VALUE-FOCUSED THINKING FOR ENVIRONMENTAL RISK CONSULTATIONS

Robin Gregory, Joseph Arvai and Tim McDaniels

ABSTRACT

This paper reviews the use of a structured, value-focused decision approach for involving public and expert stakeholders in environmental risk-management consultations. We argue that a structured process provides the foundation for achieving a high-quality, participatory decision making process. We review several key elements of a structured approach to eliciting stakeholders' values, use examples from case studies to illustrate analytical techniques that have proven particularly helpful in linking analysis and deliberation, and discuss results from a small-group experiment that compares the quality and type of participants' input from conventional and structured value elicitations. In a concluding section we note some of the perils, promises, and challenges of using a structured, value-focused approach to incorporate and communicate stakeholder views as part of environmental risk-management decisions.

1. INTRODUCTION

Environmental policy debates increasingly focus on ways to incorporate the values of concerned citizens into policy decisions. As a result, there is a renewed

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interest in public involvement methods designed to enable lay stakeholders (e.g. residents of potentially affected communities and regions) as well as broader interest groups to participate effectively alongside technical experts and government representatives in complex policy debates (Renn, 1999; Chess & Purcell, 1999). Participation requires, at minimum, a requisite level of competence on the part of both public participants and the facilitators or analysts who elicit, summarize, and transmit information about stakeholder concerns to decision makers. At the same time, there is a recognized need for improved data to answer stakeholders' questions about the anticipated physical, economic, and social impacts of project or program initiatives. This desire for accurate factual information has led to new initiatives in field work and modeling efforts as well as the development of extensive GIS and other computer-based networks.

We support these efforts and view them as encouraging for the widespread adoption of more democratic, community-based environmental risk-management practices. At the same time, we are dismayed by what appears to be a neglect of science-based standards for the conduct of public participation efforts. Despite substantial recent advances in our understanding of individual and group judgmental processes – thanks to research by social scientists including psychologists, decision scientists, behavioral economists, and survey researchers – there continues to be little agreement on what constitutes a successful deliberative process. One result is that we see little discrimination on the part of most policy makers between rigorous and more casual, including inadequate or misleading, stakeholder participation decision processes.

This observation is mirrored by a continuing imbalance between the limited efforts designed, on the one hand, to incorporate broad-based stakeholder values into policy decisions and, on the other hand, the large-scale efforts to conduct technical assessments of anticipated biophysical, economic, and ecological impacts. Numerous examples of this imbalance exist. In the United States, one of the most visible cases is the ongoing effort by the Department of Energy to clean up the nation's legacy of nuclear wastes. Many papers have been published over the past decade describing the program's emphasis on expert, technical input from engineers and physical scientists and its general neglect of meaningful involvement from social scientists and from stakeholders (Flynn, Kasperson, Kunreuther & Slovic, 1997). Another U.S. example is the recent initiative by the Environmental Protection Agency to protect coastal areas as part of the National Estuary Program. Despite high-sounding rhetoric about combining both community input and expert information, the program has placed most of its resources into developing complex models of ecological systems and little progress has been made in understanding the views and

concerns of local citizens (Gregory, 2000). Similar examples of this imbalance between citizen and expert input to environmental risk decisions can be found throughout Canada (e.g. hazardous wastes, hydroelectric facility development), Europe (e.g. forest management, protection of coastal marine environments), and Asia (e.g. habitat protection, chemical risk management).

From our perspective, as researchers who work as analysts and facilitators with both expert and public groups, one important reason for this imbalance is the general absence of understanding about what constitutes high-quality information on stakeholder values. Beyond a small set of descriptors of the generally desirable (e.g. that a public involvement process should involve all interested parties, start early, establish a level playing field, be transparent, and provide open access to information) there is little in the way of criteria or analytical tools to distinguish excellent processes from the merely passable or inferior. This situation is a sharp contrast to that for natural-science input: Although differences about methods exist, usually there is a reasonable amount of agreement among, for example, ecologists, atmospheric chemists, engineers, or wildlife biologists about what constitutes careful scientific identification of the anticipated impacts of an action and how this information should be analyzed and presented. Improving the quality of input on stakeholder values used in policy decisions has been highlighted in the recent U.S. National Research Council (NRC) report *Understanding Risk* (NRC, 1996), which cites the link between analysis and deliberation as a key to identifying and addressing stakeholders' concerns. However, little specific guidance is provided in the NRC report regarding the design of a public involvement process (e.g. how to conduct deliberative approaches) or its goals (e.g. achieving high-quality decisions).

One reason why concordance is not likely to exist on the values side is that the different players responsible for assessing stakeholder views – decision scientists or psychologists or public involvement specialists – often hold different ideas about what should be done to elicit stakeholder concerns. The range of issues, and disagreements, is broad and fundamental. How should values information be collected? Is it best to employ individual interviews, surveys, or small group discussions? What analytical techniques can be used to provide insight, and when are they likely to be particularly helpful? How should values information be analyzed? How can results best be communicated to decision makers (presumably, so that they are reflected in the development of policies)? If the professionals charged with the conduct of studies are seldom in agreement, it is not surprising that policy makers generally lack a strong basis or trustworthy guide for assessing the quality of stakeholder-involvement work. As a result, they lack a clear basis for weighing the evidence from a consultative process against other pressing political, personal, or scientific inputs.

In this paper we review the use of a structured decision approach to involving public and expert stakeholders in environmental risk-management consultations. We argue that a structured process provides the foundation for achieving a high-quality, participatory decision making process. The basis for the approach is the work of Keeney (1992) on value-focused thinking (VFT) and the structured analytical basis provided by multiattribute utility theory (Keeney, 1982; Keeney & Raiffa, 1993) and behavioral decision analysis (von Winterfeldt & Edwards, 1986). Our discussion also draws from a recent synthesis of good practice in decision making (Hammond, Keeney & Raiffa, 1999) and from research into the mechanisms by which individuals construct preferences for items or activities with which they are unfamiliar (Payne, Bettman & Johnson, 1992).

We first review several key elements of a structured approach to eliciting stakeholders' values and discuss some of the analytical techniques that have proven particularly helpful in linking analysis and deliberation, using examples from case studies to illustrate key points. We then discuss results from a small-group experiment that compares the quality and type of participants' input from conventional and structured value elicitations. This discussion leads us to argue for a reassessment of the role of participatory decision processes. We believe such processes should be vehicles for providing insight to decision makers, rather than a means for delivering consensus agreements or numbers for inclusion in a benefit-cost analysis. In a concluding section we note some of the perils, promises, and challenges of using a structured, value-focused approach to incorporate and communicate stakeholder views more fully as part of environmental risk-management decisions.

2. A STRUCTURED APPROACH FOR IDENTIFYING STAKEHOLDER VALUES

In our view, the general goal of a public involvement process should be to place the values and concerns of the potentially affected individuals squarely in front of the policy maker so that they lend maximum insight to decisions about project or policy options. As any practitioner knows only too well, this is far easier to state as an abstract goal than to achieve in the context of a specific project with an inherited history and context, limited budgets, unreasonable deadlines, and well-defined agency and individual personalities. In addition, for many environmental risk-management decisions, both the relevant stakeholder values and the potential impacts of actions are subject to substantial uncertainty. To the extent that the action in question is unfamiliar and novel, neither the concerns of stakeholders nor the results of management initiatives will be known with the same precision that usually accompanies more routine transactions.

The starting point for a stakeholder-based process is to determine whose values or concerns matter in the decision: which individuals or groups legitimately are in and which are out? Being clear about the objectives of the consultation will help to determine whose values are essential. In most small-group or survey efforts, for example, it will be important to include both local residents and technical experts (who might be from industry, government agencies, or universities) and to include representatives of the range of different viewpoints (Edwards & von Winterfeldt, 1987). The scale of the initiative also matters. For a small, local project selecting participants may not be too difficult but for a larger, more complex undertaking some limits will need to be placed on the set of participating stakeholders. The decision about who to include is linked to decisions about which evaluation techniques will be employed: the selection of a small group of representative stakeholders who might meet in person once or twice a month over a one-year period implies a different participant base than does a survey that can be sent out over the internet. An assessment also must be made of whom the decision makers will be, remembering that they also count as stakeholders. Increasingly, it is rare to find a single decision maker who is charged with the final selection of an action, which means that analyses and other communications need to be targeted to a variety of audiences.

We believe that the ultimate goal of a structured decision process should be to provide additional insight, both for the participants and for the agency empowered to make the decision. A typical structured consultation process should directly involve stakeholders in the following five steps (Gregory, McDaniels & Fields, 2000):

(1) clearly characterizing "what matters" to stakeholders in the form of objectives
(2) creating a set of attractive alternatives
(3) employing the best available technical information to characterize impacts of the alternatives, including uncertainties
(4) identifying the tradeoffs that the alternatives entail
(5) summarizing the areas of agreement, disagreement and reasons for those views among the stakeholders.

The five steps outlined above constitute the primitives of most well-defined decision making processes (e.g. see Hammond, Keeney & Raiffa, 1999). The potential for a proposed action to result in beneficial or adverse effects provides the fundamental reason for making any decision, and serves as the basis for structuring the elements of a decision making process. Values (or interests) denote what matters, in terms of the specific decision problem at hand (Keeney,

1992), and are distinguished in the negotiations literature from the *positions* on which strategically-based stands are taken (Sebenius, 1992). A value-focused approach can be distinguished from an alternatives-focused approach that starts the assessment process by looking into the suggested options rather than by clarifying the underlying reasons for why an alternative might be favored or opposed.

An approach focused on values begins by working with stakeholders to identify a small set of objectives that are important to them when evaluating a management alternative. These objectives can be displayed in terms of a hierarchy (e.g. a value tree) that shows the relationships among the different objectives. A related technique is to clarify the relationship between end objectives (what fundamentally matters in the context of this decision) and means objectives (what matters because of its influence on a more fundamental objective). Instrumental objectives frequently will appear as means whereas moral values typically are ends in themselves. For example, community members may desire an increase in fish populations (a means objective) in order to improve local employment opportunities and, in turn, the assist community stability or to increase the quality of life; the same individuals might want a higher percentage of the spring catch because it would make the overall distribution more fair (a fundamental objective). These value judgments, in turn, can be used as the basis for creating more attractive alternatives that stand a better chance of achieving wide support, because they have the capability to anticipate and address the concerns of the principal parties involved in the environmental dispute (Gregory & Keeney, 1994).

These approaches to structuring values build on the concepts of decision analysis (Keeney, 1982) and also reflect insights from cognitive psychology, policy analysis and behavioral economics. In essence, they serve as a template with which a facilitator can guide group discussions and make effective use of the limited time devoted by a stakeholder group. Cycling iteratively through these steps, encouraging participants to express and explore their values fully and refining the associated information on consequences (impacts) until participants are satisfied they can express well-informed judgments about which alternatives to support, is the key to a structured, decision-aiding approach for environmental management deliberations (Gregory, Keeney & von Winterfeldt, 1992; McDaniels, Gregory & Fields, 1999).

Decision aiding in the context of an ongoing group deliberation, occurring over days or months or years, requires careful communications skills that help to establish the competence of impact judgments and build trust among participants. In addition to enhancing trust and communication, however, the facilitator in a structured decision-aiding approach provides an overall

analytically-based framework for focusing informed dialogue. Balancing these roles can be difficult. In dispute-resolution processes, for example, trust is generally built by the facilitator (or mediator) acting as a neutral leader, often granting participants a veto over the structure and content of the deliberations. In decision aiding, in contrast, the facilitator typically plays a more active, participatory role, in part due to the interactive nature of the explicitly constructive process by which values and impacts are pieced together and examined. Trust is built in several ways: through the process of carefully discovering, disentangling, and structuring the values of participants; showing where the views of participating stakeholders are similar or different; demonstrating how information about the anticipated consequences of actions can help to characterize the relevant objectives; and recognizing differences among the views of experts.

3. LINKING VALUE-FOCUSED ANALYSIS TO DELIBERATION

The prominence given to identifying and defining values as part of a structured value-focused consultation process requires the decision-aiding facilitator to be a skilled analyst as well as a good listener. Many of the formal analytical techniques of the decision analyst are brought to the consultation table to encourage dialogue and deliberation. For example, the analyst may help stakeholders to move from vague, qualitative expressions of uncertainty (using words such as "unlikely" or "reasonably probable" to describe impacts) to quantitative expressions (using percentages, probabilities, or frequencies). To accomplish these steps, a short primer on decision making under uncertainty or an introduction to probability is often required. As another example, stakeholders may spend two or three sessions developing good measures of an objective and (often working with technical experts) defining the range of possible impacts on this attribute. This is detailed and often stressful work but it helps participants pay attention only to those objectives that serve to distinguish among the relevant alternatives. As a result, objectives that usually may be central to an individual or a resource management agency can come to be viewed as less important for making the particular choice that is on the table because they are not affected by the actions under consideration.

In our experience, defining stakeholder values is more difficult than typically thought. Much more than "careful listening" is required, in part because stakeholders themselves are often unsure how they feel about proposed initiatives. They may have little understanding of choices or tradeoffs that they

have not been asked to think about before in any detail. Not all practitioners would agree with this assessment. Some (often those trained as economists) believe that the required values can be elicited in a straightforward manner so long as the measurement process follows the model of conventional economic markets. Others (often trained as facilitators or mediators) believe that their own ability to listen and to form emotional linkages with participants will lead to well-formed expressions of value. In our view, neither market analogies nor emotional bonding will lead to high-quality expressions of value because the specific values themselves do not exist prior to their elicitation. In other words, the expressions of value are context-specific and are constructed in the course of their elicitation. This perspective of constructed preferences (Payne, Bettman & Johnson, 1992; Slovic, 1995), supported by a rich body of research by psychologists and decision scientists, leads directly to the observation that what users of information should receive, for example in terms of data on potential impacts, should match what they want to know. It should not repeat what they already know or address concerns that are of little interest or relevance (Fischhoff, Bostrom & Quadrel, 1993).

In reviewing the use of a structured approach to involving stakeholders in environmental risk-management decisions, four tasks stand out as essential. These four are addressed below. In each case, a key element of a structured approach is the use of specific analytical tools to encourage and deepen deliberation. The ultimate objective is to provide information that will be most helpful to the decision makers in the context of the specific risk-management problem under consideration.

3.1 Identification of Stakeholder Concerns

Objectives

A structured process typically begins by asking stakeholders to express all those things that matter to them, including both content and process considerations, in the context of a proposed management initiative. Identifying and defining values that arise in the context of a novel problem is difficult work and requires both introspection and deliberation on the part of participants. A variety of techniques are used to assist stakeholders to think through and express their values, using iterative processes to refine their definitions. For example, one of the key distinctions made during value elicitations is between the means and ends objectives identified by stakeholders. Although this distinction is straightforward conceptually – ends are valued in and of themselves, whereas means are valued insofar as they contribute to the availability or amount of some other objective – it is often less clear in practice and can lead to

informative discussions among participants about the relationships among key actions and their principal concerns.

Ends and Means

One of the important lessons in creating a means-ends diagram is that useful information is received from all stakeholder groups: input from technically-trained stakeholders (e.g. fisheries biologists, economists) joins with the expertise of lay participants (e.g. farmers, private forest-lot owners). All members are engaged in a learning exercise reflecting the linkages between possible program actions and their own values. The dynamic nature of this values exploration not only helps to energize the discussions among group members but also serves as a mechanism for encouraging brainstorming and creative thinking on the part of all participants.

An example comes from a multi-stakeholder, multi-agency consultation charged with aiding cleanup of the Tillamook, Oregon coastal estuary (Gregory, 2000). Detailed value elicitations with key participants led to the construction of a means-ends network, which dramatically helped to clarify that a small set of concerns were central to all three of the major stakeholder groups (community residents, state and local management agencies, and technical experts). As shown in the middle portion of Fig. 1, we noted explicitly the distinction between the six "fundamental objectives" of the estuary management program and the "means" objectives, and all further analyses were linked back to these six underlying concerns. Even though the weights placed on the fundamental objectives – their relative importance to each stakeholder – were quite different, the knowledge of these means-ends relationships among key concerns helped to focus and gave direction to subsequent discussions.

Measures

In a structured decision-aiding process, an attempt is made to assess the performance of alternatives in terms of the objectives using attribute measures that make sense to stakeholders. As discussed in the decision-science literature (Keeney, 1992; Clemen, 1996), attribute scales provide a measure of the extent to which an objective is achieved. If the objective is to maximize profit, for example, then a reasonable measure of success might be "annual profit in dollars," where more is preferred to less. There are essentially three types of attributes. *Natural attributes*, such as the dollars of profit referred to here, are in general use and have a common interpretation (other examples: "acres of habitat" for measuring species protection, or "number of fatalities" for measuring the success of a new AIDS drug). *Proxy attributes* provide an indirect measure of what is valued in situations where direct measures make little sense, such as the

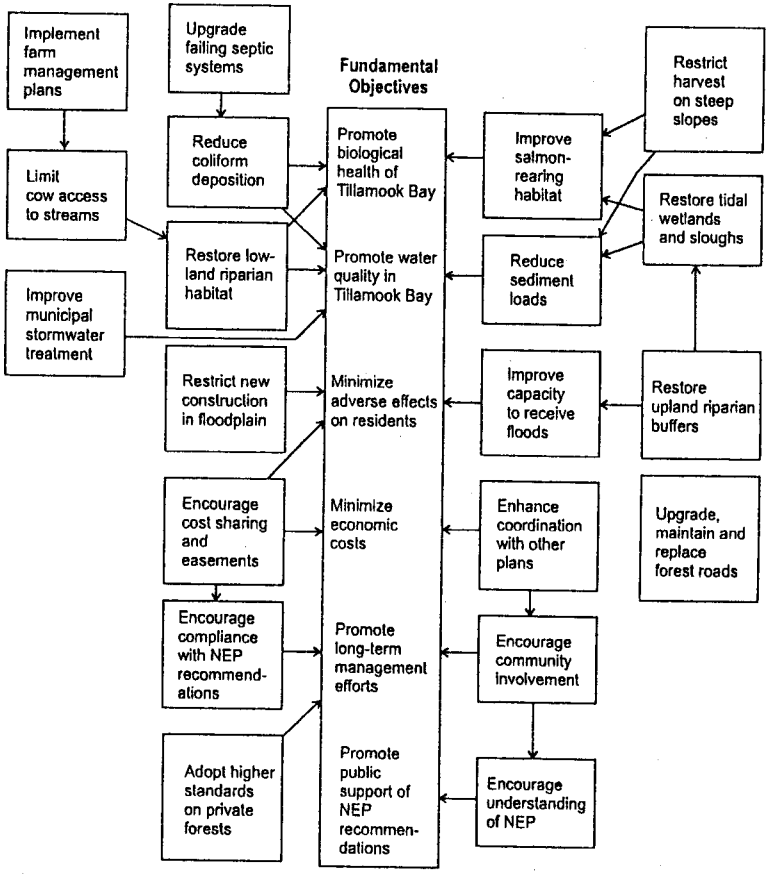

Fig. 1. Tillamook Bay National Estuary Program (NEP) Means-ends Network.

Note: Thesix fundamental (ends) objestives are shown in the centre box. Means objectives, many of which become actions in the Tillamook Bay estuary plan, are shown at the sides. An arrow denotes "influences", between means objectives and from means to ends. *Source*: Gregory, 2000.

use of airborne sulphur dioxide concentrations to assess the rate of disfiguration of stone statues over centuries within a major city. *Constructed attributes* are situation specific and typically involve the construction of an index that describes the range of possible impacts for the attribute of concern in the context of the given problem. For example, a constructed scale for ecosystem health might

include considerations such as "protect wetlands" and "maintain rare species habitat." The relevant scale for a particular problem might include the range shown below:

Attribute level	Description of Ecosystem Health
(1)	no loss of wetlands and loss of 5 acres rare species habitat
(2)	loss of 10 acres wetland and loss of 10 acres rare species habitat
(3)	loss of 30 acres wetland and loss of 25 acres rare species habitat
(4)	loss of 50 acres wetland and loss of 40 acres rare species habitat

Constructed scales provide a means for making tradeoffs between different levels of a hard-to-define value (in this case, ecosystem health) and other, more easily defined values (for example, costs for factories with different levels of environmental safeguards). The following type of question can be posed: Are stakeholders willing to increase the cost of an initiative by $20 million in order to reduce adverse environmental impacts from attribute level 3 to level 2 on the constructed Ecosystem Health scale? Although factual information is used to inform the endpoints of the scale (e.g. what are the best and worst possible consequences, given the specific context under consideration?), stakeholder values are used to identify the key elements of concern and reflect judgments for which there are no external benchmarks of correctness. Constructed scales thus provide a possible mechanism for addressing one of the key issues giving rise to protected values or what have been termed "taboo tradeoffs" (Baron & Spranca, 1997), which is the perceived incommensurability between value dimensions of the environmental or health-risk policy issue under consideration.

Affect

Because value conflicts are at the center of making responsible tradeoffs, it is important for the decision-aiding facilitator to provide an environment in which participants feel they can speak freely and evoke emotions as well as logical thought. Recent findings in judgment and choice research acknowledge the importance of affect – the feeling states that people experience, such as happiness or sadness, as well as qualities associated with a stimulus, such as goodness or badness – as a key element in how individuals form judgments and make decisions (Finucane, Peters & Slovic, in press). A structured approach facilitates the incorporation of emotion into stakeholder deliberations, including the development of improved alternatives based on tradeoff analysis, through the construction of scales (e.g. indices for emotions including anger, pride, or

outrage as well as scales for moral or ethical concerns) and through the recognition of their source in the specific problem context. In our experience, allowing affective responses into environmental deliberations is a necessary component of trust-building and, in addition, often serves as a catalyst for helping participants to define their values more fully and to create improved alternatives.

3.2 Presentation of Multiple Stakeholder Concerns

One of the dominant findings of risk-management research is the richness and diversity of concerns that stakeholders bring to policy evaluation settings (Slovic, Fischhoff & Lichtenstein, 1984). In a typical situation, these values will range from the scientific and aesthetic to economic, environmental, social, health, recreational, and religious considerations. Clarifying the range of values and the factors influencing how well the values are achieved are key to helping stakeholders construct an informed judgment in the context of the specific problem and policy setting.

One useful tool for depicting values and the factors affecting them is an influence diagram, which graphically shows the relationship among key components of a decision process at a single point in time (in contrast, for example, to the more common flowchart, which depicts relationships over time). Influence diagrams show the main components of a decision situation as nodes, distinguishing between decisions (shown as rectangles), chance events (shown as ovals), and consequences (shown as rectangles with rounded corners) (Schacter, 1986). Arcs (i.e. arrows) are used to express relationships of relevance or sequence. Influence diagrams serve as a basic tool for developing mental models of a decision situation, which are formal depictions of the context and decision structure that an individual or group employs to think about a situation (Bostrom, Fischhoff & Morgan, 1992). Mental models are particularly useful at visually demonstrating differences in expert and public views of a decision situation; for example, showing the reasoning behind the different risk-management strategies proposed by a public and by an industry stakeholder.

Another useful visual tool from the decision sciences is the presentation of decision trees to illustrate the connections and hierarchical relationships among different values. Decision trees again use the distinction between squares (representing decisions) and circles (representing chance events), specifying consequences at the end of the branches that designate possible decision pathways. Decision trees flow from left to right and require care in construction; for example, the branches that emanate from each chance node must correspond to a set of outcomes that are both collectively exhaustive (i.e. no other possibilities exist) and mutually exclusive (i.e. only one can happen). Decision

trees can be very simple or very complex, providing a way to track and display the details of a decision. They also can be used as the starting point for evaluating different options, where the objectives form the rows of a matrix and the various alternatives are displayed across the top. This systematic presentation of how well the alternatives satisfy each objective, known as a consequence matrix, is a powerful tool for clarifying the acceptability of different options and is useful as the starting point for the in-depth consideration of tradeoffs and conflict across objectives (see Section 3.4).

3.3 Addressing Uncertainties and Learning Over Time

In many contexts involving stakeholder decision making, there are substantial uncertainties that make decisions difficult. Holling (1978), Walters (1986), and others have developed adaptive management as a means of coping with profound uncertainties in managing complex natural resource systems. It can be characterized as an approach that explicitly recognizes uncertainties (in the underlying science, in ecosystem and human reactions, or in the realization of both short- and long-term consequences) and, in response, suggests that multiple approaches be tried on a small scale and their results closely monitored in order to maximize learning (what worked? what didn't?) while minimizing the occurrence of costly failures. An adaptive approach therefore views decision making under uncertainty as an iterative process rather than as a one-time exercise and uses both formal experimental designs and informal processes to provide opportunities to learn over time.

Incorporating adaptive management concepts into public involvement activities has substantial advantages. Foremost is that adopting this perspective can turn one-shot, all-at-once decisions into longer-term sequential decisions, which can be revisited as new information is derived from management experiments. Incorporating adaptive management as a response to addressing uncertainty also requires and fosters institutional flexibility, which in turn leads to a more responsive institutional design. In addition, there tends to be more of an orientation towards joint problem-solving rather than positional stances among participants. These results are positive steps in any approach to environmental decision making.

This conversion to a sequential decision process can help relieve legitimate fears among stakeholders that "we don't know enough" to make a decision, or equally legitimate fears that "the science may change." Both of these concerns were stated by stakeholders in a structured decision process conducted recently for water management in British Columbia (McDaniels, Gregory & Fields, 1999). Recognizing these concerns led to creating a new objective concerned

with fostering adaptive learning over time. Explicitly stating this objective led to the creation of a new dimension in the water management alternatives, concerned with establishing an ongoing management council to foster adaptive learning.

3.4 Making Tradeoffs across Multiple Objectives

"Is it worth it?" is perhaps the most difficult question in any decision context. It focuses attention on the inevitability of tradeoffs: the need to give up something valued in order to gain something that is also valued but for different reasons. Questions about tradeoffs are ubiquitous in environmental decision making: the difficulties that arise in addressing tradeoffs responsibly are the principal reason why expert and stakeholder input to tough management choices is required.

Tradeoffs are a key part of a structured decision making evaluation process because they allow the different dimensions of value to be compared without translating directly into a single metric (e.g. dollars). Instead, a range is designated for each attribute scale, based on the anticipated scope of impacts as reflected in the alternatives under consideration. Weights can be assigned to each of the scales, expressing the relative importance of the objective (over the relevant impact range) to the value of the alternative under consideration. Variations in assigned weights then provide important information about what matters to different stakeholder groups.

Tradeoffs are particularly troubling for stakeholders who believe they are representing broader constituencies in high stakes negotiations, and so are responsible for the well-being of others. Stakeholders often feel that grappling with difficult tradeoffs raises cognitively and emotionally troubling dilemmas in which deeply held, morally significant, "protected" values may be affected (Baron & Spranca, 1997). In such circumstances, it is not surprising that some stakeholders may resent attention to issues such as costs when they believe moral concerns such as health, environmental quality, or justice are involved.

Yet, despite the discomfort that stakeholders may feel in addressing tradeoffs, such issues are unavoidable in addressing public policy issues regarding environmental and health risks. These tradeoffs are part of the fundamental policy decisions we face. Keeney (1995) has written clearly about these issues in discussing decisions that policy makers face about managing activities that create life-threatening risks. Keeney emphasizes the need for clear tradeoffs in the context of balancing economic and moral concerns relating to health policy tradeoffs, in part because spending more on any one health policy issue means spending less on other similar activities. If stakeholders refuse to consider such tradeoffs, then technical experts will likely make them and develop policies without the benefit of insight about the views of stakeholders.

4. AN EXPERIMENTAL EXAMINATION OF DECISION STRUCTURING PROCEDURES

Despite a wealth of writing on the topic of public involvement processes, and no shortage of assertions about which of the many competing methods is best, there have been few empirical comparisons of different approaches for eliciting stakeholder values. As a result, we asked for and obtained funding from the U.S. National Science Foundation for a series of studies that would directly compare conventional, unstructured value elicitation processes (similar to those used in many focus groups and contingent valuation studies) to the more structured, value-focused process that we have been discussing in this paper.

One experiment was designed to study the influence of a structured decision process that encourages value-focused thinking and deliberation on decision making for a risk-management problem involving many conflicting objectives (Arvai, Gregory & McDaniels, in press). Specifically, we wanted to determine if a deliberative risk communication approach that helps to structure decision making by drawing participants' attention to their values, objectives, and tradeoffs in the decision context leads to higher quality and more thoughtful risk-management decisions.

4.1 Context

The risk-management context considered in this experiment concerned the potential ecological benefits of enhanced salmon habitat that could arise from changes in the ways that hydroelectric facilities are operated in the Canadian province of British Columbia (BC). This issue is a particularly salient one in BC due in part to new provincial water management planning processes aimed at better balancing electricity benefits with ecological productivity (for a working example of this process, see McDaniels et al., 1999). Managing water allocations between electricity generation and ecological needs also has attracted attention in the United States, with heightened concern about the conflict between fish habitat requirements and electricity generation on the Snake and Columbia rivers, and is a primary concern of the world-wide review currently underway by the International Commission on Dams.

4.2 Design

The experiment made use of an extensively pre-tested workbook prepared in two versions: the unstructured 'alternative focused' (AF) condition consisting of 15 pages and the structured 'value focused' (VF) condition consisting of 18

pages. The workbook was not designed as a stand-alone questionnaire, but rather as a means of structuring the experiment by asking questions about the risk-management problem and providing space for recording answers. All workbooks were completed by individuals. The workshops were led by a facilitator, whose role was to answer procedural questions and to encourage discussion among participants.

The only difference in the general structure of the two treatments was the inclusion, in the VF condition, of a value-focused orientation. Following the suggestions of Keeney (1992) and Hammond et al. (1999), participants in the VF condition were explicitly instructed to consider their values and objectives to help them clarify what they wanted to achieve with their decision. They were then told to consider the alternatives in the context of how well each option might meet their stated objectives. Finally, participants were instructed to consider tradeoffs among conflicting objectives that arise in selecting among the 6 available alternatives.

The experiment had a multi-part design with one independent variable (the value-focused or alternative focused structure) and several dependant variables. The dependent variables used for judging decision quality included participants' self-ratings of their knowledge level, how comfortable they were with their decisions, how well their decisions reflected their values and concerns, and how satisfied they were with their decisions. We also studied the content of stakeholder deliberations and the rationales for participants' decisions. In addition to measures of decision quality, we also asked participants for their opinion about the role that the public should play in participatory decision approaches in addition to their feelings about their stress and mental difficulty levels during the decision making process.

We hypothesized that participating in a value-focused risk communication approach (as opposed to an alternative focused approach) would make people feel more comfortable with their decisions, more satisfied that their decisions reflected their values and concerns, and in the end, more satisfied with their decisions. We also hypothesized that an explicit emphasis on values and value tradeoffs in a value-focused approach would lead participants to discuss of a wider array of decision-relevant issues during deliberations. Linked to our expectations about the content of deliberations and measures of decision quality, we also hypothesized that participants in a value-focused process would feel more knowledgeable in terms of their ability to make an informed decision.

The subjects in this study were paid adult volunteers recruited from the Vancouver, Canada metropolitan area. Over the entire sample, six small groups comprising 44 subjects participated in the AF condition and another eight small groups comprising 57 subjects participated in the VF condition.

4.3 Stimuli

Both the AF and VF protocols consisted of 3 primary elements. These included: (i) risk communication elements presented in written and audio formats; (ii) various judgment and decision making tasks; and (iii) several deliberation periods. Information was presented in four formats. These were a short newspaper account, a 1-page written statement outlining the issues behind the decision context, expanded information in printed form including a map showing river locations and a summary table discussing the pros and cons of six management alternatives. This expanded information was accompanied by short audio-documentary (of approximately six minutes in length), recorded by a local radio personality specifically for this experiment.

Interspersed between the risk communication elements were several judgment and decision tasks. The first of these followed the short newspaper account and 1-page written statement, which asked subjects several self-rating questions on 7-point Likert scales regarding their knowledge of, and interest in, fisheries and electricity issues (Table 1). The second set of decision tasks followed the expanded printed information and accompanying audio-documentary. This task asked subjects to vote for their preferred alternative in a mock referendum, followed by strength-of-preference questions in the form of a willingness to pay appraisal (asking for participants' maximum willingness to pay to achieve the stated salmon habitat enhancement benefits) for each of two alternatives. The third set of decision tasks followed the contingent valuation questions and involved both open- and closed-ended self-ratings of the answers provided during the referendum and contingent valuation exercises.

4.4 Results

Analyses were carried out on the data obtained from subjects' completed workbooks and the transcribed content of the deliberation periods in the AF and VF conditions. Statistical tests were used to summarize and compare subjects' responses to the closed-ended self-rating questions using 1-tailed paired-sample and 1-tailed two-sample *t*-tests.

Subjects' responses in both the AF and VF conditions showed that their self-rated levels of knowledge about hydroelectric power systems and the associated environmental effects and salmon habitat requirements in rivers increased significantly after completing their respective risk communication protocol. For example, subjects' knowledge of salmon habitat requirements in rivers increased from a base level of 3.84 to 4.21 in the AF condition, and from 3.63 to 4.30 in the VF condition. Both of these differences are statistically

Table 1. Closed-ended Rating Questions.

1. Do you think policy decisions involving fish/power tradeoffs in B.C. should include public input or should they be made largely by technical experts?

1	2	3	4	5	6	7
entirely by public input			both public and experts			entirely by experts

2. In general, how knowledgeable are you about hydroelectric power systems and their environmental effects? (very little knowledge; about average knowledge; great deal of knowledge)
3. In general, how knowledgeable are you about salmon habitat requirements in rivers? (very little knowledge; about average knowledge; great deal of knowledge)
4. In terms of your ability to answer the specific policy questions presented in this workshop, do you feel that you had enough information about the issues to give an informed answer? (not nearly enough information; just enough information; too much information)
5. Given what you know about the issues now, how comfortable are you with the prospect that the input you provide today could influence policy decisions in the province? (not at all comfortable; moderately comfortable; very comfortable)
6. For the referendum question, how satisfied are you with your selected policy alternative? (not at all satisfied; moderately satisfied; very satisfied)
7. For the willingness to pay questions, how satisfied are you with the answers you gave? (not at all satisfied; moderately satisfied; very satisfied)
8. In general, how stressful did you find the decision making tasks (referendum and willingness to pay) presented during this workshop? (not at all stressful; somewhat stressful; very stressful)
9. In general, how mentally difficult did you find the decision making tasks (referendum and willingness to pay) presented during this workshop? (not at all difficult; somewhat difficult; very difficult)
10. How accurately do you feel that your input to these questions on salmon/power policy alternatives reflects your true values and concerns? (not at all accurately, somewhat accurately, very accurately)

Note: Subjects' answers were expressed on 7-point Likert-type scales as shown after question 1. Scale end and mid-point(s) for the other questions appear in parentheses.

significant at the 0.01 significance level (see Table 2). Similarly, subjects' responses in both conditions showed that they became more comfortable with the prospect that their input during the risk communication protocols could influence policy decisions. In the case of the AF condition subjects' comfort levels increased from 4.34 to 4.57, a statistically significant difference at the 0.05 level. In the VF condition, subjects' comfort levels increased from 4.44 to 4.88, statistically different at the 0.01 level.

Subjects in the VF condition also felt that they had received more information about the various issues over the course of the workshop that could be used to make an informed decision. Self-ratings about the amount of information in hand increased from 3.11 at the start to 3.93 at the end of the workshops, a statistically significant difference at the 0.001 level. On the other hand, subjects in the AF condition reported a much smaller, and statistically insignificant, difference in the amount of information they obtained over the course of the workshop (3.23 at the start 3.52 at the end) on which they could base an informed decision.

Analysis of subjects' closed-ended responses in the VF condition showed that their level of satisfaction with their referendum response was marginally higher than subjects in the AF condition (see Table 3): the mean rating of AF participants was 5.05 whereas VF participants gave a mean rating of 5.40. Conversely, subjects' in the VF condition were slightly less satisfied with their responses to the two willingness to pay questions when compared to subjects in the AF condition, with participants in the AF condition reporting a mean rating of 5.18 on the 7-point satisfaction scale compared to a rating of 4.89 for VF participants. Neither of these differences, however, is statistically significant.

Despite no significant differences in their reported level of satisfaction, participants in the VF groups felt that the value-focused decision process was more effective in terms of helping them make decisions that better reflected their 'true values and concerns" (Table 1, item 10). Participants self-ratings of this aspect of the decision increased from 5.45 in the AF condition to 5.88 in the VF condition, a statistically significant difference at the 0.05 level.

4.5 Experiment Conclusions

These results demonstrate that participants in a structured, value-focused risk communication approach were able to make higher quality decisions in the context of a complex environmental risk-management problem. Decision quality is enhanced because the VF structure encouraged participants to first think about their values and objectives and then to carefully consider tradeoffs among them. This was done by first prompting subjects in the VF protocol to engage in a

Table 2. Summary of Within-condition Comparisons.

Self-rating Item	Alternative Focused					Value Focused				
	0_{Start}	s_{Start}	0_{Finish}	s_{Finish}	p	0_{Starts}	s_{Start}	$0_{Finishs}$	s_{Finish}	p
1. Public and/or Experts	4.07	0.82	4.00	0.72	0.41	4.12	0.71	4.09	0.76	0.53
2. Knowledge About Power	3.71	1.34	4.23	1.10	2.18×10^{-5}	3.58	1.34	4.39	1.13	1.74×10^{-8}
3. Knowledge About Salmon	3.84	1.58	4.21	1.41	0.003	3.63	1.48	4.30	1.30	2.82×10^{-5}
4. Amount of Information	3.23	1.54	3.52	1.28	0.08	3.11	1.59	3.93	1.46	0.0002
5. Comfort with Giving Policy Advice	4.34	1.48	4.57	1.30	0.05	4.44	1.69	4.88	1.75	0.007

Note: the *p*-values reported here are for a one-tailed paired-sample test.

Table 3. Summary of Between-Condition Comparisons.

Self-rating Item	Alternative Focused		Value Focused		
	0	s	0	s	p
6. Satisfaction with Referendum	5.05	1.49	5.40	1.45	0.13
7. Satisfaction with WTP	5.18	1.48	4.89	1.72	0.20
8. Stress	2.88	1.60	3.17	1.32	0.19
9. Mental Difficulty	3.13	1.51	3.87	1.77	0.02
10. Values and Concerns	5.45	1.15	5.88	1.13	0.03

Note: the *p*-values reported here are for a one-tailed two-sample test.

process of identifying, defining, and discussing the wide range of different value attributes that they could later use to help structure the decision making process. This task was followed by the written exercise asking subjects in the VF condition to make tradeoffs by ranking their values and objectives in order of importance as they related to the available alternatives.

Encouraging participants in the VF condition to discuss and reflect upon all of their relevant values allowed them greater flexibility to add additional value attributes or under-represented issues on which to help base their decisions about management options. For example, participants in the VF condition paid greater attention to social and environmental issues including salmon enhancement, achieving broader ecological goals (e.g. maximizing biodiversity), maintaining provincial revenue levels, and maintaining their current standards of living.

In addition, the VF approach also helped participants clarify and structure their values by providing increased exposure to the concerns and objectives of others in their workshop group. The manner in which this was achieved – independent brainstorming followed by group discussion – has been shown to be effective in terms of generating a more comprehensive set of attributes (Hill, 1982) on which to base decisions. Further, explicitly instructing participants to make tradeoffs and review alternatives after reflecting upon objectives and the associated impacts information was helpful because considering different aspects of the problem has been shown to bring to the forefront considerations that can influence decisions (Janis, 1982, Slovic, 1995). In part, this is helpful because making tradeoffs among a wider array of values and objectives helped participants to overcome the well-documented tendency to emphasize single objectives when addressing difficult choices (March, 1978).

Both the wider range of values and the deliberative framework helped to de-emphasize the obviously dominant features of the available alternatives (costs and expected salmon returns), allowing participants to make more thoughtful, higher quality decisions in situations where a single 'right' choice was not

readily apparent. There was no reason why participants in the AF condition couldn't do this as well. However, consistent with findings in other studies (Fischhoff et al., 1978; Bohnenblust & Slovic, 1998), the unaided participants in the AF condition tended not to consider the full range of their values when evaluating different management options. Whereas the majority of participants in the AF protocol focused mainly on value attributes outlined in the summary table and in the accompanying audio (i.e. costs, electricity, and environmental issues), the decision structuring elements present in the VF condition helped to increase the salience of other concerns so that participants defined an enriched set of fundamental objectives.

5. GOAL OF CONSULTATION PROCESS

Both the discussion of linking analysis and deliberation using value-structuring techniques (Section 3) and the experimental comparison of structured and unstructured methods (Section 4) demonstrate some of the reasons why we believe that a structured approach to consultations is likely to yield a higher-quality, more defensible way to involve the public in environmental risk-management debates. Yet this view is not generally accepted among public-involvement practitioners; in fact, it is decidedly a minority view.

We believe that a principal reason for this skepticism regarding decision-aiding approaches is their focus on clarifying areas of agreement and disagreement among stakeholders rather than on reaching consensus (Gregory, McDaniels & Fields, 2000). This distinction mirrors the theoretical basis for structured approaches, in multiattribute theory and decision analysis, as compared to the basis for much of the current thinking and practice in environmental management and consultation in "alternative dispute resolution" (ADR). The role played by ADR is particularly strong in the United States, where litigation has become a major industry and where where negotiated processes are seen as the alternative to the courts. This ADR orientation has resulted in environmental negotiation being widely seen as a process of resolving conflicts and reaching consensus, rather than as one focused on fostering more informed and wise policies. For example, Peelle (1988) defines a successful citizen participation process as one that involves the public in a meaningful way and leads to "any outcome which reduces conflict between stakeholders and agency proponents and results in a legitimate and lasting decision."

Our central criticism of a consensus-driven process is the lack of explicit attention and thoughtful exploration typically given to the values and objectives of participants (Gregory, McDaniels & Fields, in press). A focus on consensus can shift, subtly or openly, key elements of the group decision making process.

Issues may be selected in such a way that they offer a high potential for agreement, which has the result that less tractable issues may be ignored. Participants in focus-group sessions, project management committees, or community stakeholder forums may be selected more on the basis of their ability to get along and work well with others than on criteria relating to their expression of a diverse range of interests. Methodologies for impact analyses may be selected to the extent that they are relatively easy to explain and to document rather than on the basis of their ability to answer participants' questions fully or to lend insight to the decision making process. And minority views within a group may be suppressed rather than explored, with conflict among group members being viewed as a problem to be overcome rather than as an opportunity for providing additional clarity regarding values and facts relevant to the decision at hand.

In our view, the goal of a consultation process should not be cast in terms of resolving disputes but rather in terms of providing insight, or "decision aiding," for the public decision process. Providing insight to decision makers about the values, beliefs, perspectives and preferred tradeoffs of stakeholder groups is far more in keeping with normal governance structures, in which legitimate agencies govern by trying to achieve socially desirable ends.

6. CONCLUSION

One of the most important contributions of structured decision approaches is their ability to convey the key elements of a complex environmental risk problem in common-sense terms that capture the primary impacts in ways that easily can be understood by the full range of stakeholders. This means that it is easier for lay participants to understand the expected physical, economic, or social impacts of an action because the use of technical language and models is tied to their own expressed values and concerns. Equally important, it means that it is easier for technically or politically sophisticated participants to understand the linkages back to what people care about and thus to anticipate variations in the support for, or opposition to, various alternatives. In addition, multiattribute methods provide new visual and graphical communications techniques that can assist stakeholders to think about the difficult tradeoffs implied by project options. Determining which objectives are more important and developing explicit measures for tracking consequences and creating improved alternatives permits the more qualitative concerns of community stakeholders to be expressed in a manner that speaks to the more quantitative audience of policy and decision makers. These improvements in clarity and insight can greatly enhance both the quality of the final recommendations and

the willingness of stakeholders to participate as part of a demanding environmental risk management consultation process.

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