WASHINGTON STATE

TOWARD A CONCEPTUAL FRAMEWORK FOR GUIDING FUTURE OCS RESEARCH

Workshop Report
Port Ludlow, Washington
10-12 January

OFFSHORE OIL & GAS

Roger E. Kasperson
with
Dominic Golding & Seth Tuler

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This workshop was organized and conducted by the Center for Technology, Environment, & Development, Clark University, Worcester, Massachusetts, under a contract with the Washington Sea Grant Program, University of Washington. The workshop and this report of its findings were supported by an appropriation from the Washington State Legislature, under ESSB No. 5533, Laws of 1987, to the Washington Sea Grant Program. Additional support was provided by grant NA 86AA-D-SG044 from the National Oceanic and Atmospheric Administration to the Washington Sea Grant Program, projects R/MS-33 and A/PC-5.

WSG 89-4 ISBN 0-934539-11-1

Contents

List of Figures

Acknowledgments

The participants are grateful for the opportunity afforded by this workshop to begin to make a difference in the way environmental studies are identified, prioritized, and selected by the Minerals Management Service of the U.S. Department of the Interior in the leasing and management of our nation's offshore oil and gas.

The sponsor of the workshop recognized from the beginning that the participants could not complete the task of developing an operational conceptual framework in three days. The participants understood the same when we accepted the invitation to attend. However, the task is too fundamentally important for natural and social scientists to neglect it any longer. Someone must begin. It was difficult but also a pleasure for us to take that first step together in January 1989 at a bayside setting in the upper left corner of the country. We were far from the seats of power on OCS leasing and development—Washington, D.C., Houston, New York, and Los Angeles—but nothing is more powerful than a good idea.

It is our hope that others will recognize the significant potential benefits of a well-conceptualized system and will be moved to complete the task.

We praise the leadership shown by Washington State in providing funds to the Washington Sea Grant (WSG) Program, University of Washington (UW), to identify information gaps and research needs related to possible leasing on its outer continental shelf. Louie Echols, Director, WSG, supported the proposition that a good conceptual framework would improve the allocation of scarce funds to the abundant need for more and better information. Glenn Ledbetter, Manager, Ocean Resources Assessment Program (ORAP), deserves credit for scoping the workshop so that the appropriate natural and social sciences would have to blend within the context of risk assessment. We know these are the essential elements, but we have not yet finished fusing them. With their proper mixing, forging, and tempering, an operational conceptual framework for guiding future OCS research eventually will be wrought and emerge from the smithy.

We commend the experienced facilitator of the workshop, Professor Roger Kasperson of Clark University, for his restraint, flexibility, and gentle guidance in helping us shape this research management tool, while letting us explore the broader context in which it is needed and should be applied. His assistants, Dominic Golding and Seth Tuler, were especially helpful in the small group sessions. It took the collective efforts of the Clark team to capture our many diverse thoughts, experiences, and ideas in this report.

The small group leaders contributed immeasurably to the success of the workshop. Dr. Garry Brewer of Yale University and Dr. Thomas Leschine and Charles Simenstad of UW carried their exhaustive burden very well,

repeatedly drawing out ideas from their members, melding a structure, and reporting to the full workshop.

Xan Augerot, Assistant to the Director, WSG, contributed substantively in achieving diversity and balance, in terms of disciplines and affiliations, among the 15 invited participants. She very efficiently made and smoothly executed the logistic arrangements for the workshop. During the event itself, she was ably assisted by three graduate students from the Institute for Marine Studies, UW, Donna Sorensen, Jean Flemma, and Susan Snow, who took excellent notes and transcribed them immediately for use by the group leaders and members.

Finally, we express our appreciation to Pamela Miller, Washington State Department of Ecology, and Daniel Bottom, Oregon Department of Fish and Wildlife, for their special interest in our efforts and product.

About the Ocean Resources Assessment Program

In April 1992, the Minerals Management Service (MMS) of the U.S. Department of the Interior plans to conduct Lease Sale #132 for offshore oil and gas exploration and development in federal waters on the outer continental shelf off the coasts of Washington and Oregon. This has been the driving force behind recent Washington state actions on this issue [earlier, the State Department of Natural Resources had imposed a moratorium on leasing for oil and gas inside state waters].

The Governor of Washington has asked MMS to delete about half of the lease sale area off the Washington coast and has joined Oregon, California, Massachusetts, and the National Resources Defense Council, an environmental group, in lawsuits against DOI, challenging its current Five-Year OCS Oil and Gas Leasing Program. Meanwhile, MMS is sponsoring several pre-lease environmental studies, and, at this writing, the first step in the sale process is less than one year away. In November 1989, MMS plans to request that oil and gas industry members indicate their level of interest in Lease Sale #132. Under the present plan, if industry interest is sufficiently high, successive steps in the lease sale process will proceed.

Through the Western Legislative Conference in 1986, members of the Washington Legislature became concerned that the state was unprepared for the potential development being planned by the federal government. Engrossed Substitute Senate Bill (ESSB) 5533 was the result. It became effective law on July 26, 1987. Of the $800,000 originally requested, the Legislature appropriated $400,000 to Washington Sea Grant to conduct the studies mandated by this law.

Why Sea Grant? First, the University of Washington has a renowned College of Ocean and Fishery Sciences, and Sea Grant is an effective pathway to that expertise. Second, Sea Grant is experienced in interdisciplinary research design, procurement, and administration. Third, Sea Grant has a communications network with other universities, giving Washington State quick access to nationwide expertise. Fourth, part of Sea Grant's mandate is to work with academe, government, and industry, without political advocacy, in a non-regulatory, information-support role. Last, Washington does not have statewide planning and assigning the responsibilities of ESSB 5533 to a mission-oriented state agency might have created concerns about objectivity and fairness.

This law is ocean information oriented, as opposed to Oregon's C-ESB 630, which is ocean management oriented. Management could be the next step for Washington State. Through its Ocean Resources Assessment Program (ORAP), Washington Sea Grant is synthesizing existing scientific information. The Legislature's Joint Select Committee on Marine and Ocean Resources acts as oversight committee for ORAP. In the early weeks of the 1989 Legislative session, ORAP reported its findings about information gaps and research needs and made its recommendation for future studies.

In designing ORAP, an overall guideline was the determination to benefit from the experience of others but not to duplicate past and current studies. Thus, ORAP has sponsored little original research but has concentrated on synthesis and planning. ORAP consists of seven projects, including the workshop from which this book is derived:

• ***Toward a Conceptual Framework for Guiding Future OCS Research***—a workshop to develop a framework that will help determine "what's important?" and help ensure that future research is both well-targeted and well-founded scientifically.

•***An Assessment of the Oil and Gas Potential of the Washington Outer Continental Shelf***—an assessment by the State Department of Natural Resources, to help identify geologic formations that might be of potential interest to industry.

• ***State and Local Influence Over Offshore Oil Decisions***—a study of the roles and mechanisms of state and local governments in offshore oil decision-making, as revealed by experience in other states.

•***Coastal Washington: A Synthesis of Information***— a report on existing information, information gaps, and research needs.

•***Coastal Oceanography of Washington and Oregon***—a regional oceanography text, making contributions to science on 15 of the 22 subjects mentioned in the law. Multi-edited and authored, the hardcover book presents the results of many years of research. Sea Grant funded the final efforts needed to make the book available in time to influence OCS decision-making and future research.

• **An Advisory Committee,** as required by law. Sea Grant recognized the need for broad educational base-building among the policy-makers in state and local governments, tribal authorities, and citizen groups. Ten Legislators, equally split by party and body, were members of this advisory committee. Sea Grant devised an innovative approach to help the 32 members of this committee educate themselves quickly about the offshore oil and gas industry and its typical facilities, equipment, operations, and impacts. The committee functioned like a task force and reported to Sea Grant on information needs and priorities. This project is a worthy model for others who must deal on a tight schedule and budget with new, complex issues of high public concern.

• **OCS Studies Plan: A Report to the Washingon State Legislature**—a plan developed by Washington Sea Grant, as required by law, building upon the other ORAP projects and other studies.

Washington Sea Grant is publishing reports of each of these projects, except for the coastal oceanography text, which is being published commercially by Elsevier Science Publishers. Meanwhile, the Legislature's Joint Select Committee on Marine and Ocean Resources has issued its own report about statewide policy alternatives and proposed legislation for adoption during the 1989 regular session.

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February 1989

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On January 10-12, 1989, the Ocean Resources Assessment Program (ORAP) of the University of Washington (Seattle) sponsored a workshop held at Port Ludlow, Washington. The purpose of the workshop was to begin the process to develop a conceptual framework for structuring and interrelating future research dealing with the potential onshore and offshore impacts of hydrocarbon exploration and development in the outer continental shelf (OCS), with particular reference to the Washington/Oregon area. Such a framework would need to reflect the current state of knowledge of both offshore and onshore systems and would need to draw upon, and integrate, knowledge emanating from a broad array of natural and social sciences.

Fourteen participants representing such diverse fields as atmospheric sciences, fisheries, marine ecology, physical oceanography, geography, community development, economics, and law (see the biographical sketches in Appendix A) convened at Port Ludlow to address the rather imposing task of developing such a framework. Over the course of three days, the participants addressed a broad range of concerns. Meeting sometimes in specific work groups and other times in plenary sessions, the participants were successful in creating at least a preliminary framework that could be used in a variety of ways to inform future research. The workshop also identified a broader range of issues to be addressed for technically sound and socially sensitive approaches to offshore petroleum development. The primary emphasis was upon potential risks and adverse impacts; further efforts would be needed to define benefits and positive impacts. This document reports on the deliberations and results of this effort.

Workshop Participants and Process

Planning for the workshop began in mid-1988 after the absence of an existing overall conceptual framework for research into the impacts of offshore petroleum development became apparent to ORAP. Professor Roger E. Kasperson was contacted and retained to help plan the workshop and to act as facilitator and rapporteur. The ORAP Manager and staff identified prospective participants, and eventually 14 agreed to be involved. The participants represented a broad diversity of academic experience, private industry, and governmental service. It was decided that three different work groups should pursue simultaneously the same broad task of developing a conceptual framework. Dr. Garry Brewer, of Yale University, and Dr. Thomas Leschine and Charles Simenstad, of the University of Washington, agreed to serve as work group leaders. Throughout the workshop, the work group leaders and workshop facilitator served as a steering committee to assess progress and to decide upon changes in workshop format and procedures.

In preparation for the workshop, participants were invited to suggest resource materials that should be circulated in advance. These were supplemented by materials identified by the ORAP staff and the Clark University group. In addition, a list of anticipated questions, together with appropriate responses, were furnished to each participant to clarify workshop objectives and procedures. The ORAP staff, the workshop facilitator, and the work group leaders also discussed workshop arrangements in a conference call prior to the workshop and met in planning session on the eve of the meetings.

The workshop itself was structured to alternate time in small work groups with broader discussion in plenary sessions. Work groups consisted of 4-5 persons each, with members chosen largely at random. The result was that the work groups tended to reflect diversity of background and expertise rather than specialization. Day 1 (Figure 1) included a preliminary discussion of workshop goals and introduction of participants, work sessions in small groups, and a preliminary discussion of initial progress in plenary session at the end of the day. Day 2 was given over largely to small group work and was a highly productive day of effort in the workshop, with several preliminary conceptual frameworks emerging. Day 3 began with the three work group leaders meeting in executive session to seek an integration of the several emerging frameworks while the rest of the participants discussed their views as to major messages (i.e., group concerns) that should be reported out of the workshop. After a presentation and discussion of the proposed integrated framework, the workshop concluded with a general discussion of means to facilitate utilization of the framework.

General Concerns

Early in the workshop, the participants made clear their concerns over the broader energy context and institutional setting in which a conceptual framework for research would be used, and by which it would be constrained. Many expressed the desire that these concerns be specifically identified and communicated as a central part of the workshop report.

One set of concerns related to national energy policy and the broad energy situation. Participants noted that alternatives to OCS petroleum development need to be considered more adequately and explicity as part of a coherent national energy policy. In particular, there was a concern that the market tended to be the sole driver of OCS development, with only limited and inadequate attention to local concerns as well as to the broader environmental and social impacts involved. While elements of national policy do exist to guide development decisions, most participants saw them as unduly fragmented and poorly integrated.

The institutional structures and processes, and in particular those of the Minerals Management Service (MMS) of the U.S. Department of the Interior, received substantial attention from workshop members. Participants recognized that the MMS structure and process of implementation are appropriate to its mission, and that this mission is dictated and constrained by law and regulation. Serious institutional gaps and mismatches were seen as eroding the effectiveness of planning and decision making. Generally, the process was considered to be remote, poorly informed, and unresponsive to local issues and public concerns. Local economic issues in particular are not currently weighed against ambiguous national policy and economic concerns.

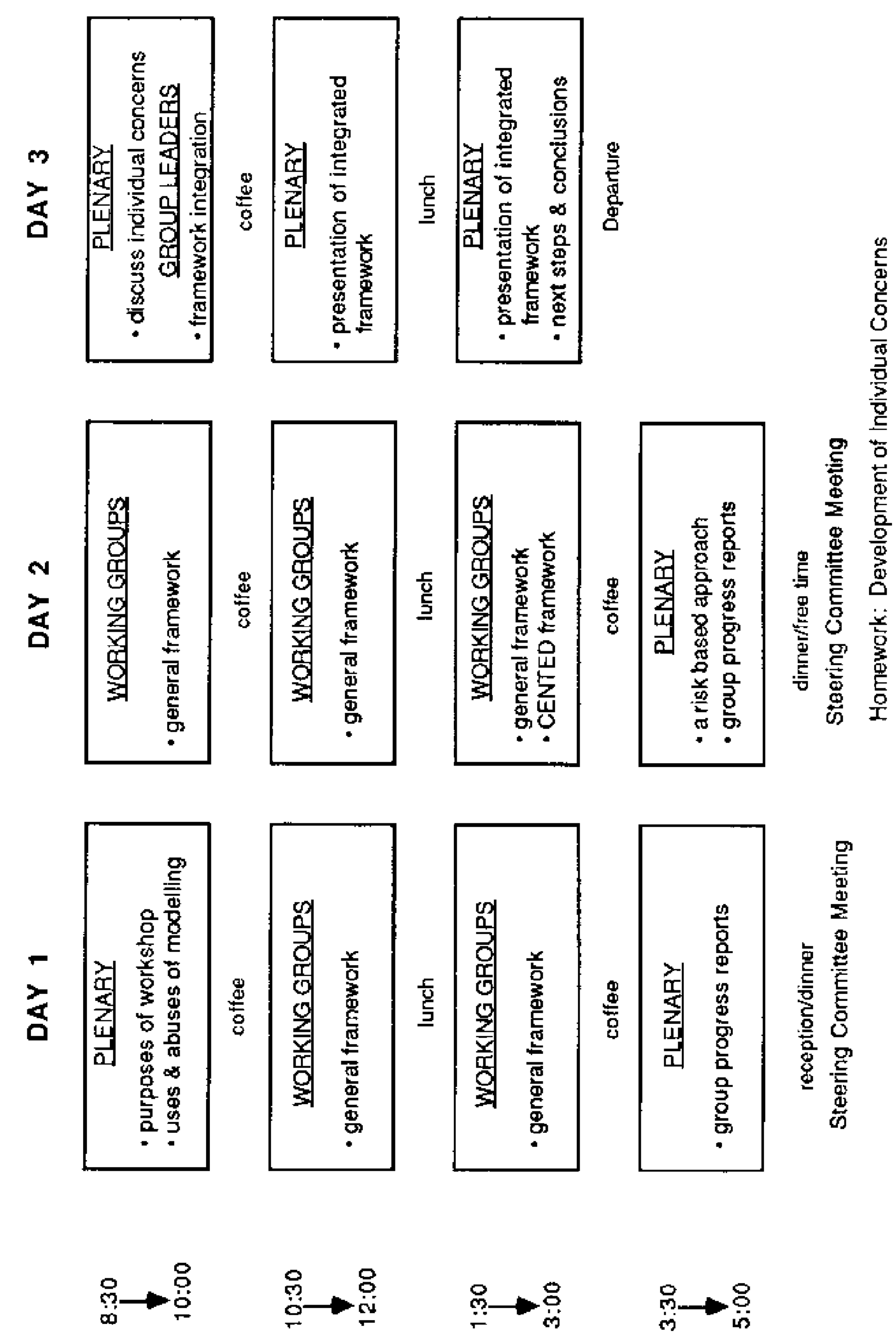

Figure 1: Schematic structure of workshop activities.

These shortcomings were seen as deriving from the nature of the whole institutional structure and not simply the failings of MMS. A perception also existed that the broad range of value issues that needed to be addressed rarely were internalized into the decision process. Several participants noted that those who bear disproportionately the burden of OCS development tend to have little or no voice in the decision process, leading to an absence of trust and to conflict and litigation. These perceived institutional problems led some participants to suggest reforms or remedies, including more feedback loops in the process, more participatory mechanisms, and a stronger state capability and presence.

Finally, there were also concerns over the assessment and management of the risks associated with OCS development. Several participants viewed the risks of transportation and shipping as relatively large, especially during onshore oil transfer, but the management of such risks as particularly weak. Others saw a lack of an overall risk management approach in which priorities were systematically defined and linked to the allocation of management resources. Generally, there was a sense that existing experience and data bases were not being effectively communicated or used to reduce and minimize risks to affected regions and peoples.

Appendix B provides a list of concerns about energy, context, and institutional setting, as stated by the workshop participants.

THE CONCEPTUAL FRAMEWORK

The development of offshore oil and gas on the outer continental shelf is a complex process that involves multiple positive and negative impacts that vary over space, time, social groups, and ecosystems. In the next section of this report, "risk trees" are used to identify these complex relationships between events and consequences. Given the enormous number of potential events and consequences, these risk trees rapidly become complicated branching networks. In order to assess the total impact of oil and gas development, it would be necessary to identify and evaluate every element and pathway in these trees. It was not the purpose of the workshop to conduct such an assessment nor to assign estimates of probabilities and magnitudes. Rather, the purpose was to build a conceptual framework that identifies the major components of this system and portrays their relationships in a readily understandable form. A conceptual framework cannot show all the details in their complexity and necessarily simplifies in order to elucidate the most pertinent elements.

Figure 2 shows the overall conceptual framework in its simplest form. It identifies the major components that must be considered in any evaluation of offshore oil and gas development. The row of "boxes" at the top of the figure represents the chain of events from the choice of energy policy, through offshore oil and gas development, to positive and negative consequences. Indicated below this chain of events are the options for managing the entire system. The management system involves a variety of actors including industry and federal, state, and local government. Management of the chain of events will influence not only the magnitude and nature of both beneficial and adverse consequences, but also their distribution over space (e.g., locally, regionally, and nationally), time (e.g., present versus future generations), and social groups (e.g., workers and various publics). The management system illustrated is the ideal system based on existing practice and arrangements. The actual options for feedback and intervention may not currently exist, or may be only poorly developed.

The national and global production and consumption of energy set the general context in which offshore oil and gas development takes place. National energy policies, whether explicit or implicit, direct this development and determine which resources and locations will be developed (Figure 2).

Assuming there is no implicit or explicit change in the nation's energy policies, the federal government will press ahead with exploitation of OCS oil and gas resources. In this case, there are various stages in the development process (life cycle), beginning with pre-lease activities (e.g., geological and geophysical surveys), exploration (e.g., exploratory drilling), development (e.g., construction and installation of infrastructure), production (e.g., extraction, processing, and distribution), and shutdown (e.g., plugging wells and platform removal). Figure 3 illustrates these stages in OCS oil and gas development and the parallel regulatory and permitting process that is part of the management system. The MMS is the principal agency with responsibility for regulating and permitting, although other state and federal agencies are involved, especially during the development and production phases that require onshore support.

Since the goal of the workshop was to imitate the process toward developing a comprehensive conceptual framework, Figure 3 shows the complete range of activities that could occur during development. In reality, there are many different scenarios. For example, exploratory drilling may indicate the absence of any commercially viable deposits in a particular tract, and no further development would occur. Alternatively, a tract may be offered for lease but receive no bids. The conceptual framework presented here is broad enough to encompass all of these sequences, and to allow for consideration of all the ensuing positive and negative effects.

Figures 3 through 7 also illustrate the use of "windows," as developed and employed at the workshop. Such windows have been successfully used to make computers more user friendly, and by analogy are used here for similar purposes. The window is a useful pedagogic tool that allows one to focus on the larger structure of the whole conceptual frameworkwithout becoming trapped in a confusing mass of detail. At the same time, the window is a flexible tool that allows one to focus on particular elements and relationships in detail. Successive windows are used here to "walk through" the complex branching hierarchy of the risk trees, spotlighting particular relationships for closer attention while excluding unnecessary and distracting detail.

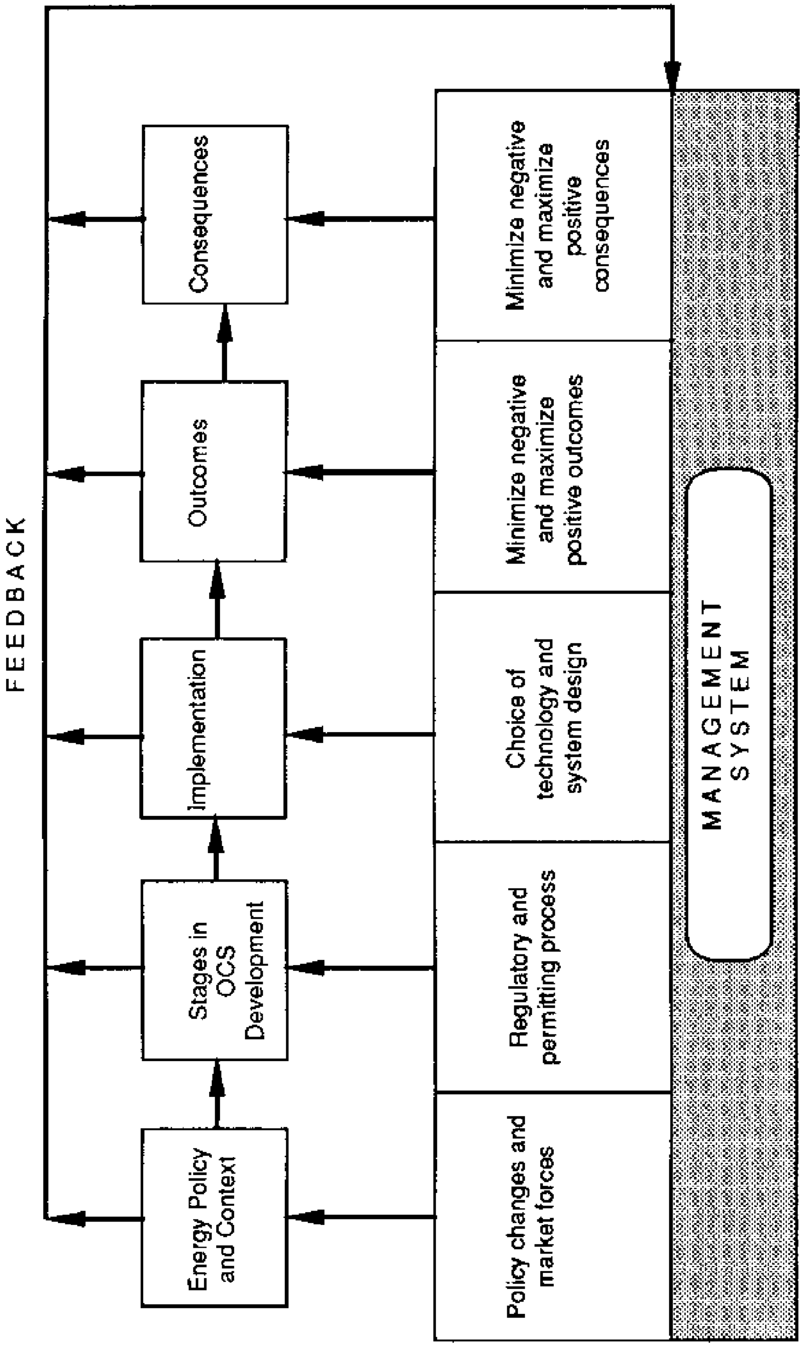

Figure 2: Offshore oil and gas development cycle and management system.

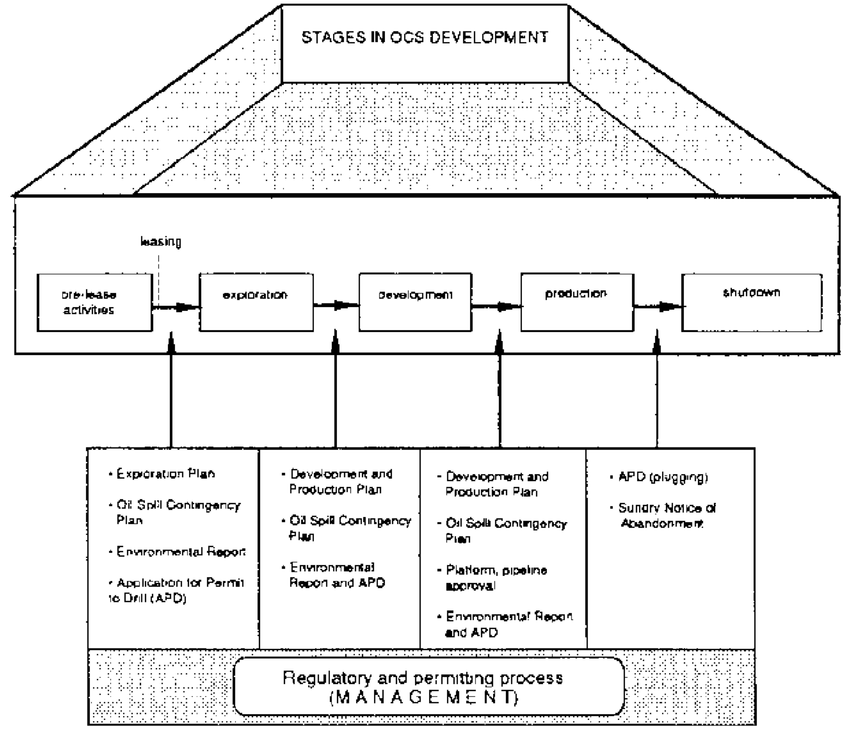

Figure 3: Stages in OCS development and the regulatory and permitting process.

At each stage in OCS development, implementation involves the choice of particular technologies (such as the type of platform to be used) and the design of the system (such as the layout and location of pipelines and other infrastructure). Figure 4 uses windows to show that each stage in development requires a range of implementing actions. In turn, each action in implementation has a range of potentially adverse or beneficial outcomes (such as an oil blowout or increased employment in construction), and these outcomes result in a variety of adverse (e.g., ecological damage) or beneficial (e.g., increased tax revenues) consequences. There are primary and secondary consequences distributed unevenly over time, space, ecosystems, and social groups. For simplicity and clarity, Figure 4 shows only consequences arising from unusual outcomes involving mobile facilities during implementation of the production phase. In reality there is a complex branching network beginning at each phase in the development process.

Figure 5 takes a closer look at the activities involved in the implementation of the production stage. Similar "windows" could be drawn that show the activities involved in implementing each of the other stages of OCS development. Using illustrative categories, Figure 5 shows that production can involve mobile and permanent or semipermanent facilities,

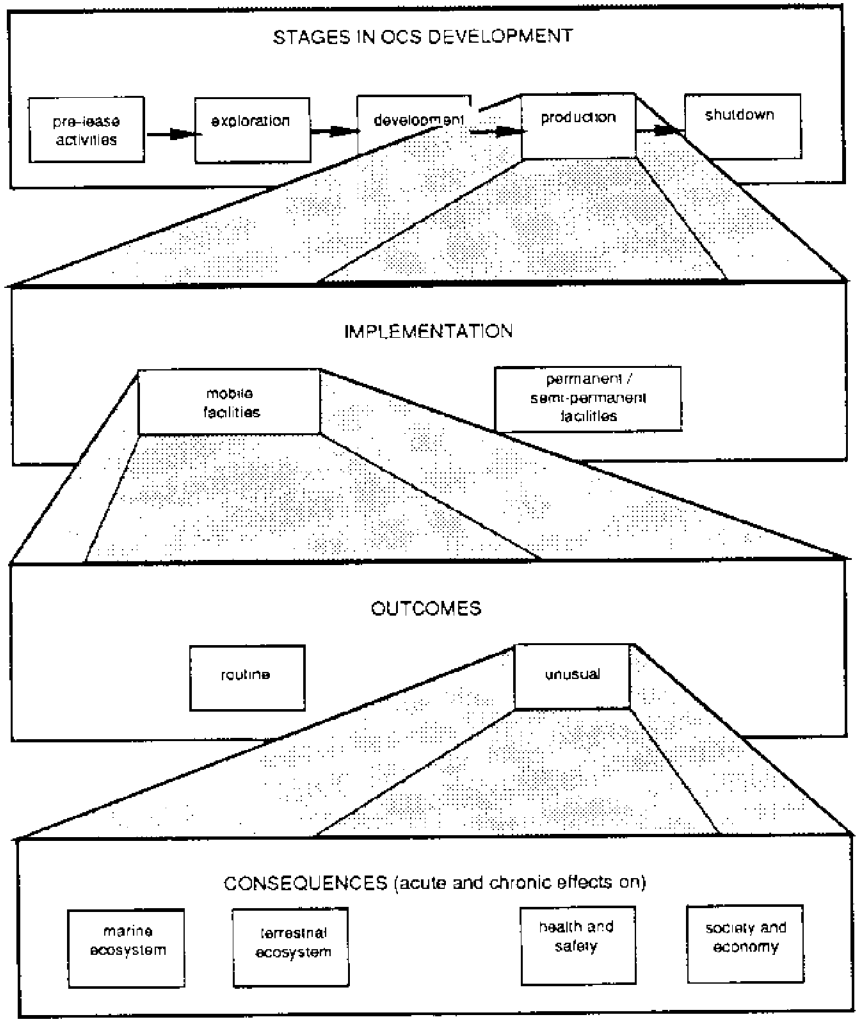

Figure 4: Hierarchy of windows for analyzing OCS development.

both on- and offshore. Mobile facilities onshore include road, rail, and air traffic to transport materials and personnel. Offshore mobile facilities include helicopters to transport personnel, and vessels of various kinds (such as barges, tankers, and boats) to ferry personnel and equipment to the offshore rigs, and to transport oil to the shore and elsewhere. Permanent and semipermanent facilities onshore include pipelines, tank farms, processing plants, transport infrastructure, and other support infrastructure (such as administrative buildings, workshops, and warehouses). Permanent and semipermanent offshore facilities include subsea pipelines, various drilling platforms, and transfer, storage, and processing facilities. A major point emerging at the Workshop was that the offshore and onshore arenas are coupled in both obvious and subtle ways. In particular, choices about what to do offshore often have far-reaching consequences onshore.

The operation of permanent and semipermanent facilities offshore during the stage of production can have a variety of adverse outcomes. Figure 6 shows one way of dividing outcomes broadly into routine and unusual outcomes.

Routine outcomes include those that are continuous or periodic events. Continuous events include general disturbances (for example, the destruction and disruption of marine habitats by the construction of permanent facilities such as oil rigs), and routine releases (such as the release of drilling muds, when permitted). Periodic events are high probability events,* such as minor accidents with or without releases. These events occur frequently enough to be considered routine, but an individual event has limited impacts. The cumulative effect of multiple routine outcomes over an extended period may be greater than the impact of less frequent large-scale unusual outcomes. For example, more oil is released into the marine ecosystem by routine spills, leaks, and flushing of tanks than by the more dramatic but less frequent major oil spills.

Unusual outcomes are the less frequent major accidents that occur aperiodically, with or without the release of oil. These outcomes have low probabilites of occurrence, but each outcome may have major consequences. Major accidents without releases might include helicopter crashes, platform fires, and explosions, with major loss of life. Major accidents with releases include platform fires, explosions, blowouts, and tanker collisions with platforms or other fixed facilities. The presence of a major release of oil is significant because of the potentially extensive damage to ecosystems, the enormous clean-up costs, and other socio-economic impacts (such as lost revenues from fishing, recreation, and tourism).

* Estimating such probabilities is, of course, difficult and is a principal activity of risk assessment. The probabilities of routine events can often be quite accurately inferred from actuarial data, given the relatively high frequency at which they occur. Low probability events are much more difficult and assessment often has to draw upon simulation, scenario construction, analogous activities, and expert judgment.

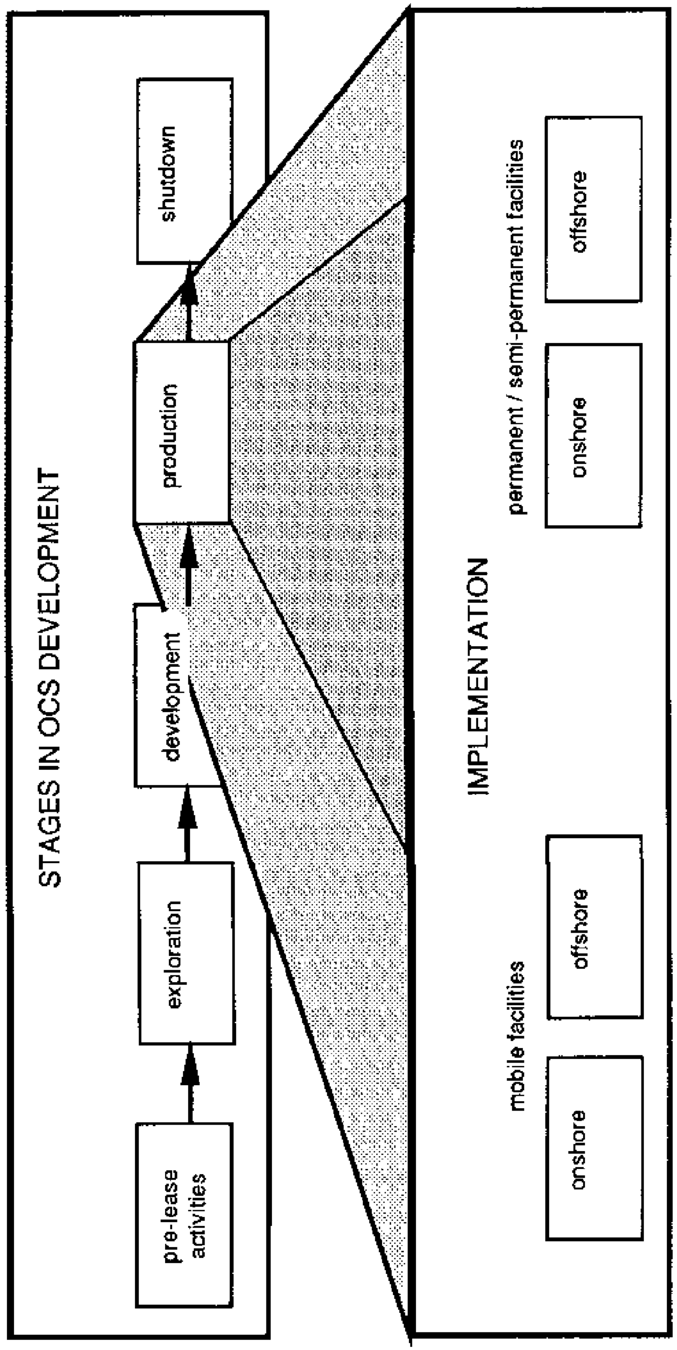

Figure 5: Implementation of the production stage of OCS development.

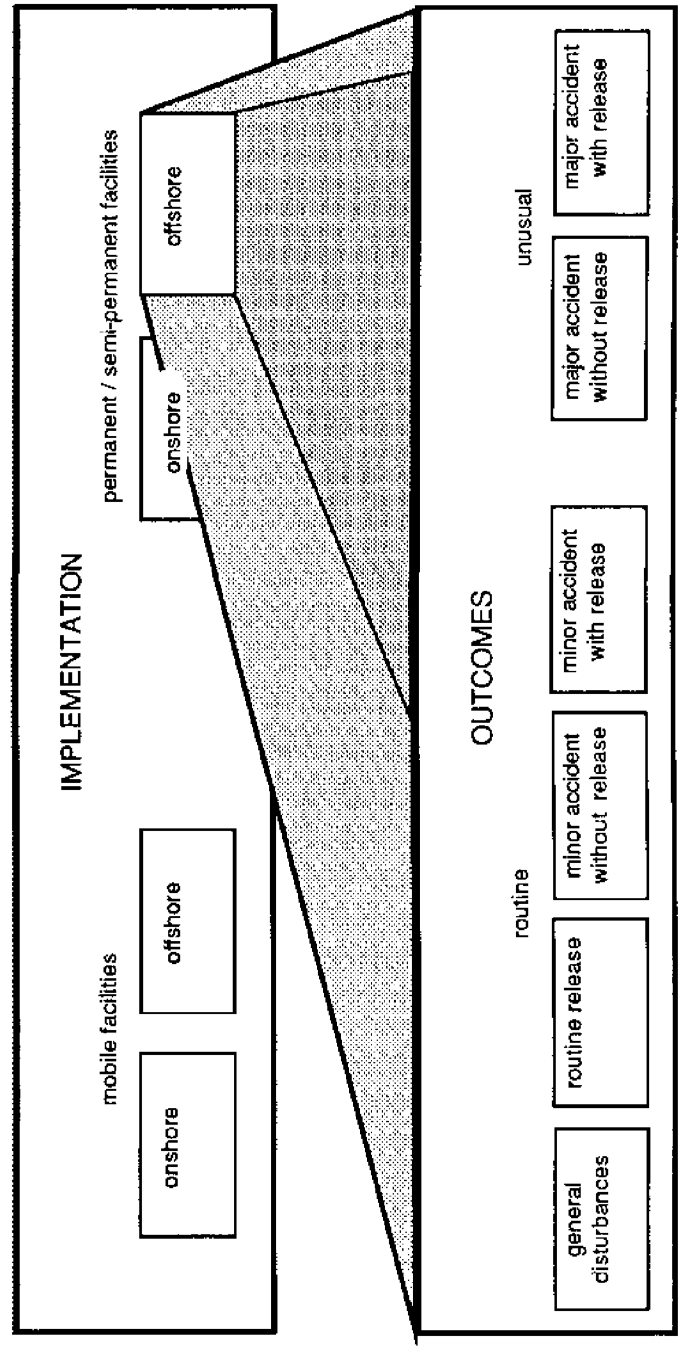

Figure 6: Outcomes associated with the implementation of offshore facilities.

Turning to consequences, Figure 7 shows that each outcome may result in a variety of acute or chronic consequences. These may be grouped broadly as consequences for the socio-economic system, public and worker health and safety, marine ecosystems, and terrestrial ecosystems. The following discussion and figures deal with the elements of implementation, outcomes, and consequences in more detail.

Returning to Figure 2, we see that management of OCS oil and gas development is a continuous process that occurs throughout the chain of events from the formation of energy policies to dealing with the adverse consequences of an accident. At each point in the chain there should be feedback into the management system, and the management system should be able to intervene with corrective actions.

Implementation of each stage in OCS development will result in a variety of outcomes and consequences, both positive and negative. Managing OCS development involves the regulatory and permitting process at each stage, as well as a range of intervention options from implementation through outcomes and consequences. For example, exploration may indicate the appropriate system design and choices of technology for implementation during development. Furthermore, during the implementation of the development stage, problems encountered should feed back into the management system, indicating the need for other technologies or modified system designs. Similar feedbacks should occur following adverse or beneficial outcomes and consequences. These indicate appropriate management actions to promote beneficial consequences and to inhibit adverse consequences.

RISK TREES

To assist OCS decision making and planning, the generic framework discussed in the previous section must be elaborated to identify specific impacts associated with offshore oil and gas development activities. Specific decisions need to be based on a detailed analysis portraying the complexity of information, actions, and relationships. This section illustrates the use of "risk trees" in such an analysis, and their application to a specific scenario during the workshop. The risk tree is one method for elaborating the full extent of elements and their interrelationships in the windows of implementation, outcomes, and consequences in the conceptual framework (Figure 2).

"Trees" can be formally represented as "nodes" linked together by "branches" (Figure 8). The nodes identify components of the system or events that occur in it. The branches identify relationships among nodes and can be used to represent component interactions, cause and effect relationships, and stages in a process. Risk trees help identify the critical links and factors that might influence specific consequences and determine where acute, chronic, cumulative, lethal, and sublethal consequences occur. While Figure 8 illustrates a structure of nodes and branches, trees can also be represented

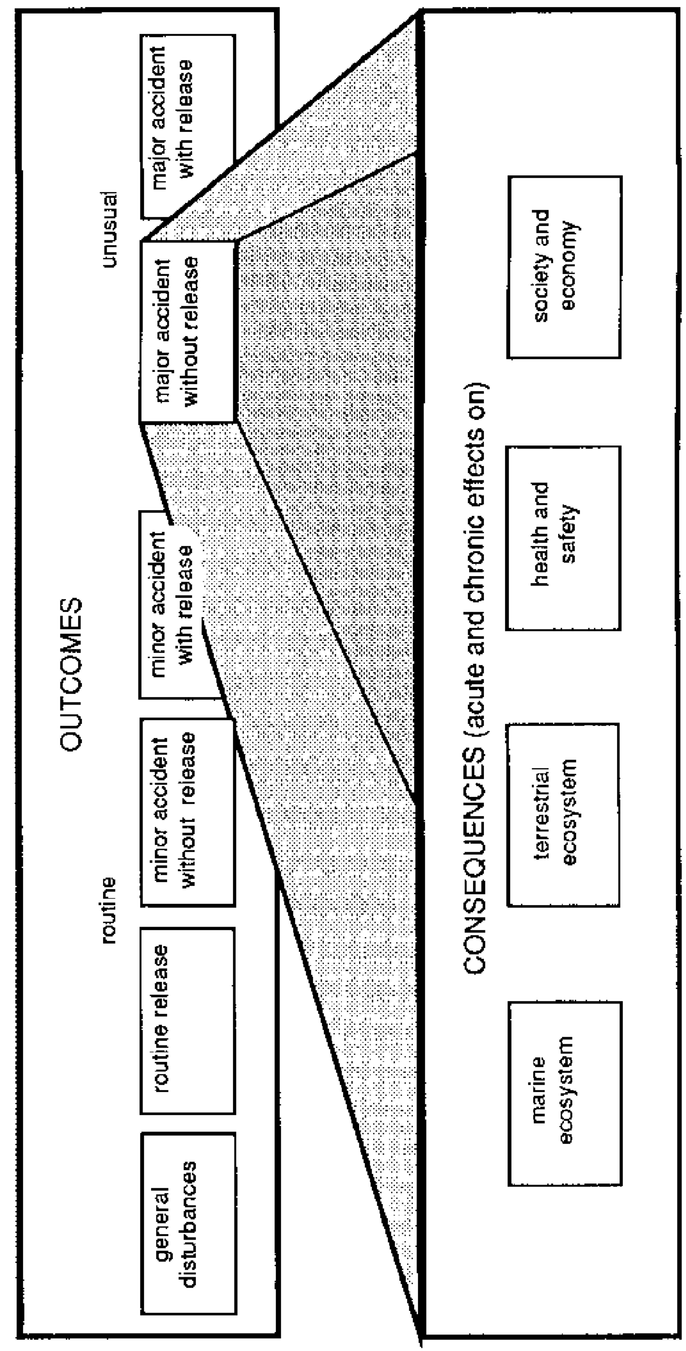

Figure 7: Consequences of a major accident without a release.

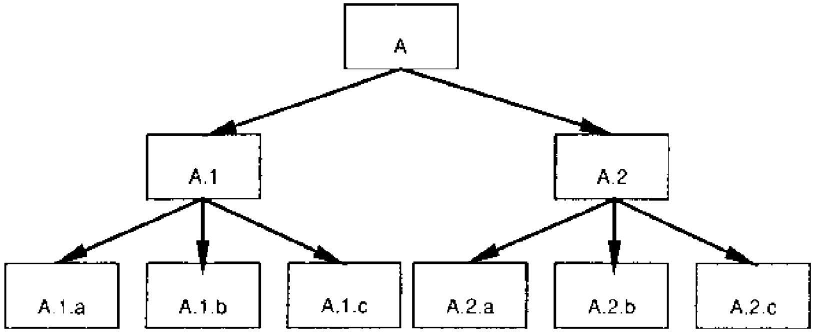

Figure 8: Example of a risk "tree." The "root" is node "A."

within a windows construct. In this case, the nodes become windows, and branches become links between windows. While both constructs provide the same information, risk trees have the advantage of showing the overall structure of the system.

A tree structure also allows the application of both qualitative and quantitative analyses. For example, qualitative analyses can be supported by trees that show the relationships between nodes in a system but without providing any type of ranking or prioritization of the risks. In detailed quantitative analyses of causes and effects, probabilities are assigned to the branches of the tree. The probabilities at different nodes are calculated as the product of all the conditional probabilities in the chain up to that point.

Figure 9 shows the matrix approach developed during the workshop to elaborate on the conceptual framework and to outline a scenario of an offshore oil and gas release. In terms of risk analysis, the model relates the life cycle of activities in offshore oil and gas development with the system components, hazards, and possible negative consequences. The life cycle stages of offshore oil and gas development include: pre-lease activities, exploration, development, production, and shutdown. These life-cycle stages are the same as those referred to previously as the stages in OCS development (see Figure 2 through 5).

The matrix shown in Figure 9 can be used to construct treelike structures to identify both positive and negative impacts resulting from offshore oil and gas development. Using windows, an example of a generalized tree is shown in Figure 10. The model begins with the identification of facilities used during a particular stage in the life cycle of offshore oil and gas development (in this case, we have selected the production stage). During implementation, mobile, semipermanent, and/or permanent facilities are put in place. Initiating events represent the linkage between implementation and outcomes in the conceptual framework. Initiating events may include collisions, human errors, extreme weather conditions, and structural failures. Outcomes may be routine or unusual, and include blowouts, controlled

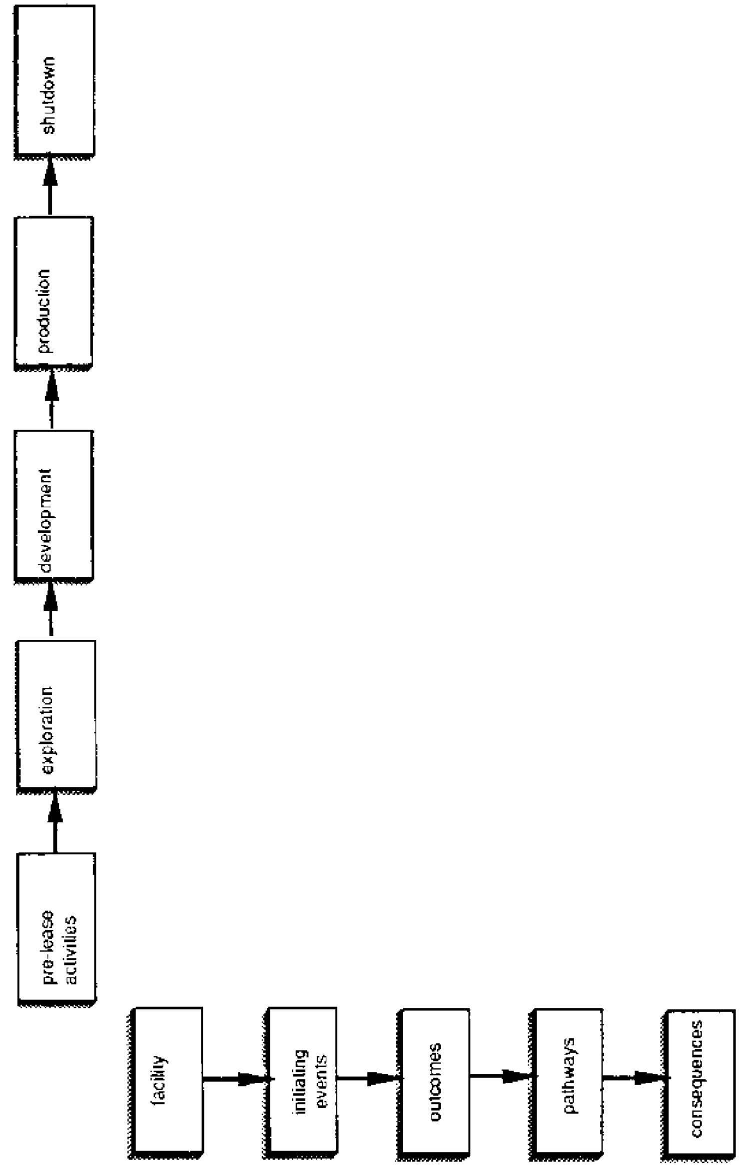

Figure 9: Matrix of OCS offshore oil and gas development life cycle and risk-tree levels.

discharges from drilling platforms, oil from flushed ballast and bilge water, and helicopter crashes. In Figure 10, the pathways refer to the patterns and routes of exposure to elements in the environment and socioeconomic system. Thus, pathways represent the link between the outcomes and consequences in the conceptual framework. Finally, adverse and beneficial consequences result from exposure to materials released by an accident, from the outcomes of activities, or from linkages to other impacts. In the model developed by the workshop, four categories of impacts were used to identify consequences: ecological, economic, social, and cultural. (Note: these provide an alternative categorization to that in Figures 4 and 7.)

A scenario developed by the group illustrates how the elaboration of the conceptual model can be accomplished using a risk tree approach. The scenario begins with a blowout five miles offshore as a result of a collision between an oil supertanker and a gas drilling platform (facility and initiating event). The cause of the collision is assumed to be human error and occurs during a 20-year storm during the winter with gale force winds from the southwest and 20-foot waves. The collision and blowout result in the release of 80,000 barrels of crude oil and a 1 km high gas plume (outcomes).

For this scenario, the group proceeded to identify ecological, economic, and social responses to oil released by the accident and the pathways by which they occur. (The group did not have sufficient time to elaborate on impacts resulting from the gas release, potential cultural impacts resulting from the accident, or possible benefits.) Figure 11 illustrates the pathways of marine and terrestrial ecosystem exposure to oil, and Figure 12 illustrates social and economic impacts resulting from the oil spill. (Again, there was insufficient time at the workshop to elaborate on the details of the socio-economic impacts.) One example of a pathway, shown in Figure 11, is exposure of sea mammals to oil from the surface suspension of lighter components of the crude and its dispersal by surface currents. Similarly, seabird exposure can result from passage through a surface oil slick or from ingestion of contaminated food sources. Although not shown in these figures, there are important linkages and feedbacks between ecological, economic, and social impacts. For example, although impacts on fish and crab larvae are difficult to trace to adult populations, larval destruction from an oil release must have important impacts on such populations and on the long-term economic resources for the region.

This scenario illustrates the utility of risk trees in identifying and portraying the potential impacts associated with accidents during offshore oil and gas activities. The impacts associated with chronic releases of materials (e.g., production waters, oil tanker washouts) and disruptions (e.g., ship traffic and marine mammal migration) can also be shown using the same structure. (The group began to develop such a scenario for the release of produced waters, but there was insufficient time at the workshop for its full development.) The relatively simple scenario and figures indicate that a comprehensive analysis of impacts must be much more detailed and show the relationships of all components and events in their full complexity. Such an approach, using a

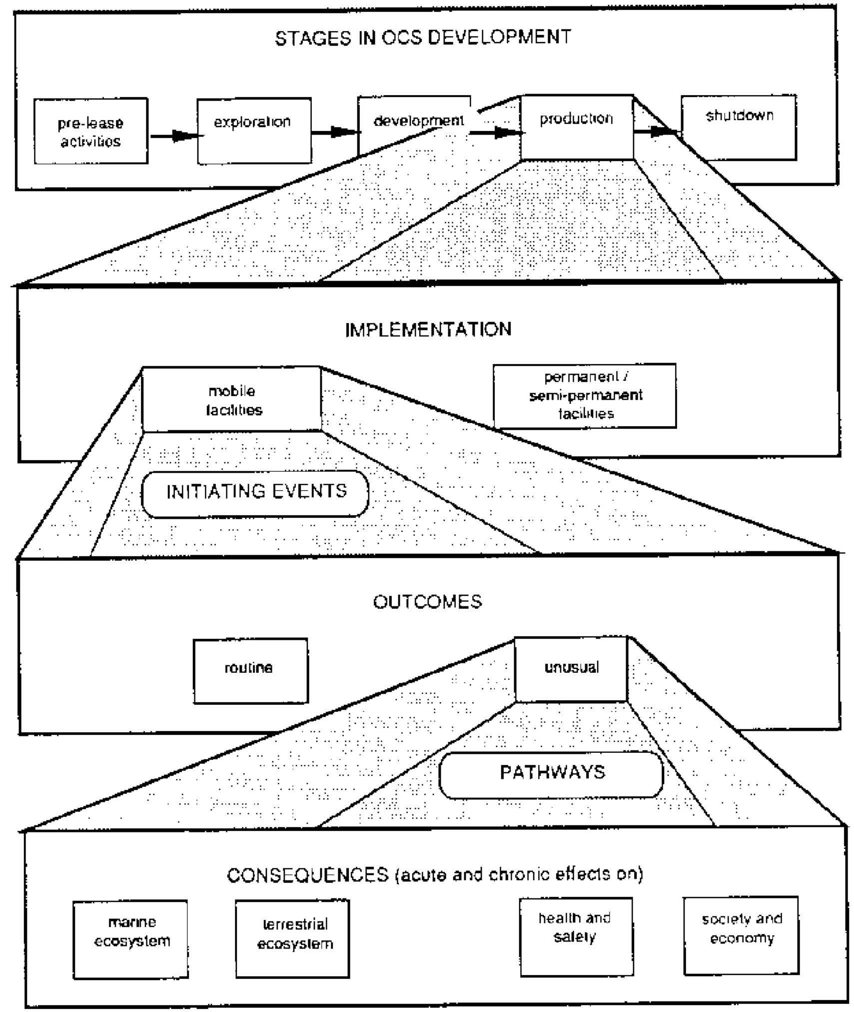

Figure 10: Window representation of risk-tree levels.

window or tree structure, will assist in the qualitative identification of all possible impacts and chain of events leading to them.*

Figure 13 shows a matrix, similar to that in Figure 9, which forms the organizing framework for the development of risk trees. The stages of the

* Eventually, a quantitative analysis could be performed by assigning probabilities to cause and effect linkages and estimating the likelihood of different impacts and their magnitudes. It was never intended that the workshop attempt such comprehensive qualitative and quantitative analyses.

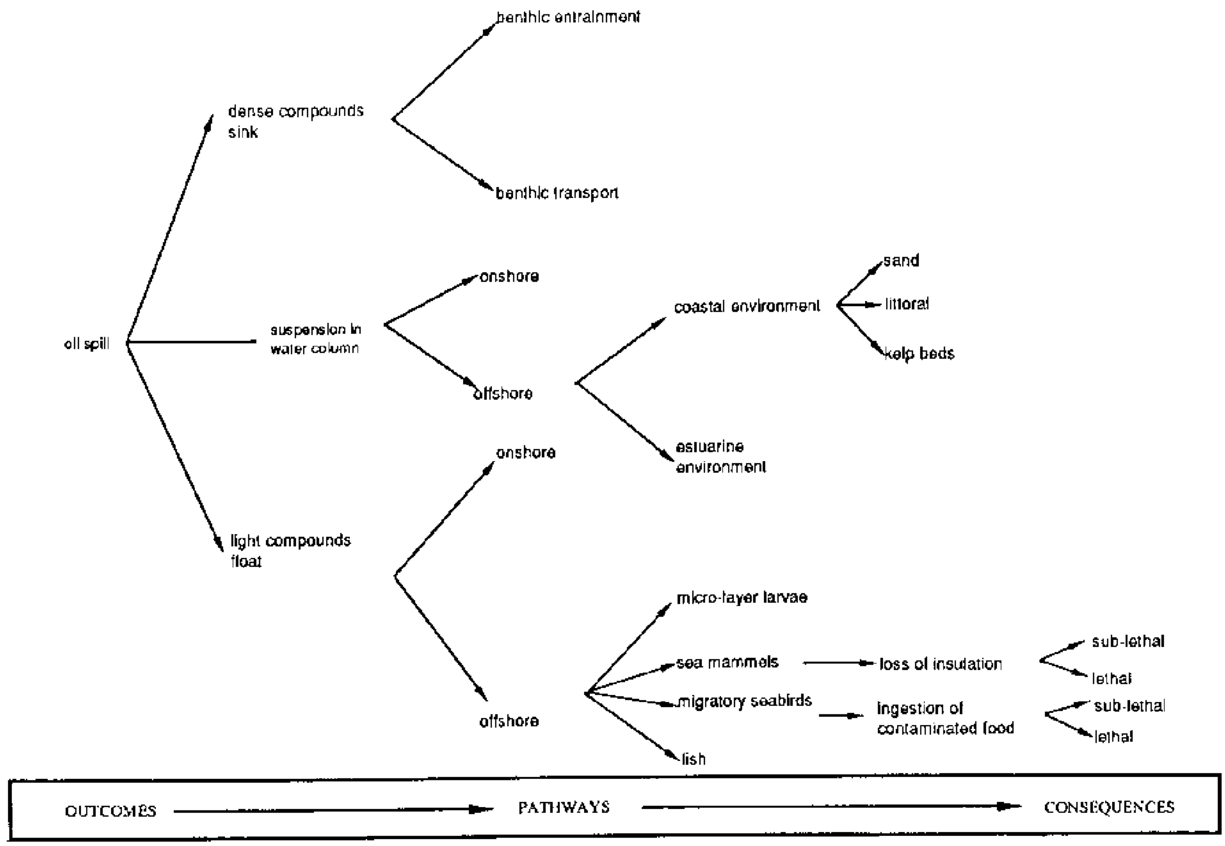

Figure 11: Example tree of selected ecological consequences and their pathways from an oil spill.

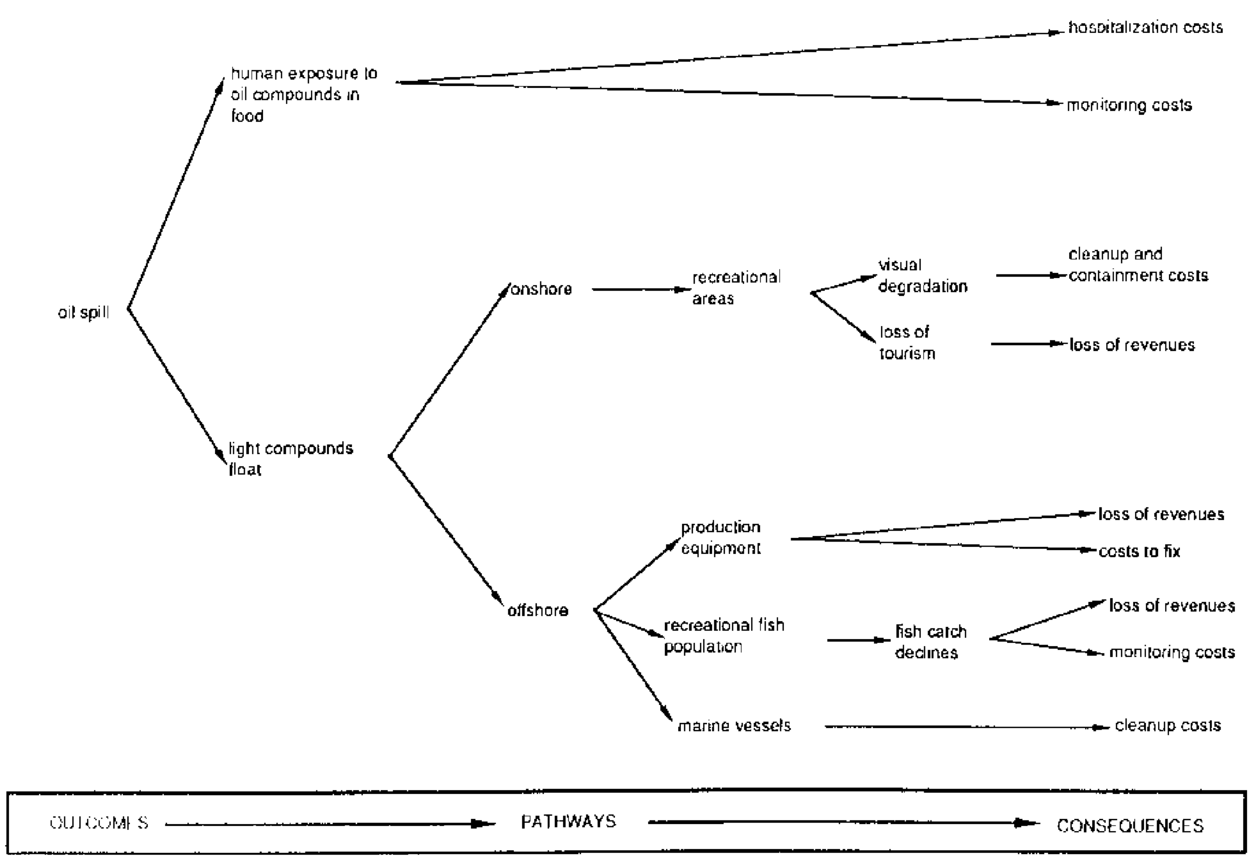

Figure 12: Example tree of selected socio-economic consequences and their pathways from an oil spill.

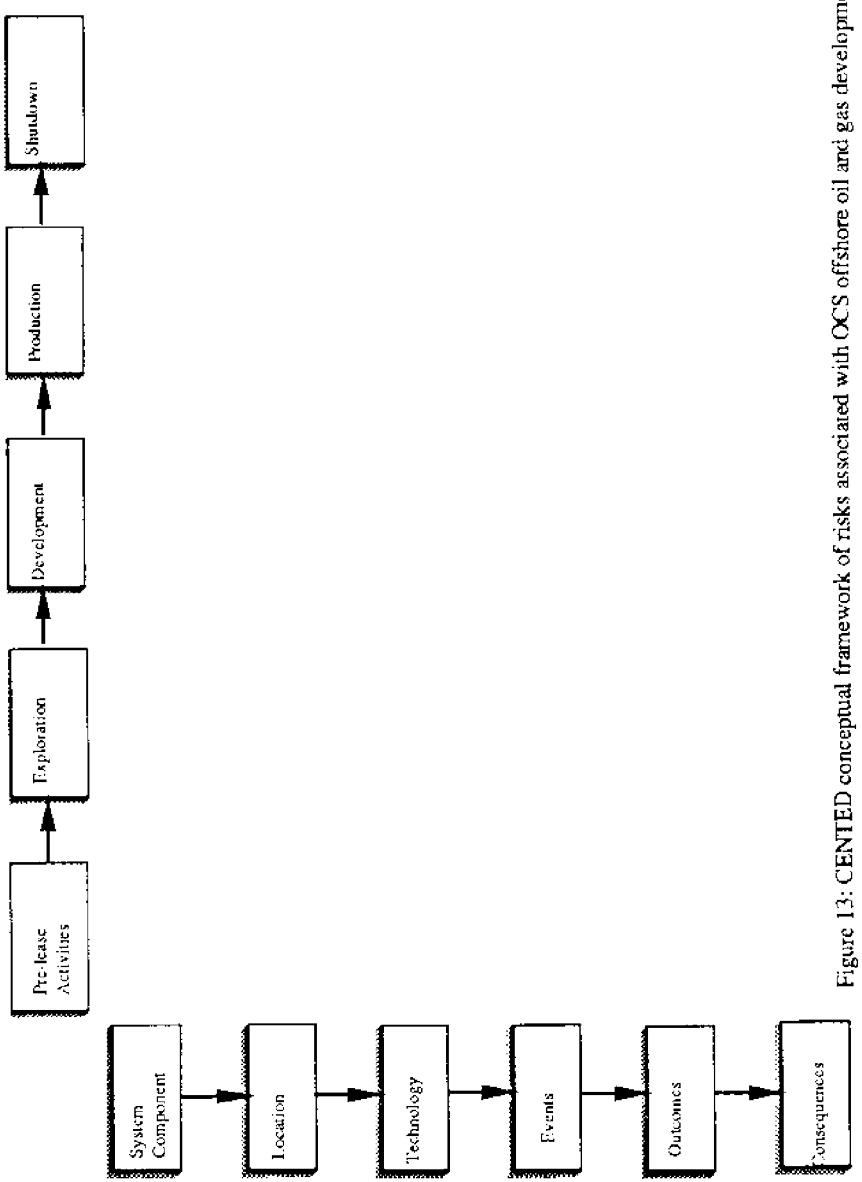

Figure 13: CENTED conceptual framework of risks associated with OCS offshore oil and gas development.

OCS life cycle are shown at the top. The boxes on the left represent generic categories of nodes at each level in the hierachical risk trees. Figure 14 shows the risk tree for the production stage. Similar risk trees could be drawn for each of the other stages in the OCS life cycle.

This approach was developed by the Hazard Assessment Group at the Center for Technology, Environment, and Development (CENTED), and is presented here to illustrate an alternative conceptualization of the system. The approach focused on risk in particular. To associate negative impacts with life-cycle stages, the tree branches from system components (i.e., permanent and semipermanent facilities and mobile facilities) to the location of the components (i.e., offshore and onshore). It then branches to potentially hazardous events (i.e., unexpected and unusual or routine and expected events). Not shown are nodes illustrating the technologies employed (e.g., ships, vehicles, offshore platforms) or the outcomes of routine and unusual events (e.g., major accident with release, major accident without release, minor accident with release, minor accident without release, routine releases, and general disturbances); each of these would represent additional levels and branches in the generic structure shown in Figure 14. This generic structure has the advantage that it is closely linked to the structure of hazards and thus is readily transferrable to risk assessments.

Finally, such events and outcomes can lead to undesirable consequences that can be categorized as socioeconomic, ecological, and health and safety. A full analysis is needed to identify all such possible examples and the linkages among them (i.e., an "impact web") so that the full range and extent of impacts can be assessed. This type of analysis rapidly becomes very complex, but this is inescapable if the analysis is to be comprehensive.

Application and Utilization

On the afternoon of the third day, workshop participants considered ways by which the potential applications and utilization of the conceptual framework could be maximized. In doing so, participants made clear that the current workshop was only the first step in creating a technically sound and broadly useful conceptual framework. Subsequent steps would be needed for further elaboration and clarification, for illustrating the applicability of the framework by the use of several specific examples, and for translating the language in the conceptual framework to that of the various potential users. A specific suggestion was that the information and data gathered for Lease Sale 132 could be used in working through the framework. This exercise would show directly the potential use and limits of the framework, and help the state optimize the risks, costs, and benefits from this planned sale.

Several follow-up activities seemed particularly important to workshop participants. Clearly, the state of Washington has begun to develop a potentially useful tool that should be brought to fruition and that should be widely disseminated throughout state and federal agencies. Equally important, the framework promises a more coherent structure for MMS decisions on

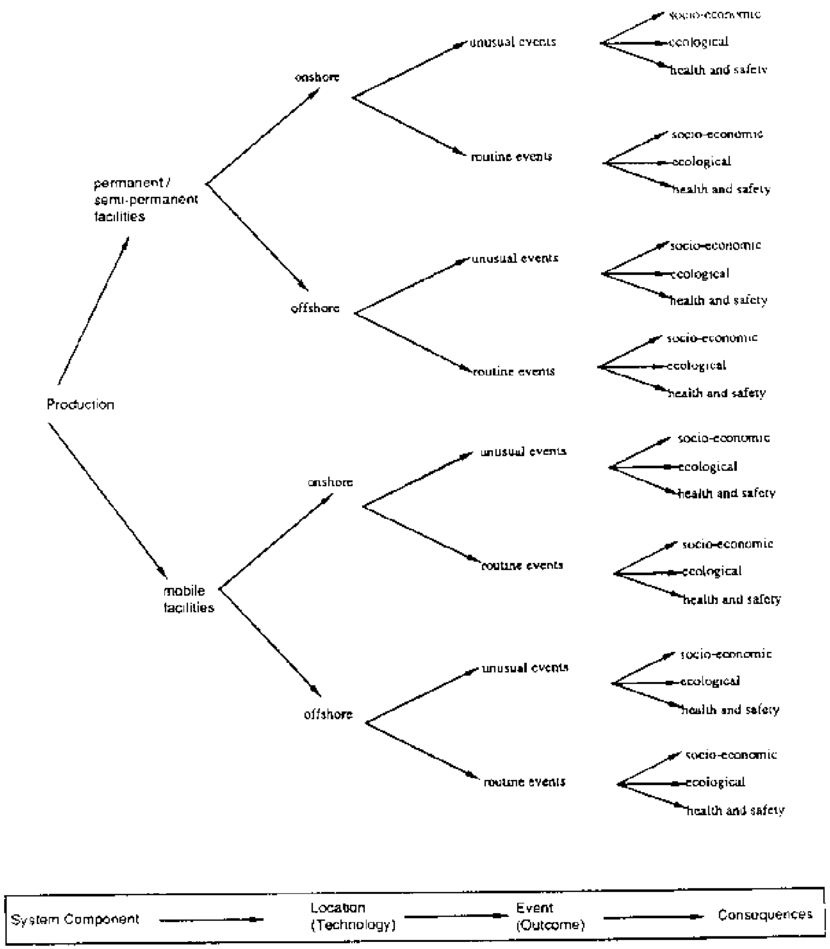

Figure 14: CENTED conceptual model of production stage.

research needs and for broader and more sensitive discussion with state and local officials.

A number of potential users and uses of the framework were identified at the workshop. Key user groups include

- the National Academy of Sciences
- the Office of Science and Technology Policy
- the Office of Technology Assessment
- the Congress
- the Minerals Management Service of the U.S. Department of the Interior

- the Washington Department of Ecology and other state agencies
- the state legislature
- the Washington university system
- local governments and citizen groups

Potential uses include

- the identification of gaps in the current pattern of MMS-funded research;
- the potential impacts on the state of Washington not currently addressed in agency and university programs;
- the assessment of available quantitative data relating to probabilities and magnitudes of consequences that could be worked out for framework components and linkages;
- a basis for systematically assessing the adequacy of feedback loops in decision making and policy development and the array of management interventions being used;
- relating of the patterns of risk-bearing to the distribution of decision-making authority; and,
- the development of scenarios to characterize expected events and worst case impacts related to offshore petroleum development.

It was clear to participants that the value of this framework is quite dependent on its further elaboration and its use in at least some of the applications suggested above. The premise that convinced ORAP to sponsor the workshop was that the process of identifying OCS environmental research needs and selecting studies should be driven not only by organizational missions but also by the state of knowledge about both natural and socioeconomic systems. Development of a general conceptual framework would force explicit consideration of the system components and their cause-effect relationships. This in turn would help reveal the most critical information gaps and suggest the highest priority research needs for making scientifically sound OCS impact assessments and decisions. An operational conceptual framework would help improve the quality and acceptability of OCS research and thereby reduce state and local conflicts with the federal government. Others are challenged to complete the task and finish creating this fundamental management tool that resource managers need to guide future OCS research.

Appendix A

Biographies

Dr. Sandi L. Benbrook manages programs and projects addressing statewide or substate impacts that result from major actions affecting Washington communities. Impact assessment, fiscal analysis, and community-based problem solving activities are typical strategies utilized to develop needed policy recommendations. Recent projects have considered the impacts associated with the proposed construction of major facilities (Everett Navy Homeport, Hanford Nuclear Repository, the Superconducting Super Collider [SSC], Early Winters Ski Resort), prisons on host communities, declines of the traditional coastal economic base, and hosting the Good Will Games in Washington State. She served as the Governor's SSC coordinator in 1987, overseeing the state's efforts to site this national research facility in Lincoln County.

Dr. Benbrook spent seven years in Washington, D.C., as a private consultant and research director for a state association. She completed numerous projects designed to influence public policies in the unemployment insurance, employment, and training arenas. She has extensive experience with Congressional and Federal Executive Branch processes.

Dr. Benbrook obtained a Ph.D. in sociology from the University of Southern California in 1976. She was the recipient of a National Institute of Mental Health Dissertation Fellowship in 1975. In graduate school she specialized in the disciplines of demography and social stratification and holds a B.A. in anthropology.

Dr. William B. Beyers is a professor of geography at the University of Washington. He received his Ph.D. and B.A. at the University of Washington; has been a visiting professor at Harvard, Cornell, and E.T.H. in Zurich. His field is economic geography, with an emphasis on regional analysis and regional economic development. He has been involved with a variety of regional modeling projects, including examining the economic impacts of national parks, OCS oil and gas development, marine recreation, and the Seattle Mariners Baseball Club. He has served as a consultant to numerous local, state, and federal agencies on economic development questions, and currently serves as a member of the City of Seattle Economic Development Commission, a body providing the mayor and council with strategic planning advice and recommendations. His research has been concerned with regional economic structure, processes of change in regional structure, and interregional economic and demographic structures. In recent years he has been involved with a variety of studies focusing on the role of the producer services in the development of advanced economies.

Dr. P. Dee Boersma is the associate director of the Institute for Environmental Studies, and a professor of environmental studies and zoology at the University of Washington. Professor Boersma's research has centered around reproductive strategies of seabirds, which generally are long lived, have small clutch size, delayed maturity and high reproductive variability. Some of her research has focused on ingestion of petroleum products by seabirds, whose populations can be drastically affected by small changes in adult survival. Currently, she is working with Magellanic penguins breeding along the coast of Argentina. She also seved on the Scientific Advisory Committee of the Minerals Management Service from 1980 to 1984.

Dr. Garry D. Brewer holds the Frederick K. Weyerhaeuser professorship at Yale University, with appointments in the School of Organization and Management and the School of Forestry and Environmental Studies. The chair was endowed as a family memorial to Mr. Weyerhaeuser, a 1917 Yale graduate and early environmental advocate, to foster integration of environmental science into public and private management.

Professor Brewer earned an A.B. in economics at the University of California at Berkeley, an M.S. in public administration from San Diego State University, and a masters and doctorate in political science from Yale. His interest and background in the oceans come from his boyhood by the sea, service in the U.S. Navy, and early professional involvements such as the FAO Law of the Sea Study Group. A member of the Woods Hole Oceanographic Institution's corporation and the National Academy of Sciences' Ocean Studies Board, Brewer also is an author of seven books and more than 150 articles in several policy areas.

Dr. Dilworth W. Chamberlain is Senior Consultant of Environmental Sciences, in the Department of Environmental Protection, at the Atlantic Richfield Company in Los Angeles. His responsibilities include advising management on environmental problems and issues and oil spill response. Chamberlain received a B.S. from California State College in Los Angeles and a Ph.D. in biology at the University of Southern California. He is a marine biologist with training in ichthyology, marine biology, and pollution effects on fish, fish populations, and other organisms. He has additional formal training in botany, vertebrate zoology, and ecology. He has conducted or assisted in environmental surveys and impact studies in California, the Gulf of Mexico, Alaska, the Alaskan Arctic, and Indonesia. Other environmental work has taken him to Norway, Canada, and Mexico. He is currently working on state and industry trade association committees and task force responsibilites that include OCS and coastal issues, natural resource damage assessment, oil spills and seismic effects, and ocean resource management.

Dr. Alyn C. Duxbury has been involved in oceanographic research in the inland and coastal waters of Washington State since 1952, emphasizing applied descriptive physical oceanography. He has been on the research faculty of the School of Oceanography since 1964 and the Institute of Marine Studies since 1975. He has participated heavily in both teaching programs and curriculum development. His interest in education led to the writing and publishing of two college text books and the development of courses through correspondence study. Dr. Duxbury's interest in the application of oceanography to coastal zone management was pursued with support from the Washington State Sea Grant program, where he served as consultant director and a scientific advisor to many federal, state, county, and municipal agencies. Under Sea Grant support, Dr. Duxbury also helped develop vocational training programs and marine curriculum materials for community college and K-12 school levels. Public education and enlightenment on the processes at work in the marine system is a specific interest of Dr. Duxbury and led to the development of a book series on Puget Sound published by Sea Grant.

Dr. Robert G. Fleagle received his bachelor's degree from Johns Hopkins University and his master's and Ph.D. from New York University. He is senior author of *An Introduction to Atmospheric Physics*, a standard text in the field, and editor of two books on science policy related to weather modification. He has been active in research, and has focused especially on interaction of the atmosphere and ocean. He has served in leadership positions in several large international experiments, most recently the Storm Transfer and Response Experiment (STREX) in the Gulf of Alaska.

Science policy issues have been an increasing interest of Dr. Fleagle in recent years, resulting in published papers, letters, and reviews relating to the need for restructuring of NOAA, policy aspects of nuclear "winter," and the global greenhouse. He served earlier in a National Academy of Sciences study which reviewed federal plans for offshore continental shelf development of oil and gas and a President's Science Advisory Committee study of national needs on oceanography. He has served as a consultant to NOAA and to the Electric Power Research Institute.

Dr. Fleagle is a professor emeritus at the University of Washington. He has held a variety of academic and policy posts, including chairman of the Department of Atmospheric Sciences at the University of Washington; Staff Specialist in Office of Science and Technology, Executive Office of the President; chairman of the board of the University Corporation for Atmospheric Research; chairman of the Committee on Atmospheric Sciences of the National Academy of Sciences; and president of the American Meteorological Society.

Professor Ralph W. Johnson has been teaching since 1955 and specializes in water law, coastal zone law, and American Indian law. He has served as chief consultant to the United States Senate Committee on Interior and Insular Affairs, and as a consultant to the National Water Commission, National Academy of Sciences Committee, the Stanford Research Institute, the Hudson Institute, and state and federal agencies. He has received Ford Foundation, National Science Foundation, and EPA grants to study and write about water management in Europe; has served as a United Nations consultant to Papua New Guinea; has lectured at law schools in England, Israel, Canada, and China; and taught as a visiting professor at Harvard Law School in 1981-82 and at UCLA in 1986-87. He has authored numerous law review articles on water law and American Indian law topics, co-authored two books, *Cleaning Up Europe's Waters: Economics, Management, and Policies*, and *Ocean and Coastal Law*, and was an author and editor of the treatise "Felix Cohen's Handbook of Federal Indian Law." Professor Johnson served, in 1977, on the National Academy of Sciences Committee to Evaluate the OCS Environmental Studies Program. He is currently a member of the National Academy of Sciences Panel to review the OCS Environmental Studies Program, and serves on the socioeconomics panel.

Dr. Roger E. Kasperson is a professor of geography and director of the Center for Technology, Environment, and Development (CENTED) at Clark University. He holds a Ph.D. from the University of Chicago and is co-author of *Participation, Decentralization and Advocacy Planning*, and co-author of *The Structure of Political Geography, Water Re-Use and the Cities, Equity Issues in Radioactive Waste Management*, and *Nuclear Risk Analysis in Comparative Perspective*. He has written widely on issues connected with risk management, risk communication, nuclear energy policy, and radioactive wastes. For the past seven years, Professor Kasperson has directed a series of research projects, funded by the National Science Foundation and the Russell Sage Foundation, dealing with technological risk management, industrial management of hazards, and ethical and policy issues involved in environmental and health risk management. His current research projects deal with emergency planning around nuclear power plants, the risk and social impacts associated with the siting of hazardous waste facilities, evaluation of risk communication programs, and global environmental change. Dr. Kasperson has served as consultant to several public and private agencies on energy and environmental issues. He was a member of the National Research Council's Board of Radioactive Waste Management and chaired its panel on social and economic issues in siting nuclear waste repositories. He has been a visiting senior scientist at the Beijer Institute in Stockholm, Sweden, and has also served on the advisory committees for the Energy Division of Oak Ridge National Laboratory and the University of Tennessee's Institute for Waste Management. Currently, he is on the editorial boards of *Environment, Risk Analysis*, and *Industrial Crisis Quarterly*.

Ray Lasmanis has more than twenty years experience in economic geology throughout North America, Europe, and Australia. He graduated from the University of Missouri, in geology with a minor in mining engineering. Since 1982, Lasmanis has served as State Geologist and manager of the Geology and Earth Resources Division, Washington State Department of Natural Resources. He serves on numerous committees and boards, the most notable of which is the State Nuclear Waste Board. Having been born on the shores of the Baltic Sea and raised on Long Island Sound, and living by choice on Puget Sound, Lasmanis has a special affinity for the sea.

Dr. Thomas M. Leschine received has Ph.D. in mathematics from the University of Pittsburgh in 1975, where he specialized in mathematical logic. Looking to combine his professional training with a growing interest in the problems of natural resources management, he accepted a research fellowship in marine policy at the Woods Hole Oceanographic Institution in the following year. He remained at Woods Hole's Marine Policy Center until 1983, serving as a policy associate on the center's research staff.

Leschine is now an associate professor of marine studies and adjunct associate professor of fisheries at the University of Washington, where he has been since 1983. He has also been a visiting scientist at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, where he did collaborative research with its Environmental and Societal Impacts Group.

Leschine's major research interest is in the area of environmental decision making, particularly as it relates to marine pollution control. He has published numerous articles and spoken widely on such topics as the federal ocean dumping and Outer Continental Shelf oil and gas leasing programs, the control of estuarine pollution, and other problems in marine policy. His research has been funded by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) and the National Science Foundation. He has served as consultant or advisor on marine pollution matters to NOAA, the U.S. Environmental Protection Agency, the National Academy of Sciences, and the Puget Sound Water Quality Authority. He is currently directing a major reevaluation of Washington State's oil spill damage assessment program, on behalf of the Washington State Legislature.

John D. Patton is acting director of the Department of Resource Management, County of Santa Barbara, California. He has an A.B. in philosophy from Tufts University and a master's degree in regional planning from the University of North Carolina. His exposure to offshore petroleum development issues is the result of working in local government in the Santa Barbara Channel area. He has concentrated on the issues of air quality, socioeconomic effects, oil transportation policy, and the multijurisdictional regulatory process for offshore oil projects.

Dr. Walter H. Pearson is a senior research scientist and technical group leader at the Battelle Marine Sciences Laboratory in Sequim, Washington. After undergraduate and graduate training in biology in Maine and Alaska, Dr. Pearson received a doctorate in oceanography from Oregon State University in 1977. Before joining Battelle in 1977, Dr. Pearson was a research fisheries biologist at the Sandy Hook Laboratory of the National Marine Fisheries Service.

For fifteen years, Dr. Pearson's applied research has focused on the effects of pollution and human disturbance on the behavior and biology of marine invertebrates and fish, whereas his basic research has emphasized the role played by chemoreception in the behavior and ecology of marine organisms. Much of his applied research has assessed the effects of petroleum on chemoreception and behavior in marine fish and shellfish. Recently, his applied research has addressed issues in the aquatic disposal of dredged materials, especially the potential impacts on the Dungeness crab resource. In his recent work for the Corps of Engineers, Dr. Pearson has made numerous presentations at interagency coordinating meetings and before national review boards to facilitate decision making by COE, EPA, and other resource agencies. He has also coordinated a panel of scientific and resource agency experts and industry representatives that advises the Corps of Engineers on measures to mitigate impacts on the Dungeness crab and its fishery.

His current work focuses on the potential effects of geophysical survey operations on commercial fisheries. He is the technical leader of the recent MMS-sponsored study on the effects of sounds from a geophysical survey device on fishing success and behavior of California rockfish, and of a similar study sponsored by California Fish and Game on the effects of sound energy from air-gun arrays on the larvae of Dungeness crab.

Dr. Frederick M. Piltz is Chief of Environmental Studies in the Pacific OCS Region of the Minerals Management Service, where he has served since 1979. He received his Ph.D. in marine biology from the University of Southern California. His research interests there focused on invertebrate taxonomy, benthic ecology, and evolutionary ecology. Fred has done research into metal toxicity to marine organisms, intertidal ecology, marine biogeography, parasitology, and oil spill impacts. He did field surveys in Chile after the Metula oil spill in 1975. Since joining the federal government, he has been an agency expert and liaison to numerous other federal and state agencies. He currently serves as the co-chairman for the Technical Advisory Committee of the National Estuarine Program for Santa Monica Bay. He has written papers on his past research and on federal scientific programs and given numerous presentations at governmental and professional scientific meetings.

Charles A. Simenstad is a senior scientist on the research staff of the Fisheries Research Institute, College of Ocean and Fishery Sciences, University of Washington. He has more than seventeen years of experience in basic and applied studies of estuarine and coastal marine ecosystems in Puget Sound and coastal Washington. The focus of this research has been on community and food web structures, determination of organic (food web) carbon sources using stable isotopes, the estuarine ecology, and particularly foraging behavior, of juvenile salmon, and the structure and ecology of epibenthic meiofauna as prey of juvenile fishes. Recent work on these relationships between fish populations and their habitats has led to investigation of functional and quantitative assessment of estuarine and marine wetlands, and development of objective protocol for design and evaluation of wetland mitigation projects. Mr. Simenstad is also co-coordinator and convenor/editor of the "Gutshop" series of fish food habits workshops which have occurred periodically since 1976. He has published more than 25 scientific papers in journals, books, and proceedings.

Appendix B

Workshop Participant Concerns about Energy Context and Institutional Setting

The workshop allocated one evening of effort and one plenary session to the development of overall "messages" (that is, individual statements of concern) addressing issues that participants believed existed concerning energy context and institutional setting. This Appendix includes the individual messages that emerged from the process. They are grouped into major categories. Many participants felt that concerns regarding national policy and institutional structures and processes must be addressed to make useful any conceptual framework.

NATIONAL ENERGY POLICY/NATIONAL ENERGY CONTEXT

• Regional energy programs must stem from national (policy driven) assessments of energy demands; consider the tradeoffs between strategies for meeting demands; and anticipate regional, national, and international programs to meet national energy needs. [Beyers]

• How is it possible to get the federal government to consider (and implement) the viable alternatives to OCS leasing and development and to articulate a national energy policy within which OCS development would be an integral part? Congress and/or the executive branch should be encouraged to create and adopt a national energy policy that would include alternatives such as a) pricing as a means of controlling demand, b) conservation regulations (e.g., automobiles with higher mpg ratios), c) tax incentives, d) reliance on foreign sources. [Johnson]

• Although the OCS Lands Act, the Coastal Zone Management Act, and the National Environmental Protection Act together constitute much of the legal structure for the development of OCS oil and gas, they do not provide an adequate and coherent national policy. A coherent policy is needed for vital reasons of public welfare and security. Such a policy would contribute much to the resolution of conflicts and minimization of litigation. [Fleagle]

• Human populations and their support systems have expanded to the point that they now affect global ecology. Those pressures on natural ecosystems come from basic needs for survival and the desire of people and their governments to raise standards of living. The results, in part, have been the conversion of native ecosystems to other uses and a loss of species due to habitat modification and destruction. Environmental protection is possible only if linked to sound, sustainable development. If these two are not linked, neither is possible over the long term. [Chamberlain]

• Oil and gas development needs to be considered in the context of a national energy policy. More energy is not the question or the solution. Energy must be used more efficiently, and priorities as to how energy should be developed and used must be set in a broader context that balances environmental quality and human wants. [Boersma]

• Natural biological variability is high. Oil and gas development has negative impacts that are difficult to distinguish from natural variability. [Boersma]

• There are values other than human values. Don't birds have the right not to be oiled? Don't tourists have the right not to have oil on their beaches? Current economic values do not value current or future benefits of high environmental quality. [Boersma]

• Most oil and gas development is considered in a vacuum. Oil and gas development is not alone in reducing environmental quality; it is additive with other uses. We should be adding all these impacts instead of considering uses separately. Global climate change and habitat destruction cannot continue without changing human environmental quality and survival for other species. [Boersma]

• Lack of a coherent energy policy confounds our attempts to solve environmental problems attached to energy production and use. The process of decision making, in the ideal, must consider more than merely the production of oil. [Pearson]

• As a nation we must develop and implement a comprehensive energy policy. [Benbrook]

• Early in the introduction to the construct of the conceptual framework, the report needs to establish explicitly the assumptions and conditions under which the model operates. This will, one hopes, establish the present "external" forcing functions, such as the extant U.S. energy policy (or lack thereof) and how the model might

be altered dramatically if these assumptions/conditions change. [Simenstad]

Institutional Structures and Processes

• Existing legislation (federal, state, and local), executive branch agencies carrying out existing legislative intent, and interagency arrangements conditioning these legislative goals and objectives need to be regarded as "interim" approaches. They all need to be reevaluated periodically to take advantage of scientific advances, development experiences, and other relevant factors. [Beyers]

• The linear decision-making sequence of MMS development needs to be reconstituted into a more flexible and less institutionalized structure that more easily permits adaptation in developmental processes. [Beyers]

• A more reactive system needs to be established to respond to inputs. Improve the outcome by reducing negative impacts. [Lasmanis]

• The current process places much decision making up front where our knowledge is the least developed. Problems arise because upstream decisions limit our downstream options. [Pearson]

• Informing officials and the public about the process and the issues needs to be done proactively. One important item to communicate is a description of the changes in a local community during the life cycle of an oil field. [Pearson]

• Decisions to lease in frontier areas require inherently more information than decisions in areas currently under production. The five-year planning cycle is too short to characterize adequately the frontier areas and to complete the leasing process. A 7-10-year planning cycle for frontier areas makes more sense. [Benbrook]

• Because conflicts are inevitable, mechanisms to handle the conflicts constructively must be established beforehand. [Pearson]

• How is it possible to get MMS, in its OCS programs, to respond to public concerns over environmental, wildlife, social, and cultural risks? MMS is an entity with a specific mission—the production of OCS oil and gas. As such, it has little incentive to alter its programs to respond to the social and physical risks that are of concern to the public. The most effective way to assure that the

MMS does respond is to change the decision-making process. This can be done by increasing the legal powers of state and local governments to participate in the OCS decision process (i.e., to put them into a structured partnership mode--at least in those situations where they are significantly impacted by OCS development decisions). [Johnson]

• How is it possible to get MMS, in its OCS programs, to respond to state and local concerns about damages that occur at the state and local level but where no revenues from OCS activity are allocated to these levels of government? One means may be to allocate a share of the revenues of OCS development to state and local governments so that these entities can balance these revenue benefits against the costs borne at this level. [Johnson]

• Development of OCS oil and gas is a major industrial activity dependent on collaborative management by government and industry. The system of management, with central responsibility for the public interest in the hands of the MMS of the Department of Interior, has been widely criticized by state officials, scholars, and public interest advocates. What is wrong with the system? Answers have to do not only with the absence of a national policy, but also with inadequate information and lack of communication among industry, agencies, and the public, with resulting public misperceptions and distrust. For example, the MMS has been encouraged to expedite leasing, but the Department of Commerce Coastal Zone Management [CZM] program that needs to respond to potential impacts has been emasculated. And the Weather Service and the Ocean Service have been left out of the system. As another example, funding for state coastal zone programs envisaged by the CZM legislation has not been available. People and institutions that experience major effects of development are not adequately represented in the management and decision-making system (there are serious institutional mismatches). The system will not work well this way. [Fleagle]

• There is a need to develop a state capability to help the coastal counties respond to near-shore and onshore aspects of the OCS process. The counties do not have the capability to protect themselves, or the state, under the CZM process or to affect significantly the process. [Duxbury]

• Future OCS research projects and direction should reflect the needs and values of the affected states as well as the federal government. These needs and values should be reviewed regularly, and the direction of research altered when necessary to strike a balance between environmental and human needs. [Chamberlain]

• It should be recognized that the process of lease-production decommis-sioning and the various associated impacts consist of a complex system of interconnected governmental jurisdictions. A simple EIS check list by MMS does not reflect the true nature of the system. [Lasmanis]

• The present system makes it difficult to address the problems and benefits of oil and gas development, because regulation and development are in MMS and the problems and costs get dumped at the local level or with other agencies (EPA or the Coast Guard for oil and gas) that lack the money to regulate. MMS should not be both the developer and the regulator. [Boersma]

• The MMS decision-making process results in a fundamental process inequity. That inequity is characterized by the absence of a meaningful role for those who bear most of the burdens and impacts in the lease decision. The process inequity generates significant conflict and undermines cooperation at later points in the process. [Benbrook]

• We no longer live in a world that can function on the basis of conflict, litigation, and brute force. We live in a world where we must learn to cooperate and collaborate to achieve human needs. [Benbrook]

• The common time frame of the MMS-OCS chronology should provide the reference or template which would allow the hanging of both structures (i.e., OCS development structure and MMS decision structure) on top of the life cycle of OCS development. [Simenstad]

• The state of Washington should immediately create a nonpartisan agency (institution) reporting to the governor and the legislature, with sufficient resources fully to anticipate, plan for, and help manage OCS oil and gas activity off the State's coast. The resources of state agencies, including the institutions of higher education, should be used in this effort (as well as subcontractors). The Revenue and Forecast Council serves as an example of such an agency, although its use of subcontractors is less than what would probably be appropriate for an institution focused on OCS oil and gas activity. This concept should be implemented in the current legislative session and should be reviewed for its relevance and scope of work biennially, as the history of OCS oil and gas activity unfolds in Washington State. [Beyers]

• For the state to anticipate situations in which it has a self-interest with respect to OCS oil and gas exploration and developmental processes, a new state agency (see above) initially must lead analysis of the (finite but rich) array of alternatives, focusing on likely OCS oil and gas futures (independent of federal visions). These analyses should be used to determine appropriate ongoing local and state government programs, policies, and positions regarding OCS oil and gas activity. [Beyers]

• Even if ORAP can provide the state with a solid understanding of the likely effects of OCS development, the state will be able to manage the set of causes that will drive them only by

1. Changing the existing multijurisdictional decision system and the leverage points accessible to state and local control.

2. Developing a set of objectives and policies for "best conditions" development of the OCS resource adjacent to the state, including criteria for a "no lease" outcome (in some cases based on risk analysis).

3. Using the decision system assertively on behalf of previously identified objectives and policies.

4. Being willing to challenge the given decision system and to work for change in that system to the extent it appears incapable or unlikely to result in implementing a "best condition" case. [Patton]

• If there is to be a "research council," it must have expertise in

1. Federal administrative law (NEPA, OCSLA, CZMA, CWA, CAA, etc.).

2. Civil law (compensation schemes).

3. Tax law (state and local revenue options from processing, transportation, etc.).

4. Offshore petroleum geology. What and where are the likely sources? Are they likely to have gas?

5. Petroleum production and transportation technology. What is feasible? How far from the point of production can various types of processing occur? What are the opportunities for consolidation of facilities? What should transportation policy be--pipelines, tankers, etc.?

6. Legislative advocacy in Congress.

7. Public information (conveying information on process and unfolding events; opinion surveys). [Patton]

Improved Risk Management and Emergency Management

• Some kind of risk plan management is needed that provides mitigation in the event of failure. This should address both resources and industries dependent on the damaged resource. This mitigation should be available without the damaged parties having to spend more dollars than potentially received in mitigation. [Duxbury]

• Equity between benefits and gains to the MMS and federal government and risks to state and local government needs to be equalized. [Lasmanis]

• The need exists to distinguish clearly the intensity and frequency of risks. The priorities of risk should be used to determine where the state invests its efforts and worries to reduce specific risks. Small risks should not unduly occupy state or county efforts. [Duxbury]

• Oil spills from shipping far outweigh any other type of risk. Yet the OCS process managed by MMS is the weakest in addressing this problem. [Lasmanis]

• Acute accidents happen and will cause damage in natural systems, reducing wildlife diversity, productivity, and probably resiliency. These risks from oil and gas development and transport need better prevention. [Boersma]

• Prevention of oil spills should be emphasized over mitigation and compensation, even though prevention is more expensive. We cannot completely avoid damage, so greater attention to prevention is needed (e.g., transportation farther offshore, double hulls, state of the art navigation, no movement in severe storm). Greater control by the Coast Guard and changes in state and federal laws will be needed. [Boersma]

• Risk analysis is not a universally known concept nor an easy one to portray. There must be some simple, straightforward explanation of what risk and risk analysis are, how such analyses are done, what they can produce, and so forth. [Simenstad]

Usefulness of a Conceptual Framework

• It is necessary at this time to look for other or additional concepts, to review values, and to develop ways to evaluate the effects of OCS leasing and development. The concepts developed in this workshop are a beginning. [Chamberlain]

• One value of this exercise is that, in working the model, we can see how the ideal differs from what we have now. [Pearson]

• The framework needs application to be useful. [Pearson]

• I hope to see a product that defines the major and/or significant actions, consequences, and probabilities as perceived by those familiar with the state of Washington. I do not expect or want to see a parallel management framework, because this is of little use to MMS. The current process is well defined and constrained by law, regulation, policy, etc. The final product will be of little use in planning research/information needs if it remains generic. If probabilities of events, as best defined by some scenario for oil and gas, are not estimated, then the agencies and interested parties are left to apply their own biases. This can, and usually does, lead to much smoke and little fire in pursuing research on issues of lesser importance. [Piltz]

• It is very important that the framework be illustrated at all levels of resolution, from purely conceptual to detailed scenarios that describe all consequences, pathways, linkages, etc. [Simenstad]