extraction to the very maximum.

In the other event--that of complete harmony between the U.S. and the USSR--the driving forces toward acceleration of OSS universe expansion would be essentially what they are now--economic in nature. A demise in the strength of both great power adversaries of today's world is possible. This could be accompanied by a rise in the relative strengths of one or more other great powers--e.g. Japan and West Germany or possibly the Peoples Republic of China (PRC). The alteration in the relative balance of international power could have any number of different effects on the offshore universe, from high stimulation to heavy inhibition.

Bonanza Oil Discovery in the OCS.

Although exploration to date does not indicate that such a discovery is highly likely, it is not at all unlikely. Should it occur, the effect on the future OSI universe would probably be to accelerate development rapidly. This acceleration would be at such priority that in the short term, other energy-related offshore developments would be set back.

Foreign Leverage Center Emergence.

In the event that an oil-rich foreign power--e.g. Saudi Arabia--were to assume a hostile posture toward the U.S. to the extent of severe denial of its oil resources, the effect on OSI development is likely to be rapid acceleration. In today's environment the threat of denial of oil appears paramount; however, it is entirely conceivable that the availability of some other raw material could suddenly become dependent upon the whim of a less developed country (LDC) rich in that material. "Interdependence" can quickly bring about such a circumstance with only minimum warning. Without adequate compensatory and timely action the effect on the economy could be crippling. Obviously any event that had a crippling effect on the U.S. economy would bring to abrupt halt any OSI universe expansion off the U.S. coasts.

The foregoing examples are the simplest cases. A more complex case could occur through coalitions of countries operating to exert leverage of any kind on the U.S.

Mobilization for Energy Independence.

The U.S. sputnik-stimulated space program exemplifies the effect of a major White House directed effort to mobilize national resources toward a technological objective. Should the present or some subsequent administration decide that such a grand scale of mobilization were appropriate in furtherance of energy independence, it is likely to reach most of its goals, and could bring about a massive extension of the OSI universe in exploitation of seabed oil resources. Depending upon the extent of oil and gas discovery in the marine environment, the expansion of the OSI universe could be dramatic by the end of the time period.

Fusion Power Breakthrough.

Although a technological breakthrough in commercial use of fusion power is judged to be highly unlikely before well into the next century, such a breakthrough could have enormous effects on the OSI universe. In the first place, the need for oil and gas would be dramatically reduced, so the impetus for offshore exploration and drilling would also be reduced. In the second place, the exact nature of the impact of this eventuality is only dimly perceived at this time.

Economic Collapse of the U.S.

Like the previous eventuality, this one is also extremely unlikely. On the other hand international alignments are fragile. The U.S. economy is heavily

interdependent with the economies of the other western economies as well as with a number of the LDC's--particularly the oil-rich LDC's.

Although the U.S. is still a "great power", its relative strength is diminishing because of the nature of the ingredients of power among nations, and because of the changing nature of relationships among nations. A collapse of the relationships among the western nations would have incalculable effects on all of them. Such a collapse is not foreseen but it is not impossible. A collapse of the economic relationships between the U.S. and its trading partners is not at all probable; but like the foregoing eventualities, its occurrence would be of enormous significance. And even a partial degradation of these relationships is likely to severely inhibit OSI universe growth, because of its effect on the U.S. economy and its capability.

Regulatory Ineptitude.

The adverse effect of inept regulatory action on the free enterprise system has been well documented. Steps appear to be in motion to mitigate these adverse effects; however, should these remedial measures be insufficient to institutionalize efficient use of resources in furtherance of environmental protection, the costs of regulatory measures will rise and contribute increasingly to inflationary pressures. These inefficiencies will also lead toward disincentives to private industry to invest in offshore capital--and hence will lead toward slow-down in the growth of the OSI universe.

Acts of Violence.

Acts of terrorism or sabotage against offshore assets are sure to bring about a frantic scramble to take protective measures for all such assets, and to slow down installation of new assets until a degree of assurance has been achieved for the safety and security of new investments.

Availability of Oil/Gas Substitute.

Current measures toward substitution for oil and gas as fuel are confined principally to coal. Other measures being investigated include extraction of methane gas from trash and waste. At the moment none of these measures appears promising as a useful and feasible substitute. However, breakthroughs occur; and discovery of a viable substitute could be closer at hand than is generally supposed. In this eventuality, the importance of offshore oil and gas would be reduced.

Movement toward the "Conserver" Society.

Large and sudden shifts in the values of a society seldom occur. But shifts (of the nature of Proposition 13) do occur on occasion. The conservation movement appears unlikely to lead toward such a shift; but it is not impossible. Should it occur, the demand for oil and gas would reduce and lead to significantly reduced pressure on the OSI universe for expansion.

Paralysis of Pluralism.

The long-held value in the U.S. that insists on pluralistic decisions has already resulted in extremely slow implementation of the provisions of the Coastal Zone Management Act and of the Fisheries Conservation Zone Act; states and regional bodies have predictably insisted on being heard in the decisions that affect them. This has resulted in delays to the mutual disadvantage of most parties to the issues. As the concepts of governing the marine environment take time to mature, they are sure to engender similar delays in the future. When action can be taken only when consensus is reached, that action is slowed. The process of oil and gas exploration and extraction in the Gulf of Mexico has been sufficiently institutionalized that it proceeds relatively smoothly and efficiently from an administrative point of view. Such is not the case on

the east and west coasts of the U.S. Here there appear to be innumerable reasons that the leasing process is extremely time-consuming.

UNCLOSS III Action.

At the moment it appears that UNCLOSS III is likely to arrive at a convention that is mutually acceptable to most of the parties involved. If so, a major step will have been taken to make the ocean's resources available for exploitation by those with the capability. In addition, Congress is currently addressing the issue of protection of U.S. entrepreneurial action in the oceans; this too should promote healthy investment in development of the ocean's resources. However, the vagaries of UN politics are such that this relatively healthy situation could change almost overnight, and this type of change could occur at any time in the future, independent of long and patient effort by the many fair-minded participants to develop reasonable and fair terms.

SECTION IV: SPECIFIC FORECASTS: OSI UNIVERSE

This section presents our specific forecast for the OSI universe by mission category. This forecast derives from the analysis of Volume II and is consistent with the macro and marine environmental forecasts of Chapters 3 and 4 of this volume. It represents our assessment of a "most probable" future, which in point of fact may not be highly probable. This is because our forecast is conditional on the outcomes of the many uncertainties and critical events described heretofore. These uncertainties and critical events may have highly unexpected outcomes, which could drive the OSI universe in any number of different directions. So to make maximum use of this study, a systematic monitoring of all the factors described in the study should be maintained.

We present our specific forecasts by mission categories in the same order that we presented these mission categories in the chapters of Volume II.

Energy

1. The size and complexity of offshore installations will increase, and the complexity of relationships between units will also increase.
2. Oil and gas will be found and extracted in deep water--beyond the OCS.
3. When the newly found oil is low grade, its extraction is profitable only when the price rises in better quality oil, so exploration and extraction processes will become increasingly more complex; this will impact on 1. above.
4. Foreign oil prices will continue to rise, with the U.S. remaining at the mercy of foreign powers for this import, bringing the lower grade oil deposits into economic feasibility.
5. The increased value of oil and gas will lead to more sophisticated exploration processes--using seismic, satellite, laser, IR, acoustic, and even gravity wave instrumentation.
6. The gap between the ability to find oil and gas on the one hand, and the ability to extract it on the other hand will remain or increase to the end of the century.
7. The rate of increase in consumer demand for oil and gas will continue to rise for the next two or more decades, then begin to decline as other sources of energy become operational.
8. The era of large scale oil/gas extraction installations will peak toward the end of the century, level off for several years, and then decline. By the end of the century there will be clear signs of this decline.
9. By the end of the century also there will be increasing diversity in offshore installations, many of which are growing in parallel with the oil and gas installations as other energy sources become promising. Fossil energy sources will be in the decline while renewable sources will be on the ascendancy.

10. Increasing numbers of offshore installations will be devoted to energy production in addition to energy extraction. The capability of power transmission cables is not likely to advance to the point that power can be efficiently transmitted over long distances--e.g. many hundreds of miles. Consequently the installations will be devoted to production of energy-intensive products.

11. The only other energy production OSI likely to emerge in significant numbers by the end of the century will be OTEC units; our forecast is that there may be upwards of 25 to 50 such units, each producing several hundred megawatts of power, by the end of the century. Many of these will be plant-ships producing energy-intensive products like aluminum or ammonia.

12. The geographic areas in which offshore installations are likely to increase their density at the most rapid rate are Alaska, the Gulf of Mexico, and the east coast of the U.S. First the shallow water regions will be populated with the OSI, then the deeper waters.

13. Environmental issues will slow, but not stop oil and gas exploration and extraction processes.

14. The technology of oil extraction "rigs" will continue to improve, leading to variety in types of rigs. Semis, bottom rigs, pipe networks, single point moorings, and all-weather structures will proliferate. Safety/security features will be significantly improved.

15. Coal is not likely to be extracted from the OCS except through shafts dug under the seabed at an angle from land bases.

16. The oceans' supply of uranium, both in suspension and in deposit, is likely to be seriously investigated, and may be exploited by the end of the century. However, OSI will probably not be constructed for uranium extraction.

17. Plans--like those now under consideration in the state of New Jersey--for construction of offshore nuclear power plants will proceed slowly, depending

upon the balance between the environmentalists' opposition and the country's need for power. This balance will shift to and fro, and it is imprudent to judge at this juncture what the outcome will be--though at the moment the environmentalists appear to be exerting the greater force toward impeding movement. In any case, the number of offshore nuclear power plants in operation by the year 2005 will be small.

National Security

1. The probability of large scale military action--World War II type-- in the offshore environment between now and the year 2005 is low. However, the probability of some form of lower level military or violent action in this environment is high. The form of this action is likely to be terrorist, sabotage, law violations, or hostage taking. The sources of this action are likely to include non-sovereign groups whose identity is obscure and difficult to establish.

2. The OSI universe is likely to provide cover and shelter as well as targets for certain antisocial groups. This will render the task of law enforcement agencies increasingly difficult.

3. The geographic implications of the growth of the OSI universe from a national security point of view parallel those of the growth of the offshore oil and gas extraction industry.

4. Decision to dispose of nuclear waste in the ocean is not likely to come by the year 2005. Land disposal sites appear more suitable during this time period.

Food

1. The drive to extract food materials from the sea will mature in the next two or three decades, but this drive will result in little or no offshore construction of assets that satisfy the criteria of "installation" as used for this study.

Minerals

1. Mining of deep sea nodules will take place under considerable conflict among the nations involved, and with considerable uncertainty and ambiguity between U.S. private industry and the federal government.

2. The federal government will gradually take on more responsibility for initiatives in nodule mining, with American industry permitting itself to be subsidized and thereby deprived of its full freedom to venture.

3. Near-shore mining will not increase significantly within the next two or three decades; however, by the end of that time there will be signs of its increase.

Movement of Industry Seaward

1. There is relatively low probability that an offshore installation will be created and developed from start to finish for the sole purpose of building an offshore industrial installation. However, there has been a very significant increase in size and complexity of offshore oil and gas "rigs"; in some regions these rigs are now billion dollar installations on the order of size and complexity of one of our huge urban buildings--e.g. the Empire State building. When several such rigs are placed in reasonably short distance from one another, each with its own living quarters and life support logistics systems, there is more than a low probability that combinations of these rigs will grow into industrial complexes. This growth would be likely to occur when the principal purpose of the rig is complemented in an economic sense by the addition of another mission--such as production of a product whose manufacture requires heavy input of energy that can be readily produced from the oil and/or gas already being produced.

Transportation and Navigation

1. The increase in commercial traffic density off the eastern coast of the U.S. will stimulate the need for increases in traffic separation schemes, many of which are likely to involve installation of offshore structures whose sole purpose is to facilitate traffic separation and sea zoning. There is likely to be only a small number of these, but as pointed out in numerous places previously in this report, the addition of the first structure of a unique type has significantly more implications to the Coast Guard than the addition of the second or nth.

2. The traffic between installations in the offshore environment will increase to heavy proportions as the installations increase, leading to all the issues associated with heavy local traffic density.

3. Pipeline and cable density will also increase, especially in the vicinity of the offshore installation complexes. Networks of pipelines and cables will be installed between the offshore structures of a single complex.

4. There will be a significant increase in transshipment installations--single point moorings or their equivalent. However, the highly complex deep water port appears likely not to proliferate for administrative and political reasons rather than technical or economic.

5. The increased traffic density will lead to more demand for the use of the Coast Guard's Vessel Traffic Service. Because of the political aspects of preserving the ship captains' responsibility, this growth will be slow.

6. Accompanying all of the above will be an increase in logistics support craft, facilities, and offshore installations.

Recreation and Conservation

1. The demand for recreational installations will be highly dependent upon the general economic health of the nation. Should the present low

productivity rate persist, it is likely that the demand for recreational structures will decline. On the other hand, should the U.S. economy resume its upward movement of the last many years, the demand is likely to increase very significantly.

2. Most of the offshore installations associated with recreation and conservation will be located within reasonably short distance from shore--which means that the Coast Guard responsibility for any form of monitoring or surveillance is likely to be minimal.

3. The normal increase in commercial traffic is not likely to lead to significant increase in breakwaters, groins, or artificial reefs for conservation purposes. Increase in the numbers of these items required is likely to be related to artificial islands and causeways developed in conjunction with the movement seaward of industrial complexes. U.S. ports are relatively mature, and their breakwaters in need of continuing upkeep and repair, but there is only light need for increase in the numbers of these structures.

4. Small numbers of artificial reefs are likely to be installed for recreational purposes in the warmer waters where fishing and scuba diving conditions can be improved with these reefs.

5. A small number of underwater chambers is likely to be installed for recreational purposes, also in the warmer waters off the southern east and west coasts, in the Gulf and in the Caribbean.

Oceanographic Science

1. The next technological generation will see advances in our capability to extract non-energy minerals from the seas--especially from deep water where

these minerals appear to be more plentiful. This advance will not lead to large numbers of offshore installations within the time period of this report, but will present the possibility that by the end of this period, much thought and planning will be underway toward such installations--approximately where the large and complex offshore oil and gas rigs were 15 years ago.

2. The extraction of kinetic energy from ocean dynamics will be economically and technically feasible by the end of the century and will also lead to a high state of planning and consideration for offshore installations to perform this function--although few if any such structures will be actually in place by that time.

3. Advances in instrumentation will lead to significant improvements in the safety and security of offshore installations. This will be safety and security both from weather and from antisocial action.

4. Advances in communications and surveillance technology will also enhance the safety and security of offshore installations; such advances will also improve the operational efficiency of these offshore installations complexes.

5. Offshore vehicles and equipment will advance, leading toward increased mobility between offshore structures within and among the complexes. Again the safety, security, and operational efficiency of these complexes will be improved.

6. Improvements in our knowledge of the environment will lead to the capability to install offshore structures with ever-decreasing risk to the environment and at lower incremental costs than present costs of environmental protection.

7. Research and development of arctic/antarctic operations is still in its early stages from the point of view of offshore structures. By the end of the century we will have the capability to install and operate offshore units in the polar regions far more efficiently and effectively than we are now able.

8. By the end of the century there will loom ahead the prospect and forecast of large and varied investment in offshore capital for resource extraction and exploitation and for the varied commercial and industrial activities associated with such capital investment and operation. Only sparse physical evidence will be actually present in the oceans until a later time period, but the planning activity will be at a high level.

9. Energy conservation and efficiency of use will increase significantly by the end of the period, leading again to changes in the prospects for offshore installations, but little if any physical evidence of actual change in the ocean environment by the end of the time period.

10. Advances will lead to significant improvements in data acquisition capabilities both through terrestrial and satellite instrumentation. By the year 2005 it will be possible to perform integrated and systematic investigation of oceanic phenomena as a whole, and to assess the presence of resources with far more confidence than is possible at present. The full potential of these advances will be visible only by the year 2005, and only slightly implemented. It will include the potential not only to assess the presence of resources, but also to exploit them. The principal evidence of these advances will be in the form of results of research rather than in the form of actual capabilities.

11. Advances will be made in equipment, machinery, and vehicles so that by the end of the century both manned and unmanned submersibles will be operating at great depths. These vehicles will find extensive use in the installation, maintenance, and repair of the massive offshore installation complexes.

12. Advances in navigation technology and instrumentation will lead to improved navigation, from both a safety and an operational efficiency point of view.

13. Weather prediction and control will have also advanced; however, the outcome of research in this area covers a wide range of possibilities and is

uncertain at this moment. Whether the control of weather is advanced without undesired side effects is problematical.

14. The techniques of containing, recovering, and neutralizing oil spills and spills of other environmentally hazardous substances will advance and promote an order of magnitude improvement in environmental preservation and conservation. These advances will also increase the capability to regulate offshore operations for environmental protection in a far more efficient and effective manner than is possible at present.

CHAPTER 6: FORECAST OF COAST GUARD IMPLICATIONS

This chapter presents the general implications to the Coast Guard of the conditions forecast in the preceding chapters. The first section (pages 6-1 through 6-5) is a description of five categories of long term issues likely to be raised by these conditions. The second section (pages 6-6 through 6-9) describes the dimensions along which these external pressures will exert pressures for change within the Coast Guard. These two sections constitute the context of the third section (pages 6-9 through 6-19), a general implications assessment. The fourth section (pages 6-19 through 6-34) is an assessment of programmatic implications.

LONG-TERM ISSUES

Five categories of long term issues are pertinent:

- o Legislation imposing increased responsibilities on the Coast Guard;
- o Incompatibility between demand for Coast Guard services and Coast Guard capability;
- o Opportunity for increased Coast Guard role in federal policy formulation;
- o Increased demand for Coast Guard personnel with special technical expertise
- o Increased demand for Coast Guard regulatory competence.

Legislation

A surge of legislation respecting the marine environment began in the 1970s. The OCS, coastal zone management, deep sea mining, the fisheries conservation zone, and Oceans Policy Studies legislation are examples, but represent only a fraction of the bills and acts that have been under consideration in Congress over the last decade. Additional legislation of far reaching importance is being or will be introduced in the 96th and subsequent Congresses. All of this legislation affecting the marine environment has and will continue to

have provisions for its regulatory implementation and its enforcement. A large share of regulatory provisions are likely to fall upon the Coast Guard to implement and most of the enforcement will require Coast Guard action.

Incompatibility: Demand for Service vs Capability

We judge that one of the biggest problem the Coast Guard will confront during the 1980s will be the ever increasing legislative demands placed upon it and the corresponding reluctance of Congress to appropriate the resources needed to meet those demands. The demands will increase not only from legislation, but also from the continued growth of the activities in the marine environment over which the Coast Guard already has responsibility.

Coast Guard Role in Federal Policy Formulation

Concomitant with the legislative upsurge and the growth of demand for Coast Guard services will be participation by the Coast Guard in related deliberations by Congressional committees and executive agencies. As the sole federal agency with a substantial operational capability in the marine environment--with the exception of the Defense Department services--the Coast Guard will offer the only experience-based counsel in these deliberations. As UNCLOSS III resumes its deliberations, the Coast Guard will continue to play an advisory role in UN action; and once a decision is reached by UNCLOSS III the Coast Guard may expect increased requirements for participation in implementing its provisions, which ever way they go.

During the process of establishing the role of various federal agencies in the marine environment, the more aggressive agencies will inject themselves into the process while the less aggressive agencies will wait to be called. This is likely to produce an imbalance of responsibility vis-a-vis capability among the competing agencies, with the more capable but less aggressive settling for

unapplied potential, and with the less capable but more aggressive acquiring more responsibility than is in the best interest of the U.S.

Demand for Personnel with Special Expertise

Interagency Policy Formulation

As the industrialization of the marine environment proceeds, the interdependency among resident elements will lead to interdependence among the federal, international, and state agencies that exercise governance over it. If the Coast Guard performs the role for which it is best suited, this intergovernmental and intragovernmental interdependence will lead to a requirement for Coast Guard officers to be competent in a significantly increased variety of operational modes, but to a decreased demand on the Coast Guard for nonoperational functions. On the other hand, if bureaucratic competition dominates, there will be a tendency for some agencies to be less than optimally utilized, and a definite possibility that the Coast Guard's full potential for national service will not be utilized.

Energy Engineering

If our forecast is reasonably accurate that the search for and extraction of energy-related resources will dominate ocean activities through the time period of this study, then the Coast Guard will experience a requirement for regulatory and law enforcement expertise in the energy-related areas--not only oil and gas, but nuclear, OTEC, solar/wind, geothermal, current, and tide sources as well.

Ocean Engineering

At present ocean engineering is little more than "land" engineering trans-

lated into the marine environment. So far little use has been made of the natural characteristics of the oceans as engineering assets rather than as obstacles. The "growing" of a subsurface structure is an example of the leading edge of a new engineering discipline. As the new discipline emerges the Coast Guard will require officers with up-to-date education and experience in it for application to the variety of structures and units to be built and used in the marine environment.

Regulatory Competence

The science/art of regulation is still in its infancy. If the free enterprise system is to be preserved, this art/science will require modification toward balance between effectiveness and in achieving regulatory objectives on the one hand, and efficiency in permitting enforcement without inordinate disruption of operations on the other hand. This balance must start with policy, but can be implemented only with professional personnel of high and specialized competence. For example, regulations that impose severe penalties for risk of oil spill may be substituted for regulations that impose procedural requirements to prevent oil spills. The achievement of this sort of balance requires balanced judgement more than procedural competence on the part of the regulators.

Increasing demand for regulatory competence will lead to increase in the strain already evident for several years within the Coast Guard to maintain operational competence in a new operational environment while keeping up with the surging increases in regulatory activities of the federal government. The argument that only operationally competent personnel can develop adequate regulations will not be challenged in the abstract, but will in the world of action. The demand will be for regulatory competence that is both effective in terms of addressing its objective, and susceptible to practical implementation by operating

units whose *raison d'être* is not compliance with regulations but some other useful purpose. This demand will lead toward development of "performance" regulation--analogous to performance specifications in engineering contracts--to replace "procedural" regulation which specifies the "how" to comply with the standard sought, rather than the "what" is to be accomplished.

A major policy opportunity will be open to the Coast Guard to impose high standards of personal safety and environmental protection on operating units without inhibiting inordinately their freedom to operate. A difficulty in accomplishing this end will be resolution of the conflict in the values "justice" and "fairness" to violators vs. resolute refusal to become enmeshed in procedural regulations.

A number of innovative regulatory processes have emerged in recent years that have the potential to reduce the overhead costs on the economy from regulatory action. Some of these are sketched here.

- o Performance standards. Replacement of regulations that require specific compliance methods with regulations that stipulate the end to be achieved. Private enterprise is thus left free to find the most effective and efficient means of compliance.
- o Economic incentives. Reward of compliance with tax benefits, government procurement preferences and constraints, or government contract fees.
- o Enforcement reform. Use of private enterprise itself to provide the inspection services--e.g. government licensed auditors, consumer agents, verifiable self-reporting systems, compliance checks on a sampling basis, and penalties.
- o Competition enhancement. Use of subsidies and other means to promote entry of firms who otherwise would have difficulty meeting capital requirements.
- o Marketable rights. Establishment of criteria for exchange of government offshore lease rights.
- o Protection of the public from catastrophic failure. Establishment of federal programs to insure private interests against penalty from the catastrophic failure of an enterprise who culpably violates regulations. This would be accompanied by resolution to impose catastrophic penalties when warranted.
- o Publication of consumer satisfaction indicators. A proposal of questionable feasibility--at least questionable at this stage of its development--is to identify how well a firm's product or service is

being received by that sector of the public with opportunity to evaluate it.

DIMENSIONS OF COAST GUARD IMPLICATIONS

This section describes the general direction toward which developments related to the OSI universe are likely to press the Coast Guard in both its operational and its administrative missions.

OSI Universe Expansion

Two fundamental characteristics of our age provide the foundation. They are summed in the words "acceleration" and "economic modernization". The exponential rise in the world's population plus the extremely high value placed on economic modernization and its associated emphasis on growth lead to most if not all human activities' expanding dimensions. Economic and societal relationships are becoming increasingly of greater magnitude and consequently of greater complexity. The OSI universe is no exception. With this expanding magnitude and complexity goes an increased burden of coordination and administration; more and different kinds of activities are taking place in every dimension that require more and different kinds of coordination and administration.

Applied to the expanding OSI universe and its impact upon the Coast Guard, this simply means that as this universe does in fact expand it adds to the demands and requirements placed upon the Coast Guard. The sheer numbers of structures offshore and the sheer numbers of vessels engaged in commercial traffic are sufficient to do this by themselves, without regard for the changing nature of the structures. As a corollary, the added complexity of relationships constitutes an additional demand on the Coast Guard. With every new development in the marine environment goes some added relationships of an operational or administrative nature to confront the Coast Guard. These new relationships

may be between physical entities, like the structures themselves, or they may be relationships between the various agencies having cognizance over the activities of these physical entities.

Complexity is also added by the introduction of new and different missions among the structures. As each new mission is added to units in the marine environment, the requirements placed upon the Coast Guard are further increased

Superimposed on the additional structures is the marked increase in commercial traffic density--including fishing and developmental activities as well as conventional commercial vessel traffic.

Technological Change.

While the expansion of the OSI universe leads inevitably to increase in the quantitative demands placed upon the Coast Guard, the technological age we live in produces a fundamental secular trend of dynamic changes in the nature of the material entities with which the Coast Guard must deal in the marine environment. This means requirements for additional training of personnel merely to continue to perform present missions. That is, the technologies of existing operational units in the marine environment are undergoing continuing change that leads to increased demands on the Coast Guard. When in addition the variety of units in operation in the marine environment increases as well as the number, the added burden to keep up is magnified several times.

Another factor that the Coast Guard must confront is that the new types of structures are emerging under the aegis of different federal agencies. This means new and different administrative and technical systems and procedures must be developed and learned for each new type of structure injected into the environment. And entirely new fields of engineering are involved in the process for the Coast Guard.

Increasing Distance Seaward.

As the economy of the U.S. moves seaward its governance will change from heavy state domination through a region of federal domination to a region heavily dependent upon international considerations. The forms that these different aspects are likely to take are still in evolution and may be for several years. This means that the Coast Guard has both a burden and an opportunity. The burden comes from the need to accomodate to the different forms, and the opportunity comes from the fact that new and creative initiatives by agencies like the Coast Guard will be needed to insure that the governance is as effective and efficient as possible.

A second source of impact upon the Coast Guard from the seaward movement of the U.S. economy is a technological one. As structures are placed in deeper water and in the arctic in the presence of ice, the technologies of construction, installation, and operation become increasingly complicated and require increasingly more innovative approaches. The technologies with which the Coast Guard personnel must become thoroughly conversant increase in number, variety and complexity.

Coast Guard Unique Capability.

The Coast Guard is a federal agency with several unique operational capabilities:

- o It is a uniformed service capable of military and quasi-military operations.
- o It is the only agency in the federal government capable of ocean search and rescue operations.
- o The Coast Guard's combination of operational expertise and regulatory competence is also unique among all agencies of the government.
- o The Coast Guard is the focal point of experience and expertise in the federal governmental concerning marine operational law enforcement.

It is clear that expansion of the OSI universe will impose added burdens and duties on some federal agency or its surrogate. Since there is no other agency with the unique capability of the Coast Guard, it is infeasible to assign most of

the new duties that will be forthcoming to some other federal agency; the expense of doing this would be far greater than the expense of gearing up the Coast Guard to perform the necessary new duties. One other alternative would be to avoid making the new assignments. This would promote chaotic conditions in the marine environment.

GENERAL IMPLICATIONS

Before the end of the time period of this study, a fundamental change in the nature of the offshore environment will be clearly visible. For many centuries the oceans have been regarded as different from the land environment in a legal, political, economic, and international sense. The societal structure within which the oceans have been perceived and used has been fundamentally different from that prevailing on land. "Ownership" of property has had little or no meaning, rights of access have been cloudy, geographic representation of interested parties has had no meaning, a "commons" attitude has been so deeply entrenched in the minds of many that it is difficult for them even to perceive their own bias. But free enterprise economic growth cannot take place in such a climate; concepts of ownership and exclusivity of access rights are essential to such growth. A change in this direction is already under way and will continue. Its exact direction is difficult to foresee, but it is clear that whatever emerges will impact on the total legal, political, military, and economic framework within which the Coast Guard will be operating in the latter part of this century and into the next.

The foregoing amounts to a qualitative difference in the nature of responsibilities that will be born by an agency of the U.S. federal government assigned to maintain law enforcement operations, to stand ready to initiate search and rescue operations at all times in these increasingly densely populated waters,

to inspect offshore installations for compliance with safety standards, to execute environmental clean-up operations after an oil spill or other event causing environmental damage, and to regulate for safety of personnel, security of assets, and environmental preservation.

Our forecast of the general implications to the Coast Guard is summarized in the following paragraphs. Our rationale for this forecast derives from all of the preceding portions of this report--the preceding chapters of Volume I and all of Volume II.

The marine environment is on the leading edge of a rising wave of expansion whose growth curve is concave upward. One of the most important aspects of this growth will continue to be growth in offshore installations. Oil and gas installations are expanding in numbers and are almost the only new installations. For the next one or two decades they will account for the predominant proportion of new installations.

As a direct result of the expanding OSI universe, the qualitative and quantitative aspects of the Coast Guard responsibility and work load will increase at an accelerating rate throughout the time period of this study. This increase will be both operational and administrative.

Offshore installations for other purposes will be constructed, possibly in significant numbers, by the end of the century. But this type of construction will not accelerate until at least the end of the century and probably not until well into the next.

By the year 2005 we forecast that the universe of offshore installations will include a representative small number of a variety of different types of installations. But at the present time it is not possible to foresee the most likely distribution of types--other than that oil and gas extraction installations are likely to dominate, in terms of numbers, at least until toward the end of

the time period of this study. Which types dominate will be determined by ongoing developments, resolution of issues, and policy decisions to be made between now and the end of the century. The chapters of Volume II identify the circumstances under which each type is likely to emerge in some numbers. Our forecast is that even though we do not know which type is likely to dominate, we do feel confident that there will be significant numbers out there. And we forecast that by the end of the time period of this study the signs will be clear as to which types will in fact dominate.

Coast Guard responsibility differs depending upon whether an installation is a "vessel". But the presence of offshore installations leads to added responsibilities for the Coast Guard whether these installations are "vessels" or not. (Coast Guard responsibility for "vessels" is defined under Commercial Vessel Safety responsibility and is significantly greater than for structures not qualifying as vessels. See Chapter 10 of Volume II.) As the universe of offshore installations moves seaward, more and more will fall into the category of vessels, because of the physical difficulties of rigid attachment to the sea floor at great depths.

The pressures toward and the barriers against significant increase in the numbers and types of offshore installations are more closely in balance than is popularly realized. The demand for energy and other resources is well recognized as a strong driving force toward their increase; the economic, political, and administrative--i.e. bureaucratic--barriers are not so well recognized. But these barriers are operating strongly to inhibit growth in the offshore installations universe.

Coast Guard work and responsibility load is not measured only by number of offshore installations. Legislation leads to different Coast Guard responsibility depending upon the type of installations, but for every new type installation

constructed the Coast Guard must gear up to an understanding of the processes to insure safety and security of assets. Every new technology implemented in an offshore installation brings with it the need for the Coast Guard to institutionalize the detailed technical knowledge of the structure and its equipment. (The technical detail of many of these structures is presented in summary form in the appendices of the individual chapters of Volume II). This is true to at least a limited degree even when only one such structure is likely to be constructed. This means that for each single installation of a new type constructed, a requirement is placed upon the Coast Guard by a number of diverse factors:

- o New technology
- o Increased complexity
- o Increased size
- o New processes and procedures

The lead times for the construction of offshore installations is on the order of several years under most circumstances. Two independent factors influence this. First is the massive size of these structures required to withstand the rigorous weather environment--and even more massive as the structures are located further into deep water. Second is the extremely cumbersome pluralistic political/administrative decision making process in the U.S. (See Chapter 12 of Volume II for a description of a model process.)

This means that a requirement for the Coast Guard to become operationally ready for any particular installation is unlikely to come as a surprise to an alert Coast Guard. So even though the nature of the offshore universe may remain unclear for some time, there should be ample time between the first signs of a build-up and the time the Coast Guard is required to act in an operational mode. During this build-up time the Coast Guard is likely to be called upon to participate in the administrative process.

Since the growth of the offshore installations universe has accelerated

during the 1970's the policy of the federal government has been to foster and incentivize private industry's investment offshore; the government's rhetorical policy has been to eschew becoming an operator. Acting against this policy has been a concurrent policy to move toward regulation of industry in the name of:

- o Preventing monopolistic restraint of trade;
- o Environmental protection; and
- o Pluralism--insuring that all interested parties have at least some voice in any decision affecting them.

These mutually conflicting policies have led the government to act concurrently to promote and yet to stifle private enterprise initiatives in the offshore environment. Recognizing its own propensity to stifle initiatives and to perhaps create conditions where the very industries which have been induced to take risks in the offshore environment have suffered from bureaucratic action, the government's operational policy--though not its rhetorical policy--has been to protect those who have been incentivized against the government's own clear but unacknowledged counterproductive action. The upshot is that "protection" takes on the form of intervention, and the federal government is becoming increasingly, directly or indirectly, an offshore operator, and so increasing numbers of federal agencies are entering the operational picture. This means increasing bureaucratic competition for slices of the "cognizance" pie.

The congressional budget process inhibits the capability of any conservative federal agency--including the Coast Guard--to be responsive to foreseen developments in the offshore environment. An operating unit offshore is supported by funds from several different appropriations. In an expanding operation, the expansion of operating funds should obviously match the needs of the components parts and functions of the operation. Unfortunately, however, certain appropriations are notoriously more difficult than others to change from year to year. (Operations

and Maintenance funds have been typically difficult for several years.) For the conservative agencies who are loath to "fight" for funds, this produces an extraordinary imbalance in funding, especially when requirements are increasing.

Based upon the foregoing and on the more detailed information in Volume II of this report, we offer the following general forecasts of implications to the Coast Guard of developments in the OSI universe.

1. The increase in offshore oil and gas operations will impose an increasingly heavy load on the Coast Guard. This will be especially true in the Gulf of Mexico and with somewhat less probability off the east coast of the U.S.--depending on the actual oil and gas discoveries in this region. Polar operations will also continue.

2. The increased load on the Coast Guard will involve more than simply the increase in numbers of rigs to be monitored. Even more importantly it will involve an increased load because of the enormous complexity of each modern rig--as contrasted, for example, with the original oil rigs that consisted of a derrick mounted on a small barge. Today's modern rigs are equivalent to mammoth buildings of many stories in height and costing many millions of dollars--sometimes over a billion. The work load on the Coast Guard--or any governmental inspection service--to monitor and enforce safety regulations in such a structure is an order of magnitude greater than that involved in the work of earlier years.

3. An increase in complexity of relationships between rigs also adds to the Coast Guard's load. As each oil-rich region is developed, the number of rigs in close proximity to each other increases, and their mutual interaction and support increases. This involves traffic and the risk of accidents, as well as additional cover for illegal operations.

4. The volume of traffic from logistic support craft in the vicinity of

offshore installations will require the Coast Guard to inspect for safety and to maintain surveillance over their operations for safety and law compliance.

5. The complexity and size of ships is also a factor adding to the Coast Guard's work load. ULCC's and LNG carriers constitute a different kind of inspection and enforcement problem than the smaller and less complicated tankers of the relatively recent past.

6. The density of offshore installations also increases the probable need for sea zoning by the federal government in the regions beyond the territorial seas and by the states in the more inshore waters. The Coast Guard will play a role in this function.

7. The increased load on the already overloaded Coast Guard will add to the mounting pressures for states to assume responsibility for the functions previously assumed by the Coast Guard in waters normally regarded as territorial. This increase in load will be particularly relevant in regard to recreational traffic, and the associated law enforcement problems to be encountered.

8. As the offshore industrial activities move seaward, international tensions over rights of access to resources and space will increase. This will add to the Coast Guard's already heavy pressure to monitor the safety and security of U.S. assets in the offshore regions.

9. U.S. policy will be to move cautiously seaward in claiming right of access and extraction of resources, despite U.N. action or inaction in support of such movement. This will cause the Coast Guard to begin to operate beyond the OCS and the 200 mile FCZ.

10. The states will not respond uniformly to the pressure, and they will in general lag behind the trend described in paragraph 8 above, despite the general trend for the states to take on jurisdiction over the regions within the 3 mile territorial waters limit. The states will lag sufficiently behind the

U.S. move seaward to offer no immediate relief to the Coast Guard.

11. Although our forecast is that the major share of increases in the varied activities in the offshore environment will not take place in massive increments until after the time period of this study, the effect on the Coast Guard will occur long before that. This is because the first of a new type structure or activity offshore will require that the Coast Guard gear up for all the many functions related to that new structure. The administrative load to accomplish this is often underestimated, but can overburden staffs and ships and aircraft units to a surprising degree.

12. Technological advances in information processing will lead to opportunities for the Coast Guard to increase its own productivity in several areas of its responsibility. Threat assessment, incident occurrence, law violation, traffic pattern dynamics, and other operational functions will be made more efficient by advances in technologies of surveillance, search, detection, communications, and data processing equipment that are likely to be available to the Coast Guard as the century nears its end. Unfortunately, acquisition of these new types of equipment will be increasingly difficult as inflation becomes institutionalized and as the Executive and Legislative Branches are pressed toward budgetary economies.

13. The Coast Guard will benefit from advances in the Navy's command and control technology as well as from Coast Guard initiative. This will result in improved capability for surveillance from satellite, radar, acoustic, photographic, and data processing technologies. A high demand for this improved capability will develop from the increased complexity of the OSI which will permit their use by antisocial forces, such as: cover of clandestine operations, bases for terrorist forces, targets for antisocial acts of violence, and targets for

hostage taking. It will also be necessary for the Coast Guard to maintain a current inventory of all OSI and their locations in order to be able to respond to emergency calls for accident, weather problems, or antisocial actions.

14. U.S. Defense Department activities in the offshore regions will increase slightly, but the number and variety of offshore range and instrumentation installations will not increase sufficiently to add to the Coast Guard's load.

15. The complexity of naval weapons will continue to progress in parallel with that of the USSR, and to aspire to the most sophisticated weapon capability. This will cause naval ship weapons to diverge from complementarity with those of the Coast Guard, which in turn will lead to the Coast Guard acquiring uniqueness in weaponry to handle the lower level antisocial action. Thus rather than continue the historic role of the Coast Guard as a similar and collaborating partner with the Navy in time of national emergency, the Coast Guard will, by the default of the Navy, acquire a unique capability of its own.

16. The seaward movement of industrial activities will move very slowly and will be susceptible to being monitored closely and with lengthy lead-times between planning stages and installation. It will be important for the Coast Guard to perform this monitoring, but beyond that the increased load will be modest.

17. Demand for both long range and short range navigation-aids will continue to increase throughout the time period. Added expense to the Coast Guard will accrue from the increase in volume, upkeep operations, and modernization activities. Navigation technology will advance leading to opportunity for the Coast Guard to increase its productivity in execution of this responsibility. This will be especially so in electronic aids, both short and long range.

18. As the offshore universe expands, so will the need for monitoring of pipelines and cables. The Coast Guard's activities in this type operation

have been modest to date, but will be forced to increase, in order to anticipate environmental damage and reduce recovery time. Advances in technology will also enable the Coast Guard to increase its success in oil spill prevention and cleanup before the end of the century.

19. Deep water ports appear to represent a concept that is not likely to take root; however, the concept of offshore transshipment facilities has already taken root in most of the rest of the world; large numbers of single point moorings have been in use for many years in Asia and Africa. As the ULCC's come more into use, the need for this or similar type mooring off U.S. coasts will increase, demanding Coast Guard attention to safety aspects.

20. The Coast Guard's Vessel Traffic Service will encounter increased demand as congestion in ports increases. This demand will be tempered by the conservative attitudes of ship masters, either protective of their command prerogatives, or legitimately concerned for maintaining control of their ships' safety in congested waters.

21. Increase in submersibles and diving operations will place a responsibility on the Coast Guard for safety, law enforcement, and regulation of these operations. Our forecast is that the use of submersibles will be on the leading edge of our forecast expansion of operations in the offshore regions. As we mentioned earlier, the bulk of this expansion will be experienced after the time period of this study, but the leading edges of it will be apparent earlier; and we forecast that submersibles will increase in numbers and in types of operations well before the end of the time period.

22. Weather prediction and to some extent weather modification will be improved by the end of the time period. The effect on the Coast Guard will be the effect of a new product on a consumer; it will enable the Coast Guard to improve its efficiency of operations. On the other hand, the increased value

of assets in the OSI universe will increase Coast Guard responsibility to aid these units in the event of weather disasters.

23. The increased load on the Coast Guard will lead to a number of measures to reduce the expenses born by the Coast Guard. This will include such measures as more user charges, special taxes and tolls, diversion of as much security and safety responsibility as possible to private enterprise and to the governmental agencies responsible for physical assets in the ocean environment.

PROGRAMMATIC IMPLICATIONS

Based upon the foregoing general implications, we now address the more specific programmatic implications to the Coast Guard of our forecast of the growth of the OSI universe through the year 2005. This section blends our more general forecasts of the preceding portions of Volume I with the description of Coast Guard roles in Chapter 10 of Volume II. Figure 6-1 depicts the structure of our approach. The first nine rows are organized in conformance with the topical headings of the last section of Chapter 10, Volume II; the remaining two rows are general functions that appear so important as to warrant explicit address. Each "X" represents the existence of a relationship between one of the numbered implications of the preceding section and one of the Coast Guard's mission-oriented programs or support activities. This section of Chapter 6 describes these relationships. We have not attempted here to establish a one-to-one correspondence between items in the immediately preceding section and the discussion in this section, nor have we made a strict correspondence between the Coast Guard's present organization and this discussion.

Underlying this section is the assumption that Coast Guard long term policy and strategy will support the continued existence of the program structure depicted here. If even some of the recommendations that appear in Chapter 8

of this report are followed, this assumption will not be valid.

The overriding effect of an OSI universe in the year 2005 that matches our forecast will be an enormous overload on virtually every Coast Guard role and every Coast Guard program.

Safety of Life and Property

1. Since for most of the period of this study, new offshore installations will be oil and gas rigs, an increased concentration of Coast Guard search and rescue operations will occur in those regions of the offshore environment where oil and gas exploration and extraction is likely to occur--namely the Gulf of Mexico and the east coast of the U.S.

2. With the move of offshore installations seaward, Coast Guard search and rescue operations will also move seaward. Whereas over 90% of the Coast Guard's SAR missions have been within 20-30 miles of the coast, this will change and an increased proportion will be further out.

3. Movement of SAR operations seaward implies a change in the Coast Guard's operating assets toward proportionately more cutters and aircraft and less of the smaller operating units--the boats which have been capable of handling the SAR missions closer in to shore.

4. The greatly increased size and complexity of oil and gas rigs--from a derrick on a barge to mammoth building-like structures capable of independent survival and operation over long periods of time in adverse weather conditions--has led to the need for a significant increase in technical expertise in designing safety regulations for placement of lifesaving and firefighting equipment in these structures, for regulating safe operations, for enforcement inspections, and for accident investigations. The rapid rate of technological acceleration in these installations is beginning to decline; technological advances will continue, but at a slower rate than in the last decade. This decline will have a mitigating effect on the demand for Coast Guard technological expertise,

Figure 6-1: Programmatic Cross-Impact Matrix

General Implications] * →		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Safety of Life & Property		X	X	X	X			X	X	X	X	X	X	X		X						X	X	
Navig. Safety		X		X				X			X								X		X			
Navig. Aids		X			X		X	X									X			X	X			X
Com. Ves. Safe.		X	X					X			X						X		X		X			X
Environ. Prot.		X	X				X	X	X				X				X		X		X	X		X
Law Enforcement		X		X				X	X				X						X			X		
Protect. Assets		X						X	X															
Ice Operations		X																						
Rec. Boat.Safe.								X																
Monitoring																								
Admin.& Train.																								

* Numbered columns correspond to the numbered items in the section "General Implications", pages 6-9 through 6-19.

but the movement into deeper water and the addition of other types of structures will continue a rapid technological advance. On balance the pressure on the Coast Guard for increased technological expertise will continue unabated.

5. The increased air and ship traffic density resulting from logistic support of the OSI universe will be the source of accidents and weather-related incidents that demand SAR action by the Coast Guard.

6. The states will continue to assume increased responsibility for functions within their respective jurisdictions--within three miles of the shore. This move will represent a form of relief to the Coast Guard from its rapidly expanding work load from the OSI expansion. However, the assumption of responsibility by the states will require additional funding, which will not be likely to come voluntarily from the states. Therefore we forecast that this move by the states will take place at a relatively slow rate. It will not provide relief to the Coast Guard commensurate with the rate of increase of Coast Guard load from the OSI expansion.

7. Within the next decade a variety of new OSI missions will emerge which challenge the Coast Guard. Each will involve new types structures that demand different approaches to protection of life and property. For each new form, before any actual installations are underway, the Coast Guard will be required to prepare to regulate safety, monitor operations, inspect, and enforce the law as proficiently as it has with oil and gas installations. The lead times for installation are long and the Coast Guard need not be caught by surprise from an operational point of view. In order to prepare for this responsibility and justify the cost of such preparation, the Coast Guard will need to become thoroughly conversant with all types of construction under consideration.

8. Technological advances in information processing will be made that

offer opportunity to the Coast Guard to increase its efficiency of SAR operations. This opportunity will be exploited only with the expenditure of resources, already short for the Coast Guard, but will enable the Coast Guard to compensate in some measure for the rapidly increasing operational load deriving from offshore expansion. The tactical data systems of the U.S. Navy are likely to be transferrable.

9. The increased use of submersibles and diving operations in deeper waters associated with the OSI expansion and movement seaward will impose a requirement for the Coast Guard to acquire a SAR capability for use in these deeper and more distant waters.

10. The OSI population in the more distant waters will lead to SAR operations in those waters (see #2 above) and will also require that the Coast Guard acquire substantial improvements in its capability for adverse weather SAR.

Navigation Safety

1a. The proliferation of offshore installations clearly adds significant navigation hazards into the approaches to U.S. ports and along the U.S. coast lines. Coast Guard responsibility is to maintain safe access routes; therefore the forecast installations will require the Coast Guard to take action to minimize risk of collision with the structures themselves and with other elements of the traffic patterns. Significant increase in the use of traffic separation systems and routing rules are likely. Zoning stipulations are also likely.

1b. Groundings and collisions have already resulted from the high density of offshore installations in the Gulf of Mexico, and have led to the need for traffic "fairways" within which ship traffic is enjoined to move. Other less stringent traffic separation systems are in effect off the east coast. Our forecast is that these traffic control systems represent only the beginning of

an era. Our "Sea Zoning" study for the Coast Guard forecasts the need for extensive federal action to create a variety of types of zoning systems for the marine environment by the year 2000; our research for the current study reinforces that conclusion.

2. Traffic patterns between offshore installations and their respective shore bases will pose navigation hazards that the Coast Guard must address. Overall traffic density in offshore regions will increase as a result of the presence of the offshore installations. This increased density will also pose navigation hazards in itself, requiring that the offshore structures be clearly and accurately positioned and marked. Criteria of cost-effectiveness will require that OSI owners install this marking and report accurately their positions. This imposes a requirement on the Coast Guard to issue procedural instructions, and to follow up to insure that these instructions are in fact followed.

3. It is possible that the requirement for accurate positioning of offshore structures will lead to regulations by the Coast Guard as to exact methods to be used by OSI owners for this accurate positioning.

4. Gradual assumption by the states of responsibility for regulation of operations within three miles of the coast will lead to the need to resolve questions of navigation safety responsibility, traditionally a Coast Guard primary function. It may be feasible and desirable ultimately to assign the states responsibility for all navigation safety within three miles of the coast. The coordination requirements will be extensive, but not insuperable.

5. Increase in bottom-mounted equipment, pipelines and cables associated with the expanding OSI universe will lead to a requirement for accurate positioning of these elements and the transmission of this information to operating mariners.

7. The demand for the Coast Guard's Vessel Traffic Service will increase

and extend to additional U.S. ports. States will be given increasing responsibility for this service--over the objection of both the Coast Guard and VTS users.

Navigation Aids

1. The installation of structures offshore clearly leads to the need to mark these structures for the benefit of passing traffic. Cost-benefit criteria will again dictate that the owners be responsible to install these aids. However, the Coast Guard will stipulate the circumstances under which each type aid is to be installed, and the specifications of the various types.

2. The density of traffic in some locations where concentrations of offshore installations occur is likely to lead to the need for additional aids to assist mariners not only to avoid danger but to make their way to specific locations within the OSI complexes.

3. Within the three mile zone, economic factors will dictate that the states be given responsibility to install, within certain limits, the aids required above and beyond those assigned to offshore structure owners. This will require significant coordination, perhaps led by the Coast Guard, and will take considerable time to develop systematically.

4. The demand for long range navigation aids will be intensified by the need for safe navigation in the vicinity of the OSI complexes. This will lead to increased pressure on the Coast Guard to promote development of satellite and other long range systems. Concurrently, the budget pressures on the Coast Guard will continue to mount.

5. The increase in operation of submersibles and diving operations is likely to lead to the need for special types of aid. Perhaps not in the time period of this study, but at the latest soon after the turn of the century there will be demand for underwater aids for use by submersibles. This function may be largely satisfied by navigation aids attached to the structures themselves,

but there will be a need to develop the associated technology and engineering; and the Coast Guard again will be called upon to specify the conditions that require aids, and the specifications of the aids required.

6. Budget considerations will lead to study of the means by which the users of navigation aids can be charged for their use in some equitable manner. The Coast Guard will eschew becoming involved in this type accounting, but may find there is no other means of satisfying all the demands placed upon it for action to acquire tangible assets for aid to navigation.

7. It is possible that development of more sophisticated VTS will lead directly to navigation aids dedicated to that service. Should the VTS be transferred in whole or in part to state or local authorities, this transfer will not take place before the demand for service has led to VTS growth under the aegis of the Coast Guard; development of dedicated aids as components of that service may thus fall to the Coast Guard.

Commercial Vessel Safety

1. The proliferation of oil and gas offshore structures and their extension into deep water is part of a trend toward more and more of these "structures" becoming "vessels" within the meaning of current legislation. This means that the Coast Guard will have responsibility for most of the safety aspects of their construction, equipage, and operation. It also means that the Coast Guard will have responsibility for examination and licensing of personnel. The load this imposes on the Coast Guard is likely to become unbearable by the end of the century. We forecast that independent of Coast Guard initiatives, there will be legislative action to bring relief from this extraordinary load. The form that this relief takes will depend upon the manner in which legislation in general on the OSI universe emerges in Congress.

2. In the event no legislative relief is forthcoming, the impact on the Coast Guard of the OSI expansion will become so large in terms of the amount of work to be done that there will be no alternative to work performance of considerably less depth and thoroughness than traditional Coast Guard standards have adhered to. The Coast Guard will find itself in the role occupied by a number of different federal agencies with respect to industrial operations on land, and will find itself ill equipped to handle this load--even if the present policy is continued to assign "industrial safety" on offshore installations to other agencies.

3. Extension of state jurisdiction to cover the region within three miles of the coast will not relieve the Coast Guard of enough responsibility to be significant.

4. Each new type structure qualifying as a "vessel"--and this includes most of them beyond a few hundred feet of depth--will also add to the load on the Coast Guard to acquire the technical knowledge and expertise to take all the safety action conventionally required.

5. We have forecast that the general movement of industrial complexes seaward is unlikely to take on significant dimensions before the end of the time period of this report; however, should even the beginning of this move become a reality, the virtually impossible load on the Coast Guard would become even more clearly impossible.

6. The growth in numbers of offshore transshipment facilities--single point moorings or deep water ports or whatever--will impose a legitimate added burden on the Coast Guard to impose safety and personnel licensing standards to insure maximum safety associated with ship operations approaching, at, and leaving these moorings.

7. As the numbers of submersibles in operation increases, the Coast Guard

will be required to establish safety inspection and licensing standards for a variety of new classes of ships.

8. Again with budgetary constraints the dominant consideration, we forecast that the Coast Guard will be forced to adopt a form of user charge system to pay for the regulatory processes involved in promotion of commercial vessel safety, especially as it relates to offshore installations classified as "vessels".

9. The multiplying and strident clamor against regulation among the forces of U.S. industry will lead to pressures on the Coast Guard to adopt new forms of regulation governing "commercial vessel" safety--new forms that reduce the social overhead costs presently being transmitted through industry to the consumer. This pressure will apply to actual commercial vessels as well as to offshore structures classified as vessels, but our point of reference here is the offshore structures classified as "vessels".

Environmental Protection

1. The Coast Guard responsibility to prevent damage to the environment from spillage of oil will be severely challenged by the expansion of offshore oil and gas installations through the next two or more decades. As these installations move into deeper and more distant waters, the challenge will increase still further. The components of the challenge include regulation, inspection, law enforcement, follow-up of spills to assess responsibility, and clean-up after the spill. One of the most important aspects of this challenge will be to develop regulations that provide protection, and at the same time do not inhibit investment.

2. The mechanical complexity of rigs, the trend toward subsurface well-heads, and advances in automation mean that the Coast Guard will be required to educate large numbers of personnel into these new technologies as the newer rigs are installed and placed into operation.

3. The increased traffic density in the vicinity of the rigs, and the increased traffic carrying oil and gas from the rigs, will increase the probability of spills off U.S. coasts by several times. Risk of collision with offshore will also be increased, and major environmental damage is likely from such collisions. Blow-out potential cannot be reduced to zero either, which means the Coast Guard must maintain an ever-increasing capability to counter the effects of such an event.

4. The need expressed by the environmentalists for protection of the environment will conflict with economic needs of other special interest groups, and will find compromise solutions in every aspect of the Coast Guard's environmental protection responsibility, including establishment of zones in which certain functions are prohibited or to which they are confined.

5. As foreign nations attempt to recover oil and gas and other resources from regions perceived to be "ours", environmental controversy will flourish, with the Coast Guard a major discussant and participant in negotiations.

6. States will be given increasing shares of the responsibility for maintaining a clean environment within the three mile limit, but the rate of increase of state responsibility will not match the rate of increase in Coast Guard responsibility at greater distances as the OSI universe expands.

7. Antisocial action will mount as a likely cause of environmental damage. This means the Coast Guard will be required to combine the operational capability to combat the hostile action with that of containing environmental damage.

8. Advances in technology will enhance the Coast Guard's capability to contain or neutralize oil spills.

9. Development of mineral extraction industry offshore will have a heavy impact on the environmental protection role of the Coast Guard. The effects of recovery of minerals from the sea floor, especially in the shallower water have

been thoroughly experienced only with extraction of sand and gravel. The other possible extraction methods are likely to raise considerable concern among the environmentalists, and require time to settle before mineral extraction on a large scale is developed.

10. Pipeline monitoring will be an additional requirement on the Coast Guard as the flow of oil and gas and possibly other materials begins to increase from offshore installations to shore destinations. There will be a need for the Coast Guard to develop means of detecting pipe leaks at the earliest possible time after they start; in deep water it will be possible for a leak to continue for some period of time without detection, and build up a significant volume of contaminant before stoppage and recovery operations are even commenced.

11. Offshore transshipment facilities will also increase the probability of oil spills. These installations will not pose a greatly different problem to the Coast Guard than other sources of spill, but they simply add to the probability.

12. Submersible operations will add a small measure to the complexity of the environmental protection responsibility of the Coast Guard.

13. All-weather oil spill recovery will be a requirement laid on the Coast Guard with ever increasing emphasis.

14. The Coast Guard administration of pollution compensation funds will increase in complexity and scope. "Super" funds will become common and more effective as deterrents to potential oil spillers.

15. Other substances will be added to the list of common pollutants as the century nears its end. LNG, the products of OTEC ship-plants, and the products of other offshore energy-intensive production plants will be the principal ones.

Law Enforcement

1. The only U.S. operational law enforcement agent in the entire region of the OSI universe beyond the three mile limit will continue to be the Coast Guard, aided and assisted by other federal agencies whose operational capabilities are considerably less than the Coast Guard's--such as the FBI, INS, IRS, Customs Service, etc. (See Chapter 12 of Volume II for a brief description of other federal agencies and their offshore environment responsibilities.) As the intensity and density of offshore activities increase, the demand for Coast Guard law enforcement action will increase. This increase will be more in proportion to the complexity of relationships offshore than in proportion to the mere numbers of offshore units.

2. In addition to the civil law enforcement action to insure compliance with regulatory standards, already covered above, the Coast Guard will confront violations of criminal law centered around the existence of offshore installations, such as drug and other contraband smuggling, illegal alien smuggling, use of offshore installations as covers for land-based crime rings, and use of offshore installations as targets for extortion schemes and hostage taking.

3. State acceptance of law enforcement responsibility within three miles of the coast will be a major source of relief for the Coast Guard, but as in other aspects of state assumption of responsibility, states will move very slowly--not fast enough to relieve the Coast Guard of its excessive load as fast as it is being imposed.

4. International controversy will occur as the U.S. interests reach out further and further seaward and conflict with the interests of other nations making "common heritage" claims. Coast Guard surveillance operations will be required to move seaward ahead of this region of conflict. Coast Guard involvement in international incidents over "rights" of private parties is also

almost certain. As part of its military preparedness role the Coast Guard will be required to maintain readiness to neutralize hostile action in the farther reaches of the ocean where international law has not yet spread, but where the U.S. policy of intentional "creep" ahead of the law will carry U.S. extension of interests.

5. Technology advances in information processing will provide the Coast Guard opportunities to establish intelligence networks as counters to law violation activities. Satellite surveillance will offer significant opportunities. A form of national surveillance network is likely to be established, a part in which will be open to the Coast Guard, and this will augment the Coast Guard's own intelligence networks to counter law violations.

6. As new offshore installations proliferate, as pipe laying in deeper waters becomes increasingly feasible, and as networks of pipelines and cables are installed interconnecting separate units, the Coast Guard will be required to monitor pipeline laying in order to insure regulatory compliance. In times of tension--either domestic or international--this monitoring will assume high importance as protection against intentional insertion of potential environmental damage mechanisms.

7. Increased density of subsurface operations with submersibles and diving units will require Coast Guard surveillance to insure against antisocial action from this source.

Protection of Assets

1. As U.S. owned assets increase in the offshore environment, so does U.S. vulnerability to antisocial action from either domestic or foreign sources. Protection of these assets will continue to be the joint responsibility of both Coast Guard and state and local authorities within the jurisdiction of the states, and the sole responsibility of the Coast Guard beyond these regions.

2. As U.S. interests install assets in the distant ocean regions, they will come into conflict with foreign interests. The posture of the U.S. will almost certainly include provision for protection of assets by military means in some way. The U.S. Navy's capability will be adequate for some forms of this operation, but will not be adequate for many of those involving lower levels of violence. (See the preceding section for explication of this point.) The Coast Guard will be required to respond to a variety of forms of antisocial action, including sabotage, terrorist activities, underwater attack, ramming, deliberate environmental pollution, taking of hostages, and others.

3. States will assume responsibility for asset protection within their regions of jurisdiction, but again at a rate slower than the growth rate of the OSI universe.

4. U.S. Naval operating forces and Coast Guard forces will become more complementary than overlapping in their capabilities as the century nears its end, leaving the Coast Guard as the U.S.'s most capable force to combat low level antisocial action against offshore assets.

5. The vulnerability of subsurface assets--like pipelines--to clandestine antisocial action will pose a problem for the Coast Guard in times of international or domestic tension.

Recreational Boating Safety

1. We forecast that the pressures of the marine environment's expansion will pull the Coast Guard away from one of its most popular functions--recreational boating safety. These pressures are leading the states toward increasingly complete assumption of responsibility for all functions taking place in the regions of their jurisdiction, and this will include a large proportion of recreational boating. Until this shift in emphasis is accomplished within the Coast Guard it will likely be objected to by many interest groups who perceive

the Coast Guard as more benefactor than policeman.

2. Coast Guard responsibility for law enforcement, environmental protection, and safety of life and property at sea will continue to pertain to recreational boating activities.

Ice Operations

1. Oil and gas extraction from the ocean region of Alaska will continue to mount in intensity of operational activity. The Coast Guard will continue to be the only U.S. agent with the capability for asset protection, law enforcement, search and rescue, environmental protection, and promotion of navigation safety in polar regions.

2. The Coast Guard will be required to adapt for use in polar regions the same competences that have been described above for use in the offshore regions of the lower forty-eight states.

3. We forecast that the rate of increase in offshore activities, other than oil and gas extraction, in the polar regions will be slower than that in the more temperate zones, and will not impact heavily on the Coast Guard until well beyond the end of the time period of this study.

CHAPTER 7: COAST GUARD ALTERNATIVES

There are three components to the central thrust of this study's conclusions:

- o The spectrum of possible futures is defined by the spectrum of possible human decisions. Should an administration decree that energy extraction warrants a "man-on-the-moon" effort, the offshore installations universe will expand greatly; on the other hand, should successive administrations conclude that the incentives of private enterprise will be sufficient to stimulate the nationally required investment in offshore energy exploitation, then we may expect an extremely slow growth.
- o By the year 2005 exploitation and exploration of oil and gas will have developed enormously, but all other developments in the offshore installations universe will be modest in comparison. The only other development of significance will be OTEC; all other energy extraction or production developments will be in various stages of growth, but none will have matured to match OTEC.
- o By the year 2005 deep water ports will not have grown in number, but will have found substitutes in either special configurations of three-point moorings or an equivalent arrangement less elaborate than the deep water port.

More specific conclusions emerging from the chapters preceding are summarized as follows:

- o The most crucial issue to be decided in the ocean environment is what form of governance is to emerge.
- o This issue is alive in both U.S. and international spheres, but there is no historical precedent to follow, and the spectrum of possible outcomes is broad in both spheres--i.e. highly uncertain.
- o The dominant type of offshore installation through the time period of this report will be oil and gas exploration and extraction; but by the end of the century other types of offshore installation will be clearly emergent.
- o The Coast Guard is the only U.S. agency with a full operational nonmilitary as well as military capability in the ocean environment.
- o The Coast Guard's principal value to the U.S. is its at-sea operational capability.
- o The growth of the OSI universe will bring pressures to bear on the Coast Guard to provide more service than its resources will permit.
 - Much of this demand will press the Coast Guard toward service in its most fundamental mode--at-sea operations.

- This demand will also produce an additional heavy pressure on the Coast Guard to provide service in other than operational modes --service that could dilute Coast Guard application of its most useful capability, its operational capability.
- o The Coast Guard has opportunity to offer significant service to the U.S. in two respects:
 - Take initiative toward an influential role in the governance of the marine environment; and
 - Resist pressures toward diluting Coast Guard operational capability by permitting the erosion or attrition of its regulatory role, in order to concentrate its resources on the role most useful to the U.S. as a whole--its operational role.

The central thrusts of three possible OSI futures emerge.

1. A major expansion of the oil/gas exploration and extraction process.

This expansion would be likely to include extension into deeper water and into the arctic. This future could come about because of major pressures from both the federal government and the oil and gas industry. We label this future F_1 , and assess its probability to be moderate.

2. A modest expansion of the oil/gas exploration and extraction processes.

This would result from low level motivation on the part of the federal government. It would amount essentially to a linear extrapolation of present trends, a "business as usual" future, with very little change from the influence of the external driving forces that appear to be currently operating. We label this future F_2 , and assess its probability to be high.

3. A major expansion of oil/gas exploration and extraction accompanied by a similar expansion of other major industrial activity--such as other mineral and/or food extraction. This future could emerge from major governmental and industry pressures toward energy and other resource independence. We label this future F_3 and assess its probability to be low.

It is beyond the scope of this study to arrange the details of each of the alternative futures, F_1 through F_3 , into scenarios; however, a thorough understanding of the previous sections of this study should lead to a visceral conception of the major details of each of these three possible futures.

In the face of these alternative futures, we postulate three alternative strategies that would appear viable for the Coast Guard:

1. Plan for F_2 but take no action beyond planning. This strategy would involve identification of long lead time items so that decisions are already made as the precursors of these issues become visible. This would be a conservative strategy in keeping with the historically conservative philosophy of the Coast Guard. It would be suitable if F_2 became a reality, it would place the Coast Guard in position to respond to either of the other possible futures, but in a catch-up mode. We label this strategy S_1 .

2. Aggressively move out into bureaucratic competition in an effort to acquire the resources necessary to be prepared for F_3 . This action would be counter to the Coast Guard's traditionally conservative position. However, if alternative future F_3 were to emerge, and if the Coast Guard is to fulfill missions assigned, this aggressive action would be necessary. This strategy would risk loss of credibility and loss of investment if F_2 emerged. We label this strategy S_2 .

3. Make a deliberate effort to divest itself of selected mission assignments under a decision to perform certain functions well rather than many functions under the strain of insufficient resources. The objective would be to render accomplishment of whatever missions are assigned reasonably feasible--i.e. within the range of expected budgetary resources. This action would require that if the missions now assigned to the Coast Guard are to be fulfilled,

some other public or private agent would be assigned them. Carried to its fullest, this strategy is probably bureaucratically untenable; it is unlikely that an agency can divest itself of significant portions of its function without being subject to "commensurate" cut-backs in resource allocation--no matter how logical the rationale for the divestment in terms of overload. Thus this strategy would have high risk that action would be taken in both Executive and Legislative Branches toward resource cut-backs to match the mission divestment; it would also be strongly counter to the Coast Guard's traditional "can-do" posture. We label this strategy S₃.

Although S₃ would be pursued at risk of cut-backs and almost certain demoralization of the officer corps, there are some actions that the Coast Guard can take in the direction of Strategy S₃ that appear to be feasible at low risk.

- o Initiate action in Congress to change the legal definition of "vessel" to exclude structures designed for offshore industrial operations--e.g. oil and gas exploration and extraction, energy production, and manufacturing. This would relieve the Coast Guard of the prospect of having every semi-submersible rig constructed for deep water operations under its "vessel" cognizance. Responsibility for the industrial safety now assigned to other federal agencies could then include all safety functions on the units affected.
- o Initiate action in Congress, and pursue it over the several years it will take to bring about significant effect, to place responsibility on the states for all Coast Guard functions now exercised within the three mile territorial waters--i.e. the regions in which the states have claimed and been granted jurisdiction.
- o Accept the administrative burden it will entail, and initiate action to establish value capture and user charge systems for cost recovery.
- o Invest the required resources in a study to reduce both Coast Guard costs and social overhead costs of regulation through development of innovative regulatory systems along the lines suggested in Chapter 6.
- o Reinforce the Coast Guard's determination to resist pressures from the Executive and Legislative Branches to
 - Reduce annual resource allocations--i.e. appropriated funds--from amounts clearly required for effective performance; and

- Add new operational or regulatory missions to the Coast Guard without matching resources.
- o Publicize those services each year that are likely to be provided at lower than desired levels because of resource limitations.

At a more specific level, we have identified a number of action items that appear appropriate at low risk to prepare for a rapidly expanding offshore installations universe. Each alternative listed below may be thought of as a decision-spectrum. A Coast Guard decision with respect to one of these issues is represented as a point along this spectrum.

1. Develop comprehensive and institutionalized plans to do the following:
 - o Acquire sufficient resources to meet the needs of the forecast offshore installations devoted to exploration and extraction of oil and gas--i.e., respond directly to each "general" and "programmatic" implication of Chapter 6.
 - o Acquire the mix of forces capable of operating in deeper waters, more distant waters, and polar waters.
 - o Acquire the mix of forces with capability to meet national defense, SAR, law enforcement, and environmental protection requirements in an optimum manner.
2. Study in detail the manner in which the OSI universe growth is likely to impact upon the profile of demand for Coast Guard activity in each of its operating missions--national defense, SAR, law enforcement, and environmental protection; this would be a force-level study.
3. Establish a systematic way of monitoring emergence of the precursors to the events forecast in the previous chapters in order to modify and refine these forecasts as time ensues, and to revise the forecasts and their probabilities as these precursors reveal themselves.
4. Plan in detail for each of the eventualities listed in Chapters 5 and 6.
5. Create a Commandant's Council on the Future to monitor the unfolding events of OSI development and recommend action.

6. Establish a "catastrophic event" precursor monitoring system. The purpose of such a system would be to be prepared to take immediate action on long lead time items. Such action would be appropriate in the event an economic threat to the U.S. developed that demanded emergency exploitation of the ocean's resources.

7. Transfer to the states most if not all of the Coast Guard non-operational functions associated with port, harbor and inland waterway safety and navigation.

8. Promote acceptance by the states of responsibility for all SAR, law enforcement, and environmental protection activities in their respective regions of jurisdiction. As an alternative, promote establishment of systems for acquiring reimbursement from the states for services rendered in state jurisdictions.

9. Publicize the probability of an extraordinarily heavy work load with the objective of mobilizing the support of the Coast Guard's numerous and wide-spread constituency.

10. Make a detailed and thorough study of the effects of forecast demand for increase in non-operational activities on Coast Guard capability to respond to operational requirements for safety of life and property, law enforcement, environmental protection, and national defense.

11. Establish a marine operational intelligence system, including surveillance, to provide the Coast Guard operating commands with current and comprehensive information/intelligence. This function will be necessary for the operational efficiency and effectiveness of Coast Guard operating forces in the extended regions of coverage of the future.

12. Transfer to another agency the Coast Guard's responsibility for navigation aids--both long range and short range.

13. Make a thorough and detailed analysis of the likely political conditions

in the distant regions of the ocean environment with a view toward anticipating practicable rules of engagement for law enforcement with respect to foreign vessels in the regions.

14. In the face of heavy pressure to move in another direction, aggressively prepare to confront the situations most likely to demand the operational expertise of the Coast Guard in the year 2005:

- o High rate of incidence of loss of life and damage to property at sea;
- o High risk and incidence of loss of the assets of private enterprise in the ocean environment;
- o Frequent environmental damage from the activities of the OSI universe.

CHAPTER 8: RECOMMENDATIONS

The Coast Guard profile in the year 2005 will be determined at least in part by decisions made on a day-to-day basis in the 1980's. The aggregate of many near-term decisions will guide the direction in which the Coast Guard may move over the next decades. Some of these decisions may be implicit, others explicit. The implicit decisions may have at least as much effect as the explicit; but their effects may not be as clearly visible. So our first recommendation is as follows:

- o The Coast Guard should take into its institutional cognizance the spectrum of possible futures presented here and monitor carefully and critically the unfolding events which will either confirm, deny, or modify this spectrum.

There are certain policy positions that we believe the Coast Guard could adopt now that would place the institution in a more favorable position to serve the nation in the year 2005 than it would enjoy if present trends are allowed to continue undiverted.

- o Adopt a resolute position to maintain Coast Guard operational capability, (if necessary at the expense of any other assignment, traditional or otherwise) despite heavy pressures to provide services that could drain Coast Guard resources elsewhere. We interpret the Coast Guard's operational capability to be oriented to four missions: safety of life and property at sea; law enforcement; environmental preservation; and military defense of the U.S.
- o Make opportunities to lead the movement of the federal government in establishing systems of governance over the ocean environment in such a way as to preserve its operational viability as an adjunct region of the U.S.
- o Support and promote the move toward states' acceptance of responsibility for the functions of governance in the region within three miles of the coast.
- o Make a thorough and ongoing analysis of the force structure required to optimize accomplishment of the four operational functions of the Coast Guard in distant, foreign-intruded, deep, and sometimes polar waters; at each budget submission press toward this structure--at the expense of forces that may offer more short-term advantage.

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