Penn State Environmental Law Review

Volume 10 | Number 2 Article 18

6-1-2002

Science, Politics, and Problem Solving: Principles and Practices for the Resolution of Environmental Disputes in the Midst of Advancing Technology, Uncertain or Changing Science, and Volatile Public Perceptions

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Science, Politics, and Problem Solving: Principles and Practices for the Resolution of Environmental Disputes in the Midst of Advancing Technology, Uncertain or Changing Science, and Volatile Public Perceptions

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Abstract

Environmental conflicts pose powerful questions and complex challenges for civil societies. More than other kinds of disputes, they are contentious, stubborn, and emotional. Many of them are laden with contested scientific information that could determine impacts and outcomes for thousands, sometimes hundreds of thousands of stakeholders, some of whom haven't been born yet. This article reports on recent research regarding the integration of scientific and technical information in mediated and facilitated cases and posits six hypotheses which lay the groundwork for additional research on environmental consensus building

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I. The Challenge

At core, environmental disputes reflect America's constant struggle over the "triple bottom line" of sustainability: the health of our environment, the vitality of our commerce, and the endurance of our communities.[1] Consider the following headline:

> "In a major move to protect wildlife in old growth forests, a judge has halted nine federal timber sales in the Pacific Northwest and ordered further reviews that could stop logging in large sections of Washington, Oregon, and California."[2]
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> Or this:
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> "The Environmental Protection Agency said today that it intended to withdraw a new drinking-water regulation approved by the Clinton administration, saying it did not believe that the decision was supported by the best available science. Arsenic, a naturally occurring substance, is a known carcinogen."[3]
>
> And, finally, this:
>
> The latest product of the mad science of biotechnology is a new critter that industry has dubbed "Enviropig." Though you might call it Frankenpig. **The Boston Globe** reports that big corporate hog producers working with Canadian scientists, have financed development of a genetically-altered porker that produces a more environmentally-friendly manure. Manure is a big barrier to the expansion of massive hog factories because swine excrete excessively. The excretion is especially stinky, and this pig stuff contaminates rivers and our other water supplies, killing fish and causing health problems.[4]

At the start of the 21st Century, citizens and decision-makers are hungry for ways to improve environmental discussions. We need smarter outcomes that are conceptually sound, more explicitly equitable, more durable and efficient, and more transparent and accountable in their trade offs and policy logic. Simultaneously, we need to reduce the transaction costs, both human and financial, that are associated with public interest conflicts over timber, land, water, hunting, pollution, fishing, and energy development.

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1. JOHN ELKINGTON, CANNIBALS WITH FORKS: THE TRIPLE BOTTOM LINE OF SUSTAINABILITY (1997).
2. The Spokesman-Review (Spokane, Wash.), Aug. 4, 1999.
3. N. Y. Times, Mar. 21, 2001.
4. The Funny Times, Oct. 2001.

The issues and problems portrayed in *A Civil Action* by Jonathan Harr,[5] and the movie based on this book, illustrate the complexity and dilemmas of these conflicts. Beginning in the mid-1960s, the City of Woburn Massachusetts operated two wells near the Aberjona River which served a number of Woburn homes. In 1979, the wells were closed because of chemical contamination and a suspected cancer cluster. In 1982, thirty-three plaintiffs, half of them were either children who were sick with leukemia or the estates of those who had already died, filed suit against two alleged polluters, W.R. Grace & Co., owners and operators of a machinery plant, and Beatrice Foods, Inc. owners of a tannery and a 15 acre parcel of land adjacent to the tannery.

In federal court, the case was assigned to Judge Walter J. Skinner who, in 1986, tri-furcated the trial. The first phase was to focus on whether plaintiffs could prove that defendants had permitted the accused chemicals to be deposited in the area and, if so, whether those chemicals actually migrated to the wells. Following this "hydrology stage," the second stage of trial, if reached, was to focus on issues of medical causation. The third stage would then address damages.

Considerable legal maneuvering ensued with trial of the first stage lasting 78 days, involving 196 volumes of pretrial depositions, and 25,000 pages of deposition transcripts. Plaintiffs retained 15 expert witnesses and defendants retained 28. Combined, defendants spent more than $10 million on fees and other litigation expenses during this first stage. In response to special interrogatories, the jury concluded that plaintiffs had not proved that Beatrice caused or permitted the accused chemicals to be deposited in the well waters. In contrast, the jury found that plaintiffs did demonstrate that Grace had deposited the accused chemicals and that some of them had reached the wells. It now appeared that the case would proceed to the second stage of trial against Grace.

Just before the second stage was to commence, Judge Skinner granted a motion by Grace for a new trial on the first stage. Counsel for plaintiffs and Grace then entered into negotiations and announced a settlement in which Grace committed to pay $8 million dollars. This amount was divided as follows: $2.6 million repaid costs and litigation expenses; $2.2 million went for attorneys' fees; and each of the 8 families received $375,000 in 1986 and an additional $80,000 five years later. The case against Beatrice and its lawyers continued for three additional years. In the end, a verdict in favor of Beatrice remained intact as did Judge Skinner's finding that plaintiffs had uncovered no evidence that the tannery ever used the primary contaminants alleged to have caused the illnesses in Woburn.

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5. JONATHAN HARR, A CIVIL ACTION (1995).

II. Another Way?

The use of strategies based on 'joint gains' problem solving, mediation, facilitation, and consensus building offer promise for cases like the Woburn contamination problem and for many other environmental issues as well. While these approaches are not a panacea, thousands of significant disputes involving public health, public lands, and natural resources have been successfully mediated or facilitated since the early 1970s. This includes 'upstream' cases when rules and policies are being made and 'downstream' issues when parties are involved in enforcement and compliance.[6] Many more cases should be solved in this manner.

Over the last twenty-five years, considerable practical experimentation along with a rich academic, legal, and popular literature has emerged dealing with out-of-court conflict resolution. Within this larger body of efforts, considerable attention has been given to the specialized challenges of reaching consensus when environmental and natural resource issues are at stake. While the fields of alternative dispute resolution (ADR) more generally and environmental conflict resolution (ECR) more specifically are still developing, consensus-building clearly has much to offer to public health, natural resource management, agriculture, urban and regional planning, and energy development.

Like ADR, ECR is not a single procedure. In actual practice, it consists of many different applications and technical processes ranging from traditional pre-trial settlement meetings to facilitated environmental "summits" to special committees and advisory boards, some of which may be conducted under specific legal regimes like the Federal Advisory Committee Act (FACA). Nor is there one single model of mediation or facilitation that prevails among practitioners that is deemed to be appropriate in all environmental cases. Approaches range from highly evaluative to highly facilitative, and from a focus on broadly defined problems with multiple issues to single-issue matters that are more distributive and allocational in nature.[7]

However different from each other they may be in form and practice, all ECR processes share certain common characteristics. They are all attempts at strategic and specific cooperation in the face of real or suspected environmental problems; they all aspire to some form of optimization, meaning, they constitute a search for Pareto-preferential

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6. GAIL BINGHAM, RESOLVING ENVIRONMENTAL DISPUTES (1986).

7. Leonard Riskin, *Toward A More Refined Understanding of Mediation: Revisiting, Revising, and Reimagining The Grid*, *at* http://www.law.yale.edu/yls/c_pages/yls_pa/103/Riskin.pdf (last visited Apr. 15, 2002).

outcomes that can maximize mutual gains; and finally, all ECRs are problem-solving exercises that inevitably wrestle with any or all of three types of problems.[8]

"Type I" problems are best described as matters that are "Technical" or "Convergent" in nature. Examples include retrofitting an older water system for conservation, finding the fastest way to Mexico City, setting a broken leg, or eradicating a termite infestation. Such problems tend to be routine and bounded, "fixes" exist, and there is agreement on both the definition of the problem and a range of solutions. Type I problems tend not to require much consideration of values and beliefs and do not usually require high levels of participation and involvement by those who have the problem. The more that people with reasonable intelligence and good will study them, the more likely that solutions will "converge" into a narrow range.

"Type II" problems are "Value" driven or "Divergent" problems. Examples include determining how we will expand a water supply once existing sources have been tapped, deciding "why" we want to go to Mexico City and what we are going to do once we get there, determining how we will effectively educate our children, or deciding how much growth is enough. Type II problems tend to be more emotionally complex, more intellectually opaque, and less bounded than Type I problems. No one "fix" seems exactly right. Though there may be rough agreement on the problem, there is no agreement on solutions. These kinds of problems require greater consideration of opinions, beliefs, and convictions. Resources and technical expertise alone will not solve them because they require high levels of buy-in by those who have the problem. The more that people with integrity, good will, and good working relationships will study them, the more likely that solutions will "diverge" into a greater range.

"Type III" issues are often described as "Wicked" or "Intractable" problems. "Wicked" doesn't mean bad. It means they are diabolically complicated with emotion, politics, and intensity. They preoccupy us, and they take a long time to dissipate or resolve. Examples include the abortion and right-to-life debate, deciding who should have first call on the last of the cheap water that is available, resolving the Israel-Palestine and India-Pakistan conflicts, and finding the balance between resource uses like logging and irrigation in the face of threats to Spotted owls and

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8. There is a rich literature on problems and problem solving. The typology of problems presented in this paper has been synthesized from the writings of E. F. SCHUMACHER, A GUIDE FOR THE PERPLEXED, (1978); *see* RONALD HEIFITZ, LEADERSHIP WITHOUT EASY ANSWERS, (1994); *see* EDWARD DEBONO, LATERAL THINKING, (1990); Nancy Roberts, *Wicked Problems and Network Approaches to Resolution, at* http://www.willamette.org/ipmn/test2/issue1/ejchapter1.htm (Sept. 23, 2000).

Columbia River salmon.

In Type III problems, there is usually broad disagreement on what "the problem" actually is, competing solutions that create on-going discord among stakeholders, and a diffusion of power that makes any one party incapable of both defining the problem and posing solutions. Integrity, good will, and good-working relationships are missing, and people are actively trying to defeat each other. Like Type II problems, Type III problems are driven by conflicting values but, unlike Type II challenges, they often have long, nasty, and remembered histories. In these circumstances, proposed solutions are generated by parties who come and go because they have either changed their minds, failed to communicate, or changed the rules by which the problem is being addressed. In these circumstances, no one can guarantee that a proposed solution will actually achieve an intended result, and the fairness of any proposed solution becomes impossible to measure.

In the context of Type I, Type II, and Type III problems, mediators, facilitators, and conveners must grapple with the challenges of managing the substantive, procedural, and relationship barriers that usually attend consensus-seeking. Much of the early literature on mediation focused on improving the mediation process.[9] Management of "substance" was assumed to be a matter for the parties' control, and mediators were often selected precisely because of their skill with process and their ignorance in the material matters in dispute. Perhaps as a result of a quarter century of progressive experimentation, practitioners now seek better traction on substantive matters in the form of new concepts, strategies, and tools for helping parties achieve rigorous outcomes. Managing the scientific and technical aspects of would-be environmental collaborations falls directly into this category.

Finally, it is valuable to understand how scientific information unfolds and braids into environmental decision-making in our prevailing legal and political culture. In general, Americans embrace three approaches to sorting out contested environmental science, and, more recently through the ECR movement, a fourth (Table 1).[10] The "Adversary Science" approach is the bedrock of our democratic institutional framework and the means by which both judicial and

9. For representative examples of "process" and "relationship" oriented mediation models, *see* KARL SLAIKEU, WHEN PUSH COMES TO SHOVE (1996); BARBARA NAGLE LECHMAN, CONFLICT AND RESOLUTION (1997); JEFFREY G. MILLER & THOMAS R. COLOSI, FUNDAMENTALS OF NEGOTIATION: A GUIDE FOR ENVIRONMENTAL PROFESSIONALS (1989); JOHN KENNEDY & SUSAN CARPENTER, MANAGING PUBLIC CONFLICT (1988).

10. Table I, Appendix, is adapted from SCOTT T. MCCREARY, JOHN GAMMAN, & BENNET BOOKS, REFINING AND TESTING JOINT FACT-FINDING FOR ENVIRONMENTAL DISPUTE RESOLUTION: TEN YEARS OF SUCCESS, 3 (Concur, Inc., Working Paper 00-01, May 1, 2000).

scientific "truth-finding" is normally done. This approach involves competing experts who are recruited to bolster each side, opposing counsel who seek to undermine each other, judges and hearing officers who are required to pick a "winner," and various opportunities for forum shopping, escalations, and appeals.

The "Expert Decision Maker" approach utilizes blue ribbon panels, science panels, and other kinds of scientific and technical experts to guide, advise, or actually make decisions. Normally, only the experts participate, and the only information that is salient is "scientific." Local, cultural, and community standards tend to be excluded or relegated to a tertiary status.

The third approach to managing contested, contentious, or uncertain environmental science is through ad hoc, off-line, usually unofficial negotiation. Not unlike other kinds of political bargaining, attorneys, lobbyists, or other advocates meet and, with or without the involvement of public officials, hammer out specific settlements and resolutions in the shadows of formal proceedings. Harr's *A Civil Action* offers repeated examples of this kind of bargaining.[11]

In America, these three models are well perfected and time-tested approaches. Newer on the political and legal scene are collaborative ECR approaches which bring stakeholders, along with their experts and advocates, into face-to-face dialogue and the joint search for an agreement. While strategies, tactics, and steps differ from practitioner to practitioner, most joint gains processes go through at least three broad stages: (1) preliminary work and startup; (2) forum management and information exchange; and (3) problem solving, bargaining, and closure. Each of these phases is a reflection of certain core functions that usually need to be performed if consensus is to be reached (Table 2).[12] Above and beyond building a good process and forging reasonable working relationships, there is, in all of ECR processes, an emphasis on mutually framed questions to help identify expertise needs, the pooling of relevant information, and an explicit search for technical agreement. Though it is usually insufficient by itself, good science is critical to good environmental consensus-building.

III. Managing Scientific & Technical Information

"Science," says physicist Richard Feynman, "is a way of trying not to fool yourself."[13] Stripped to essentials, it is a method of inquiry based

11. JONATHAN HARR, A CIVIL ACTION (1995).
12. Table II, Appendix.
13. This quote, attributed to Richard Feynman, can be found at Bill Arnett, *Bill Arnet's Home Page*, *at* http://www.dkrz.de/mirror/arnett.html (last updated Jan. 22,

on a sole but critical premise: That the degree to which an idea appears to be true has nothing to do with whether it actually is true, and that the way to distinguish facts from conjectures is to test them by experiment and verify them by replication and peer review. In the context of adversarial or expert decision-making, contested models, opposing methods, contradictory facts, and divergent assumptions are routinely put to the test of peer examination and independent analysis. In ECR processes, no such protocols are inherent. The question arises, then: How should alternative or fiercely argued scientific and technical contentions be handled when stakeholders are simultaneously struggling to integrate good science and reach agreements? Are the same approaches used by experts and advocates useful in the new collaborative approaches?

In 1998, I was part of a working group of environmental mediators that conducted a broad inquiry aimed at better understanding the scientific and technical challenges in environmental collaborations. We were interested in capturing and making explicit the best strategies and techniques that can be used when stakeholder groups struggle to find consensual outcomes in science-intensive environmental disputes. The project, conducted and sponsored by the Western Justice Center Foundation, the United States Institute for Environmental Conflict Resolution, and Resolve, Inc., resulted in an 80-page monograph and resource document which is available to the public at different electronic locations.[14]

Thanks to funding support from these three sponsors, our group held regional focus groups with lawyers, scientists, agency representatives, and mediators. These meetings, held in Tucson, San Francisco, Los Angeles, and Washington D.C., resulted in interviews and consultations with more than 100 people, all of whom were experienced in environmental conflicts. In our interviews and focus group sessions, we were interested in four topics:

1. the epistemological assumptions mediators, facilitators, and conveners bring to the issue of science as it braids into and through environmental conflicts;
2. the scientific and technical challenges collaborators, facilitators, and experts have encountered in environmental cases;
3. the strategies that conveners, mediators, and facilitators most often employ to meet those challenges; and
4. the actual tools and techniques that they use to manage those

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1997).

14. Peter S. Adler et al., *Managing Scientific and Technical Information in Environmental Cases: Principles and Practices for Mediators and Facilitators* (2000).

situations.

Broadly speaking, we found four different case patterns: (a) conflicts where science was truly at the center of the storm and critical to problem definition and solution-searching; (b) cases where science was an important but not necessarily central issue; (c) disputes where science was a camouflage or red herring to the real issues; and (d) controversies where science was generally irrelevant to the problem and to any proposed solutions. Additionally, we found twenty-three specific science-related challenges (which we termed "Rocks on the Road"), forty practice principles that form a set of bedrock ideas about consensus-building in science-intensive environmental cases, two dozen "implicit" mediative strategies that we sought to make "explicit" in the document; nearly fifty tools and practice tips that we solicited from highly experienced mediators and facilitators; and a variety of useful books and references for people who are interested in this topic.

As we undertook our inquiry, we were struck by the great variety and complexity of science-intensive challenges stakeholders face when they try to forge agreements. The following are two of the twenty-three "Rocks on the Road" we found arrayed in the same format as can be found in the full monograph:

The Access to Data Problem

There is good scientific or technical information available but some or all of the parties have trouble accessing it. They cannot quite articulate what they need to know, how to identify it, or whom to contact.

Example: *Competing recreational users (hikers, horse riders, and bicycle riders) are engaged in a rule-making dispute over management practices in a multi-purpose wilderness area. Although the stakeholders are bright, intelligent people, they are highly positional and unaccustomed to these kinds of conflicts.*

The Irrelevant Information Problem

Scientific and technical information exists and the parties know it exists, but they choose not to examine it. They believe the information is irrelevant to reaching an agreement or there is no practical solution to the problems of conflicting interpretations.

Example: *Government agencies and environmental groups sue* *several industries over the removal of Polychlorinated Biphenyls (PCBs) from river sediments. There are major scientific and factual disagreements over the levels of PCB contamination that actually warrant action. There are also disagreements about the amount of sediment that has been deposited on the river bottom and bank. Plaintiffs and defendants agree to a settlement that results in a cleanup with no admissions of liability.*

Other challenges included managing multiple disciplines that are arriving at diametrically opposed policy conclusions, helping groups with missing or incomplete information, dealing with proprietary information in which some of the parties have critical information that could help resolve the matter but the data is confidential, and dealing with uncertainty among the experts where, despite great amounts of advocacy, research, and applied studies, major scientific and technical ambiguity remains.

As a logical follow-up to the identification of these challenges, we were especially interested in the practical strategies that can be used to address these kinds of challenges when conveners, stakeholders, mediators, and facilitators confront them. We collected many different strategies and organized them into a procedural framework that mirrors what happens in actual mediation and facilitation cases. Examples of some of these strategies can be found in Table 3.[15]

Finally, we took all twenty-three of the "Rocks on the Road" that had been identified during our preliminary meetings and interviews and asked experienced mediators from different parts of the country to offer practical advice on what they would do if they were faced with that particular challenge. Here are two examples of approaches suggested by colleagues:

The Access to Data Problem

Competing recreational users (hikers, horse riders, and bicycle riders) are engaged in a rule-making dispute over management practices in a multi-purpose wilderness area. Although the stakeholders are bright, intelligent people, they are highly positioned and unaccustomed to these kinds of conflicts.

Lucy Moore, Lucy Moore Associates, Albuquerque, New Mexico: *Here are some options I might pursue. I could find mentors*

15. Table 3, Appendix.

for my group. I would look for a comparable situation elsewhere, hopefully not far away. I would invite a couple of those participants (from the process to revise the forest management plan, or create open space for a neighboring town, or whatever) to talk to the group. Hopefully, they will have a good outcome that highlights the kind of data that is useful in helping craft a solution. I could find a professor who might come and outline for the group the kind of data they might need, and give them generic ideas about where to find it. I could hold a "Let's Look at the Landscape" session, in which I would bring in experts, scientists, policy people, tribal leaders, and others to educate the group on the ecology, law, institutional authorities, and cultures which make up the proposed wilderness landscape. I would suggest to the group that although they are of course educated, highly intelligent, committed, and motivated, there are facts about the area we will be negotiating that are important for us to understand together. We need a common language and platform from which to work. I would encourage questions to identify additional data needs, and get direction from the presenters about how to get that data. Hopefully, I would end the session with a common understanding of the landscape and a list of questions and sources for answers that will spur the group to learn more. I could arrange a group field trip to the area in question. I have found field trips to be great equalizers when there is a disparity of interests, or when there are some highly trained technical people and some uneducated community members.[16]

The Information is Irrelevant Problem

Government agencies and environmental groups sue several industries over the removal of PCBs from river sediments. There are major scientific and factual disagreements over the levels of PCB contamination that actually warrant action. There are also disagreements about the amount of sediment that has been deposited on the river bottom and bank. Plaintiffs and defendants agree to a settlement that results in a cleanup with no admission.

Bill Humm, Environmental Settlements, Lee, New Hampshire:

I am going to try an approach that succeeded in a similar case I worked on that involved the voluntary cleanup of a municipal aquifer contaminated with hazardous waste. My task was to help a dozen

16. Peter S. Adler et al., *Managing Scientific and Technical Information in Environmental Cases: Principles and Practices for Mediators and Facilitators* 35 (2000).

> *Potentially Responsible Parties (PRPs) allocate cleanup costs. The usual practice of collecting 'waste-in' data seemed unproductive in this case since records were spotty. Moreover, all parties maintained that they were minor contributors to the problem. There was nonetheless a desire to find a basis for settlement. In a brainstorming session, I helped the parties design their own variant on the old silent auction technique. This process required each PRP to convey via the mediator a confidential bid reflecting a settlement offer. I was also authorized to prepare a report on the PRPs reflecting the total value of the bids, and the amounts of the highest and lowest bids, and certifying that all PRPs had submitted bids. Although the first few rounds of bidding fell short of the amount required for cleanup, the tool nonetheless built confidence among the PRPs that an acceptable allocation was within grasp. I was able to reassure the PRPs that no one was 'low-balling' and that one PRP (perceived by the others as being the major contributor to the problem) was making a bid proportionately larger than the others. Individual PRPs increased their bid in the subsequent round of bidding, based partly on their inference of what others were doing. Meanwhile, I encouraged each of them to focus on the value of avoiding lengthy litigation rather than worrying that one of them might commit fewer dollars than another. With settlement close but still elusive, I convened the CEOs, several of whom no longer felt the need for the confidentiality of the bidding process. They openly acknowledged their bid and challenged the other[s] to increase theirs. Within hours, a settlement of the cost allocation question was achieved. Though the tool was crude, it was effective in this case, perhaps largely because the parties 'invented' it themselves.*[17]

Other examples of techniques identified in the monograph are included in Table 4.[18]

IV. Thoughts Towards a Theory of Practice [19]

Although the emerging literature on environmental conflict resolution is increasingly rich with case studies of environmental consensus-building, surprisingly little theory-building has taken place in

17. *Id.*
18. Table 4, Appendix.
19. This theory was developed by the author and Connie Ozawa, Department of Urban Planning, Portland State University in conjunction with the *Collaborative Resource in the Interior West* project sponsored by the Liz Claiborne and Art Ortenberg Foundation.

the specific area of integrating technical and scientific information into ECR. Based on the interviews and focus groups that led to *Managing Scientific and Technical Information in Environmental Cases: Principles and Practices for Mediators*[20] and on a more recent examination of ten cases of environmental consensus-building cases in Montana, Wyoming, and other states in the interior West, Connie Ozawa and I offer the following five propositions as a starting point for additional observation and research.

A. Hypothesis 1: Environmental collaborations are more likely to succeed if the political issues of concern are discussed prior to the examination of technical issues.

Like other aspects of a conflict, the scientific and technical aspects of environmental disputes are embedded in a political context. Inevitably, value choices are at play. These underlying values are the ultimate arbiters of political decision-making, even when a plethora of scientific information is available. Substituting scientific and technical information does not void the making of value choices. Rather, it more fully informs the value choices that need to be made by creating data-driven points of reference.

Environmental disputes are also rarely caused by scientific or technical information *per se.* More often, they tend to be about: (a) perceived or actual competition over interests; (b) different criteria for evaluating ideas or behaviors; (c) differing goals, values, and way of life; (d) misinformation, lack of information, and differing ways of interpreting or assessing data; and/or (e) unequal control, power, and authority to distribute or enjoy resources.

Finally, not every environmental case is actually science-intensive, nor is scientific and technical controversy the primary story in many seemingly science-laden cases. Parties often use scientific and technological issues as a strategic or tactical weapon. Even when parties do not use science as a camouflage for other issues, they typically bring information to the table that bolsters their position or that defeats that of their opponents. Consensus-based environmental decision-making requires a search for jointly usable information, which, in turn, requires a collaborative inquiry.

20. Adler, *supra* pp. 33-64.

B. Hypothesis 2: *Environmental collaborations are more likely to succeed when the scientific and technical aspects of a decision are explicitly examined by all the parties involved.*

Conflicts over information, data, ideas, and knowledge are an inevitable and integral part of most environmental decisions. This holds true whether the decisions are in the policy formation or rule-making stage or in compliance and enforcement proceedings. Jointly usable information, therefore, requires trust in information and the methods by which it is produced. Trust tends to diminish when parties perceive that the science has been generated from a particular point of view, unilaterally funded by an opponents, or generated with a particular outcome in mind. Conversely, trust often can be built if the questions asked and the methods employed in information gathering are jointly developed.

C. Hypothesis 3: *Environmental collaborations are more likely to succeed when the limitations of scientific knowledge and the uncertainties and incompleteness of information and knowledge are implicitly or explicitly acknowledged.*

By itself, scientific and technical knowledge is rarely the single resource that will inform and lead to consensual environmental decisions. In most cases, parties bring to the table different kinds of knowledge that may be equally considered or ranked according to perceived importance: traditional knowledge, social and cultural knowledge, legal knowledge, economic knowledge, remembered knowledge, and the place-based wisdom of communities. These represent rich sources of data and information that will usually defeat or significantly delay "scientific" or "technical" solutions if they are not included for consideration. However, all knowledge (including traditional, cultural, local, and remembered-in-nature) is subject to questions about validity, accuracy, authenticity, and reliability. Every type of knowledge has standards of quality that can be examined, debated, or shaped.

Useful scientific and technical knowledge also rarely remains static in the subject matters that come into play in environmental conflict. Knowledge builds off new questions and new information. However sizable our information and knowledge base is, our understanding of environmental, social, and economic realities remains incomplete. We will never know everything we need to know to make perfect decisions, particularly when the decisions concern predictions of future impacts.

In collaborative processes, risks and uncertainties need to be clarified and explicitly acknowledged both in lay terms and in scientific or technical terms. In general, there are three kinds of uncertainties that tend to arise in environmental cases: (a) uncertainties in which the measurements or observations are insufficient to bound explanation and interpretation; (b) uncertainties that arise because the measurements conflict; and (c) uncertainties over competing or fragmentary theoretical frameworks. All three types may need to be confronted in stakeholder processes.

D. Hypothesis Principle 4: Environmental collaborations are more likely to succeed when participants work together on scientific and technical modeling.

Environmental decision-making processes often require some form of modeling in order to define problems, review impacts, and illustrate choices. The promise of models may seduce policy-makers and disputants into believing that models are infallible. However, all models are inherently uncertain. It is misleading to believe that a number generated by a model is a singular value that predicts a future state with absolute certainty. Participants must understand (and scientists must be assisted to honestly portray) that there is a range of quantities that surround any numerical output from a model. This variance reflects, among other things, the assumptions of the modelers and the complexity of the natural system. A joint recognition of the limitations of the models will enhance its credibility and acceptability among all participants.

Models are also rarely fully predictive; they are best thought of as illustrative. Models serve best when participants understand that models usually can only describe ranges of options and are merely tools, albeit sophisticated tools, to aid in making informed choices. Scientists working for opposing parties may bring different models to the table based on differing assumptions about inputs, interactions between variables, and outputs. The models then are staged to be in opposition to one another, when in reality they simply miss or talk past each other because they are, at their core, incomparable.

This also occurs when scientists of different disciplines model the same natural system from different perspectives. For example, an earth scientist analyzes global climate change through the lens of geologic time. Atmospheric scientists take many detailed measurements of the present-day climate and believe that such measurements are the key to predicting climatic change. Both approaches are valid. However, the results of the two models may yield different conclusions and advocates of each approach may disagree with each other.

E. Hypothesis 5: *Environmental collaborations are more likely to succeed if participants, experts, advocates, policy-makers, and third parties are able to confront and overcome the inherent "role" impediments they each bring to the consensus-building challenge and understand the validity of other perspectives.*

Public agencies, community groups, and private businesses tend to approach the scientific aspects of their disputes differently. Private businesses usually feel compelled to put out information defensively, offering only that which they believe is required by law, and no more. Community groups and environmental advocacy organizations, which usually have fewer resources to work with, often feel compelled to use their information offensively and in terms that may appear strident and accusing. Government agencies charged with making decisions (particularly those involved in enforcement and compliance) are usually required by law to meet standard burdens of scientific proof.

Similarly, classically trained theoretical scientists are less likely to offer solutions or make practical conclusions than applied scientists are. Conversely, they are more likely to identify further questions that could be explored and answered which may be useful for agreements built on adaptive management practices. Applied scientists are more likely to offer a range of solutions, and professions such as medicine, engineering, and the design professions are more likely to offer specific fixes.

Scientists often believe their work to be value-free and their methods to be observable and replicable truths. However, all science is based on assumptions. These assumptions are affected by culture, perspective, prior experience and other influences. It is especially important in science-intensive disputes for mediators, facilitators, and conveners to help scientists with their roles and possible role conflicts just as they might do with lawyers, accountants, or engineers in other kinds of cases.

Finally, professional mediators, facilitators, and consensus-builders have their own vocabulary and their own modes of thinking and problem solving. Many "third parties" tend to think in terms of agreements, decisions, and solutions, all of which somehow imply failure when there is no tangible result to a process. Managing and sometimes limiting the inherent third-party bias for action is important. In many environmental conflicts, the right action may very well be no action.

V. CODA

Connie Ozawa and I were recently asked by a group of water and air quality scientists to talk about the burden of proof in environmental collaborations. "How much science," they wanted to know, "is really enough?" They were hungry for an answer that could be grounded in statistical validity, positive correlations, and standard deviations. Our answer, of course, was this: What is appropriate, relevant, and useful in the many environmental cases our society is confronting can never be fully prescribed by the rules of science just as laws and statutes cannot prescribe answers to every factual situation covered by that law. In collaborative processes, "how much science is enough" must be negotiated.

One test of ECR, therefore, is whether the best of what science offers can be successfully enjoined with the best of what the politics and policies of a given environmental conflict offer. Kai Lee calls this approach "civic science" and defines it as "irreducibly public in the way responsibilities are exercised, intrinsically technical, and open to learning from errors and profiting from success."[21] The outcomes of good civic science, he says, should be environmental decisions that are at least as good, if not better, than what would happen otherwise in terms of their conceptual soundness, equity, technical efficiency, and practicability. All of these bring us closer to the illusive "triple bottom line."

21. KAI N. LEE, COMPASS AND GYROSCOPE 161 (1993).

Table 1
FOUR MODELS OF ENVIRONMENTAL DECISION-MAKING

	ADVERSARIAL DECISION-MAKING	EXPERT DECISION-MAKING	OFF-LINE, AD HOC, & IMPROMPTU DECISION-MAKING	COLLABORATIVE DECISION-MAKING
Auspices	Courts, legislatures, and administrative bodies.	Scientific organizations, expert panels, blue ribbon committees.	None	Neutral, credible organizations with strong access to stakeholders.
Convener	Judges, hearing officers, legislative committees, and other deliberative bodies.	Senior scientists or a science organization.	None	Career or appointed public official, usually teamed with a non-partisan facilitator
Participants	Experts aligned with each side and guided by attorneys and lobbyists.	Scientific Experts	Unpredictable. Usually, public officials and lobbyists.	Experts <u>not</u> necessarily aligned with parties, decision-makers, stakeholders
Methods of Introducing Information	Bills, resolutions, budget proposals, depositions, interrogatories, testimony.	Written research reports, discussions, debate.	Private submissions, reports, fact sheets.	Various oral briefings, memos, reports, facilitated dialogue.

Extent of Information Sharing	Information is strategically withheld or provided.	Information is shared. Usually, strong emphasis on peer-reviewed findings or academic research	Unpredictable.	Information is pooled. May be mix of peer reviewed and "gray literature" studies.
Technical Level of Discussions	Technical, though often geared to terms contained in legislation or regulation	Comparable to a scientific conference.	Unpredictable.	Strong effort made to "translate" technical information and make it policy-relevant.

Table 2

CORE MOVES

(Startup Moves. . .)

i. Appraising the conflict for possibilities.

ii. Organizing leadership, sponsorship, and the capacity to convene.

iii. Gaining the participation of all affected stakeholders.

iv. Designing a forum.

(Management Moves. . .)

v. Establishing protocol and forging working agreements on the issues to be resolved.

vi. Organizing productive and respectful exchanges of relevant information.

vii. Pushing the parties to discern the underlying interests of all stakeholders.

viii. Helping the parties discover, clarify, or create the greatest joint gains possible.

(Closure Moves. . .)

ix. Assisting the parties in making informed choices.

x. Helping ratify, memorialize, and prepare for implementation.

Table 3
STRATEGIES
(Some Examples of AStartup@ Strategies)
1. Do a formal conflict assessment and incorporate scientific and technical issues into your preliminary scoping. Collect information about the technical and scientific aspects of the dispute (along with all other aspects of the conflict) through observation, secondary sources, or interviews with the parties. Raise questions that identify potential information needs, the kinds of data that stakeholders are relying on, and the potential data conflicts that are likely to emerge.
2. Draw a picture or map of the key players, groups, and interests that, if left out of the process, might be affected, might contribute to a solution, or could potentially sabotage a whole process. Identify their technical and scientific sophistication early. Do not presume this has been done by the sponsoring organization.
3. Question parties' assumptions that science-related issues (lack of data, not understanding the data, misinformation, or different interpretations of data) are actually the core of the questions at hand. Often parties will say publicly that science-related issues are at the core of the problem, but then allow privately that they are not central to the problem. A solely scientific focus in environmental conflicts may miss or distort the issues and the process that follows such definition.
(Some Examples of "Management" Strategies)
4. Generate multiple descriptions of the technical and scientific problems as opposed to a more inflexible single-problem definition. Grappling with descriptions often will stimulate an understanding of how problems are linked with each other in the minds of both scientists and stakeholders.
5. Don't focus on data and data analysis too early. It is usually more important to understand the legal, political, social, economic, and scientific context to generate a clear set of questions and to position the search for high quality information as a vehicle for informing these other kinds of judgments.
6. Discuss the parties' various perceptions and definitions of 'risk' and 'precaution.' Find out how their ideas apply to the case. Definitions will vary among stakeholders. Discuss the nuances so that the many meanings of both terms are understood.
7. Use data as a discussion point rather than assuming it will inherently lead to an answer.
(Some Examples of "Closure" Strategies)
8. Help parties understand that when they have sufficient agreement on technical issues, they should go ahead and negotiate solutions. Often,

scientists want to keep fighting until they get complete agreement on precise numbers. However, the accuracy that is necessary to develop a solution may not be as extreme as scientists would prefer. For instance, it may not be necessary for all parties to agree on the exact level of pollution in order to recommend a remediation strategy which handles both the high and low estimates of the various parties and achieves regulatory criteria.

9. Promote dynamic, flexible, and adaptive agreements that balance reasonable stability (which is usually needed for business reliability) with flexibility and performance-based adaptability (which are needed for higher levels of environmental assurance).

A contingent agreement for additional rounds of negotiation based on further research and testing.

The capping of future liabilities by private parties through the purchase of an insurance policy or bond to cover unknown exigencies. For example, an insurance policy could be made to cover a capped high and low of the disputed potential cleanup costs for an underground cleanup.

An agreement that will be revisited within a certain period of time.

10. Help the scientists maintain face at the conclusion of an agreement that still poses great uncertainty.

Table 4

EXAMPLES OF TOOLS & TECHNIQUES

Get scientists to try on different "lenses" and look at issues and data sets from different angles of observation.

Monetize and graphically display the ecological and monetary costs of different options.

Bring in participants who have solved similar problems elsewhere.

Ask the 'do no harm' question: "Are there any decisions you might make now, with the information you have now, that might eclipse other critical decisions later or prevent something beneficial from happening in the future?"

Create a separate 'fish bowl' dialogue among the scientific and technical advisers to discuss and analyze the data in front of the parties.

Collect questions for an outside group of experts to consider and then organize a special technical team or review panel to generate ideas.

Develop a game or simulation focusing on multiple perceptions of the problem.

Shift meeting sites so participants understand the place where others come from—for example, meet at their offices, laboratories, factories, or community halls.

Peer Review: Hire an expert who is trusted by everyone to review the data for the group.

Stage a well-bounded public debate and bring in the leading expert in the country on an issue to discuss the issue in public with the other scientists.