A Framework for Analyzing Dialogues over the Acceptability of Controversial Technologies

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This article asks under what circumstances controversial technologies would be considered seriously for remediation instead of being rejected out of hand. To address this question, the authors developed a conceptual framework called public acceptability of controversial technologies (PACT). PACT considers site-specific, decision-oriented dialogues among the individuals and groups involved in selecting or recommending hazardous waste remediation technologies. It distinguishes technology acceptability, that is, a willingness to consider seriously, from technology acceptance, the decision to deploy. The framework integrates four dimensions: (1) an acceptability continuum that underlies decision-oriented dialogues among individuals and constituency groups, (2) the attributes of these individuals and groups, (3) the attributes of the technology at issue, and (4) the community context—social, institutional, and physical. This article describes and explores PACT as a tool for understanding and better predicting the acceptability of controversial technologies.

Imagine this scene. The party responsible for a hazardous waste site in a community is being prodded by regulatory pressure and local concerns to remediate that site. Although there are some traditional technological options

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available for remediation, none is ideal because of technological limitations, high financial costs, or associated ecological disruption. One of the parties to the decision process suggests using a relatively novel and potentially controversial remediation technology—genetically engineered microorganisms (GEMs). Under what circumstances would the parties engaged in decision making[1] seriously consider GEMs as a remediation option? Likewise, under what circumstances would the application of GEMs be viewed as so outlandish, so controversial, as to render it a nonoption? These two questions are at the heart of this article, which proposes a conceptual framework, public acceptability of controversial technologies (PACT), for addressing the social acceptability of controversial technologies.

Communities have decades of experience in grappling with tough technological choices. These choices include siting nuclear or chemical facilities, determining how best to dispose of municipal and hazardous wastes, and determining how—and to what level—to remediate contaminated sites. Despite this experience and despite decades of research, it remains nearly impossible to predict reliably or to explain consistently the variations among communities during such decision-making processes. Some situations are fraught with tension and contention, while others receive scant public attention. Technologies considered seriously and with deliberation in some communities are barred from consideration in others.

Simplistic explanations for rejection, such as "NIMBY-ism" (not in my backyard) or "it's all political," are more dismissive than enlightening. For example, to attribute outrage responses to NIMBY-ism fails to explain why a technology was rejected out of hand in one location but discussed and perhaps even deployed in another. Similarly, explanations focusing on the uniqueness of sites fail to distinguish factors that truly are particular to certain sites from those that may be generalized across sites.

More fruitful explanations explore individuals' perceptions of technological risks, noting how—and positing why—perceptions vary among classes of individuals (e.g., experts vs. laypersons).[2] Others employ risk communication,[3] the degree to which science informs decision making,[4] or the role of power and authority in decision making.[5] Some researchers have looked to environmental values and mental models to explain preferences and to recommend improvements to the decision-making process.[6] Others have focused on negotiation and conflict resolution, investigating the dynamics of interactions and the factors that improve or hinder resolution.[7] A growing body of research focuses on the elements of effective public participation,[8] while other, process-oriented research seeks explanations in the decision-making process itself.[9]

In short, a tremendous amount of work deals with barriers to technology deployment. But none of this work is fully satisfactory for predicting whether controversial technologies truly can be placed on the table for discussion because none provides an overarching framework.[10] Thus, the recommendations that flow from this work (early and frequent public participation, adaptive learning decision modes, etc.) have not proved to be useful predictors of acceptability. Existing literature, for example, fails to explain or predict the circumstances under which early public participation would quash or promote consideration of controversial technologies (e.g., incineration).

PACT is our attempt to provide an encompassing explanatory framework within which to understand and better predict the social acceptability of controversial technologies. We present PACT in the context of the public influence over scientific and technological matters such as remediation. More accurately, we reframe such matters as social issues—social decisions that have technological and scientific dimensions. The decision-oriented dialogues on which PACT focuses are real-world manifestations of these issues. At one level, viewing the participants in the dialogue raises questions about such matters as (1) legitimacy—of the participants, the groups they may represent, and of the forum for involvement; (2) representation—the degree to which participants represent the public, particular constituency groups, or segments of the population; (3) exclusion—who is intentionally or unintentionally excluded from participation and which parties remove themselves from the process; and (4) power and authority—among individual participants and formalized advisory groups. At another level, the dialogues and their outcomes serve as experiments in technology-oriented decision making, raising questions about normative issues such as (1) the appropriate role for nontechnical constituents in decision making; (2) optimal forms of participation; (3) the degree to which different parties, values, and interests should shape or determine decision outcomes; and (4) the role and influence of different levels and forms of knowledge.

By building on and synthesizing a great deal of existing work, PACT provides a lens through which to see the world of decision making about controversial technologies. This lens is unique in that it allows the viewer to choose a panoramic or a telescopic viewpoint. As a panoramic view, PACT identifies the structural underpinnings of the landscape as well as the dynamics that create and maintain it. We refer to these underpinnings as *dimensions*. For GEMs, the dimensions consist of the technologies at issue, the context in which they would be applied (e.g., the nature and extent of contamination, the affected community), individuals and constituency groups involved in the decision-making process, and the decision-oriented dialogues themselves. Dimensions are the essential elements that influence and determine the shape

of the acceptability landscape, much as geology, hydrology, and ecology shape the natural landscape. However, as in many landscapes, there may be particularly prominent or significant features—the telescopic portion of PACT's lens allows one to focus on those features. When comparing landscapes, different features may be prominent (water—a lake or river; vegetation—or the lack thereof; a mountain or valley; etc.). Likewise, the prominent features of the landscapes that constitute localized decision-making arenas may vary across sites (e.g., the urgency of the human health or ecological threats of contamination, trust or distrust among parties, the predictability of the technology in question). PACT helps identify and interpret those features.

PACT distinguishes the concept of public acceptability[11] from both technical feasibility and technology deployment. In a decision-making context, acceptability gauges whether the technology or technological method at issue conforms with societal values and norms sufficiently well to be placed on the table as a viable alternative to other technologies. Technical feasibility gauges whether the technology performs as promised in a reliable and predictable manner. A technology or method can be technically feasible yet fail the test of social acceptability. Technology deployment is the process by which a technology actually is put in place and used. Neither technical feasibility nor social acceptability guarantees that a technology will be deployed.

We believe that the PACT framework fills a gap among the literatures that describe stakeholder involvement, stakeholder-related risk communication, and approaches to stakeholder-related negotiation. It focuses on the behavioral arena in which interested parties enter into dialogues and reach conclusions over acceptability. By studying these processes of interaction, observers and participants can gain a better understanding of community decisions over acceptability. The approach, in principle, can be applied at different levels of abstraction and to different types of dialogue. Applied in its most abstract form, the framework imposes the fewest boundaries on the analysis and permits the broadest range of exploration and discovery, while imposing the greatest cognitive and analytical burden on the researcher. Imposed in a more constrained form, the framework guides analysis along specific lines.

The PACT Framework

Overview

In developing PACT, we sought to meet two criteria. First, we wanted PACT to enhance understanding of the complicated and sometimes lengthy process that determines the acceptability of controversial technologies—in

our case, remediation technologies. We unbundled the concept of acceptability from that of deployment because our concern is less with supporting specific technologies than with understanding attributes that affect acceptability. Such information can, in turn, influence the attributes of technologies chosen for development. Second and more pragmatically, we wanted a methodological template that will be used to promote productive dialogues aimed at resolving the issues surrounding the use of innovative or controversial remediation tools for site-specific hazardous waste cleanup. In this sense, our approach supports deliberate decision making about controversial technologies, in contrast with reactive decision making or decision making by default. Whereas our work is general and of potential use to any participant in the community dialogues, it is of special interest to our sponsor, the U.S. Department of Energy (DOE), which bears the dual burden of developing innovative cleanup technologies and organizing specific aspects of the community decision process that will determine the acceptability of possibly controversial technologies.

PACT provides a vehicle for addressing numerous relevant issues, such as the relative riskiness of a technology, the technology's financial costs, or the technology's human health and ecological consequences. However, because we are focused on community decision processes, we organize our inquiry about the dialogue process to learn how these issues are discussed instead of focusing solely on the technical details associated with the issues (e.g., the risk or cost estimates themselves). Similarly, because our focus is situation specific and decision oriented, we have geared PACT toward people's positions pertaining to a technology rather than toward generalized public opinion.[12] We are more interested in predicting how individuals or constituency groups will maintain or shift their positions with regard to acceptability during the course of the dialogue process than in predicting their starting or ending degrees of acceptability.

We use the PACT framework to focus on site-specific, decision-oriented dialogues about selecting technologies for hazardous waste remediation. The combination of site-specific conditions and a decision orientation creates circumstances in which the proverbial rubber meets the road. Abstract or contextless sentiments and opinions (e.g., hazardous wastes should be remediated; using GEMs is unacceptable) become palpable (e.g., to what degree should these wastes at this site be remediated? what remediation technology is best for this site?). It is in these decision settings that conceptions of the ideal must be translated or transformed in some way to manifest themselves in reality.

We consider dialogues to include formal and informal, face-to-face or remote, simultaneous or sequential interactions among individuals and

constituency groups (constituents) that pertain to considerations about using particular hazardous waste remediation technologies.[13] Our population of interest is the constituents actively engaged in a decision-making process. We refer to formalized, multiparty bodies such as site-specific advisory boards as "public groups" because involved constituents, views collectively are taken to be the public positions on technologies. The public group itself becomes a group with its own identity and with its own characteristic intragroup and intergroup dynamics. For purposes of exposition, we limit our consideration of constituents to public groups, recognizing that there are many ways in which constituents may be involved in (or excluded from) technology decision making.

Individuals and constituency groups may come to the table in the public group with a particular set of interests, concerns, or positions. However, these parties tend not to act unilaterally or in isolation from the other participants in the decision-making process (otherwise, they may have little or no influence on decision making). They act and react in response to others engaged in the decision-oriented dialogue. Participants' positions may evolve over time through the dialogue with other parties, whether those parties are internal or external,[14] to the public group. For example, individuals representing constituency groups may have to proceed gingerly, simultaneously representing, promoting, and defending their groups' interests as well as participating effectively in the public group; these individuals cannot change their position unilaterally. Individuals who represent themselves have more flexibility but may need to maintain some consistency if they wish to be taken seriously.

We have sketched briefly the nature of decision-oriented dialogues. However, at least one other aspect of the dialogue process is critical to consider: what influence might the public group or its member constituents have on acceptability decisions? One perspective links their influence to their role in determining decision outcomes; the greater a public group's standing or power to affect or determine decision outcomes, the greater the public group's influence on acceptability. Another perspective sees public groups and other parties influencing acceptability asymmetrically. From this perspective, while participants have little effectiveness in promoting the consideration of innovative or controversial technologies, they have considerable ability either to block or not to put any roadblocks in the way of serious discussion of the technology.

Acceptability

PACT posits that it is through the dialogue process that acceptability and, ultimately, acceptance of technologies such as GEMs are determined. As

previously stated, *acceptability* refers to the willingness to consider the technology in question as a viable alternative. Conceptually, we treat acceptability as a continuum rather than a dichotomy; the degree of acceptability also may change over time. We have chosen to use "willingness to negotiate" as evidence of and a measurable proxy for acceptability.

Willingness to negotiate about a technology may be conditioned by concerns about the technology itself or by a range of other concerns, such as the nature of public participation in decision making. Individuals or groups can place any number of conditions on technology acceptability. The following four conditions illustrate a gradation of responses, ranging from impervious barriers to full acceptability, using GEMs to help clarify points:

1. Absolute, nonnegotiable conditions that cannot be met (e.g., requiring absolute assurance that no GEMs will persist or evolve in nature before considering GEMs at all). These conditions constitute "show stoppers."
2. Absolute conditions that in principle can be met (e.g., consider GEMs only if certain matters associated with terms of deployment, such as where, when, and what GEMs, with what prior testing, monitoring, and safeguard measures). These conditions may constitute show stoppers depending on the feasibility and cost, broadly defined, of achieving them. Furthermore, these conditions may not fully be under the control of the technology proposer.
3. Conditions that tilt the discussion toward or away from considering one remediation technology as compared with alternatives, including a no-action option. For example, a predisposition against GEMs might be overcome if the alternative would take significantly longer to accomplish, be more costly, or involve greater worker or neighborhood health or environmental risks. This condition is the first one in which the sponsor of the technology could negotiate with participants to develop jointly an optimal path for considering the innovative or controversial technology seriously.
4. Conditions that define the full acceptability boundary. Here, each of the involved parties believes that, in principle, more of one attribute can compensate for less of another attribute. Each party holds this belief even though different participants place different values on the package of attributes relevant to each alternative.

The Decision-Rule Continuum

The logic of PACT, depicted graphically in Figure 1, is developed around a decision-rule continuum that underlies the dynamics of GEMs-related dialogs. The continuum is bounded by two end points. At one extreme, participants apply a binary decision rule[15] (yes or no; consider or refuse to consider), and at the other extreme, they apply a decision rule that treats everything as negotiable. Intermediate points along the continuum constitute conditioned

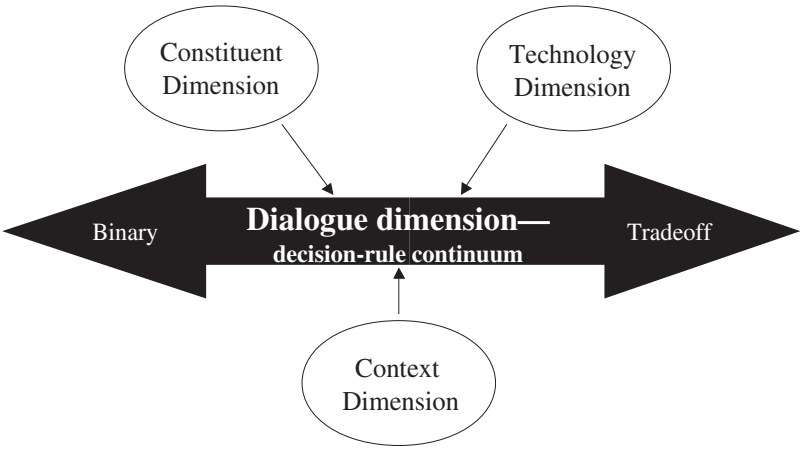

Figure 1: Public Acceptability of Controversial Technologies (PACT) framework interprets dialogues through shifts in participants' positions along a decision-rule continuum.

decision rules in which participants impose conditions that may not preclude serious consideration but that add burdens in excess of those placed on other technologies that are fully acceptable. The pattern of any individual's or group's decision rules may change during the course of dialogue in response to the communications and stances among involved parties. During the next phase of research, we plan to track patterns of movement along the decision-rule continuum as the dialogue over technology acceptability proceeds.

Participants may apply different decision rules along this continuum to the suite of issues about which they are concerned. For example, meaningful involvement in a decision process may be nonnegotiable, but the level to which contaminated soil is remediated may be negotiable. Decision rules may apply to such issues as remediation strategy selection, decision-making processes (e.g., the role of public involvement), public and environmental health, technology deployment, or the financial costs.

It is useful to think of the dialogue process that PACT focuses on as divided into three parts. The first part is the set of initial conditions. Participants may come to the dialogue process with established positions that reflect strong or fuzzy opinions, extreme views, or neutrality.

The next part of the dialogue process is the dialogue itself. During the course of continuing dialogue, participants may solidify their initial positions,

or they may change their positions through formal and informal interactions with other participants. For example, constituents may enter the dialogue process to seek information about a particular technology, information that may extend well beyond technologies, their attributes, and attendant risks. Once receiving that information, constituents may or may not find the technology acceptable (i.e., worth considering as a serious alternative). In this sense, the dialogue process is educational. We do not assume, however, that these kinds of educational efforts lead in any particular direction with regard to acceptability. Educational campaigns may be more valuable in their long-term influence on the views that people bring to decision-making dialogues than in their ability to alter peoples' positions on issues in the short-term for specific decisions.[16]

We developed PACT with the recognition that issues falling outside the realm of technology and its attributes can influence changes in participants' positions. For instance, participants may be propelled toward a negative binary stance because they interpret the positions or responses of another party as being inappropriate or offensive. This movement may occur when the offending party's position falls outside of the other's comfort zone or because of different perceptions of participants' standing (power and authority) in the decision-making structure. Thus, the offending party may have caused this movement along the decision-rule continuum completely inadvertently. Take, for example, an organization such as the League of Women Voters, whose predominant interest may be process oriented—providing mechanisms to ensure that different perspectives and relevant information are aired. An attempt by a participant to force the league to state a position on acceptability might, in fact, move the league away from acceptability. As other examples, some parties may always express binary positions of support or opposition, or their primary interest may be in finding a platform from which to state their positions (Hoban 1995; Moore 1993).[17] Attempts to disabuse such participants of their position will virtually always prove futile (Painter 1988).[18] This situation may be exacerbated when the parties taking binary stances are more powerful than other participants.

The third stage in the dialogue process is making the actual decision about technology deployment (as distinct from the deployment itself), which is a process that may take many different forms. Examples include a local referendum, a formal negotiation, an administrative procedure, market processes, and court cases. While we do not focus on this stage, it is important to note that different decision processes may rely on very different criteria for making determinations about deployment. Thus, for example, outsiders may not vote in local elections regardless of their roles during the dialogue process.

Participants also enter the dialogue process with differing amounts of power and authority, ranging from very little to the ability to extract concessions to the ability to veto the deployment decision. For example, the views and desires of an established group composed of individuals who are both financially strong and well connected in a community may have considerably more sway than many other groups.

On the other hand, some public groups of long standing, such as advisory boards, may be viewed by some as being co-opted by the sponsoring organization. If these groups grow to identify with and support the goals of the sponsor or its program—or if the public groups are seen in that way—the nature of the decision process can be affected. In particular, the degree to which public groups are perceived as extensions of the sponsor or program can affect the degree to which the public group and its views are accepted by the larger community.

PACT Dimensions

We constructed PACT around three sets of attributes that influence participants' initial positions and movements from these positions along the decision-rule continuum.[19] We refer to these sets of attributes as *dimensions* and label them *constituent dimension*, *technology dimension*, and *context dimension*. Each dimension is described briefly below, followed by a discussion of some of the issues associated with each dimension.

Constituent dimension is divided into values, motivations, and strategies. Each participating individual or constituency group[20] may have different patterns or "footprints" that represent combinations of values, motivations, and strategies. The shape and size of these footprints may change over time, perhaps as affected by differential power and authority among participants. Constituents also vary with regard to what they stand to gain or lose from remediation decisions and with regard to their power and authority.

Technology dimension refers to attributes of the technology or technologies under consideration that affect their acceptability. Attributes include technical parameters, potential harm to human health and the environment, and the predictability with which the parameters and/or harm will occur. Because of our decision orientation, we treat these attributes as comparative rather than discrete; for example, instead of constructing a decision as acceptance or rejection of a technology like GEMs, the decision is more likely to be framed as a choice among multiple technology options. Therefore, the technology

dimension of PACT entails the attributes of the technology of particular interest in relation to other technology options.

Context dimension describes the settings in which the technology may be used and the technology choice may be made. Categories of attributes that constitute the context dimension include the physical context, including the initial state of the site and the contamination profile, the social context, and the institutional context. We do not intend PACT to be applied in assessing these attributes. Rather, PACT provides a framework for identifying the kinds of context issues raised by those engaged in technology decision making, which issues are most salient with regard to acceptability, and how communication about such issues influences the degree to which different participants take binary versus trade-off stances.

How PACT Dimensions May Influence Social Acceptability

At one level, we developed PACT to take a panoramic view of the social acceptability of controversial technologies that identifies the essential components—the structure—of that landscape. As we shifted our view from the panoramic to the telescopic, we generated many ideas about how PACT's dimensions would function internally and in combination with other dimensions to influence technology acceptability (i.e., willingness to negotiate). Then, based on literature and our collective experience, we pared down the list to those elements we think may be the most important influences on social acceptability (illustrative examples are described in the text). At this stage of framework development, we deliberately posited simple relationships (1) between pairs of elements rather than multiple elements or elements moderated by intervening variables and (2) that focus on discrete constituents (perhaps involving interactions among them) rather than on the composite picture presented by the diversity of constituents involved in decision making.

In considering these elements, we are less concerned with uncovering the strongest influence than with the potential for achieving a richer, more robust understanding of technology acceptability. In one sense, viewing the dialogue process through the lens of one of these elements gives one entrée into the system, a starting place from which to explore the whole. Multiple elements, taken together, allow varying and overlapping viewing fields. It is this suite of perspectives that allows a more complete understanding of the technology acceptability system.

Decision-Rule Continuum, Dialogue/Group Interaction Elements: Comfort Zones and Dialogue Dimensions

Comfort zones are the boundaries surrounding a participant's initial position, within which the individual or group willingly will move. Two aspects of comfort zones are the following:

- Overlapping frames of reference: Some overlap is required to provide people with the ability to communicate effectively with one another (Maser 1996; Theobald 1997). Completely divergent perspectives do not allow people to anchor others' thoughts to their reality. Hence, before attempting to reconcile differences, parties to a negotiation typically seek to determine common points of reference.
- Autokinetic effects: In the dynamics of dialogues, the degree to which statements, perspectives, or decisions differ from one's own view helps determine whether individuals are more likely to move toward that other view or to retreat and adhere more strongly to their own view or core position.[21]

The manner in which parties engage in dialogue also affects their movement along the decision-rule continuum. This dialogue dynamic refers more to how parties do and did interact than with the substance of any particular stance. For instance, past betrayal by one party could be a major barrier to later alliance formation or adherence to that party's position.

These concepts underscore the potential movement by participants along the decision-rule continuum during the course of decision making. Simply stated, parties act and react in response to one another. We suggest that the greater the comfort zone overlap, the greater the willingness to negotiate. However, it is the possibility of movement along the decision-rule continuum derived from repelling forces that is particularly powerful, whether those forces derive from comfort zone or other dialogue dynamics. These interactions help to explain some of the breakdown in communications that occurs during decision making as well as some seemingly irrational participant intransigence.[22] For example, a group that has little interest in resolving a site-specific situation may resist virtually any compromise. These interactions also may help to explain some parties' bafflement and perhaps anger when their well-intentioned statements or offers backfire.

Constituent Dimension Elements: Values

Values, and environmental values, have been categorized in numerous ways in existing literature.[23] For our purposes, a core versus trade-off value distinction is the most salient. In many ways, core and trade-off values

represent opposite ends of a continuum. Core values are deeply held and relatively slow to change. While they may not dictate behavioral choices absolutely (e.g., individuals whose core values include the sanctity of human life may, under some circumstances, take a human life), even considering choices that threaten those values causes great discomfort. Constituents may be willing to negotiate on many other items to protect core values. Choices involving trade-off values (those values that individuals or groups are willing to give up, but only in exchange for something else desired more) cause less or no discomfort. Both core and trade-off values can pertain to items, such as human life or the environment, as well as processes, such as participation in decision making or maintaining one's power or bargaining position.

For environmental remediation generally, participants may be faced with what Russell (1990) in another context termed "cruel choices."[24] Each alternative may impinge in some way on core values; it is uncomfortable to make any choice. As an example, Bilyard et al. (1996) have noted that in the view of the Native Americans they queried, GEMs may be the least acceptable of bioremediation technologies. The reason for this judgment is the core belief that the earth is sacred and the first drop of contamination is the worst.[25] From this perspective, adding GEMs to the environment desecrates the earth. However, when the earth already is desecrated by hazardous chemicals, we wonder if there are circumstances under which a technology such as GEMs, while repugnant to Native American core values, would be considered seriously as a remediation technology.

Based on this reasoning, we focus on two aspects of values that may influence acceptability greatly. First, to protect core values, parties may be willing to negotiate on many other issues (trade-off values). Second, while participants will not willingly negotiate their core values, they may accept trade-offs among core values if faced with a strong forcing condition.[26] These two notions demonstrate that willingness to negotiate may represent tendencies rather than absolute conditions. In addition, willingness to negotiate may apply to particular aspects of decision making, not to remediation decision making as a whole. Some core values may never be challenged during the course of decision making. However, in those situations where every alternative threatens at least one core value, we most want to investigate empirically patterns of movement along the decision-rule continuum—toward or away from binary stances—during the decision-making process.

Technology Dimension Elements: Predictability/Uncertainty

Familiarity long has been associated with perceptions of risk; familiar hazards (e.g., driving cars) often are perceived as less risky than unfamiliar

risks (e.g., living near nuclear power plants).[27] We see familiarity in terms of the predictability of the technology and its application.[28] This predictability is influenced by numerous factors, including the following:

- comparable scale of use (bench vs. field tests, small scale vs. large scale);
- similarity of conditions (contaminants, soil profile, site hydrology, etc.);
- effectiveness in similar or other settings;
- problems, direct or secondary, at other locations; and
- financial costs.

These factors, and therefore predictability, are not absolute. They are judgments based on (varying) interpretations. Furthermore, the dynamics of one-way or interactive communication about these factors may, themselves, affect parties' judgments and interpretations (including judgments of trustworthiness of communicators and the information communicated).

Although a deceptively complicated statement, we suggest that the greater the familiarity with—predictability of—the technology, the greater the willingness to negotiate. The obvious exception to this statement is those cases where past experiences with a familiar technology are viewed negatively.

Context Dimension Elements: Institutions

Institutional context attributes seem to play a frequent and strong role in decision-oriented dialogues. We highlight just one aspect of institutional context here:

- The rigidity (tightness) and proximity (urgency) of a decision schedule will increase willingness to negotiate if that schedule is seen as real (with significant penalties for missing the date).

This statement recognizes that remediation decision making often is presented as schedule-driven. However, the reasons underlying that forcing event are not always apparent or meaningful to constituents involved in decision making. When the penalties associated with not meeting the schedule are seen as real, and particularly if they are seen as irreversible (e.g., for some human health or ecological impacts), then we suggest that groups will have increased willingness to negotiate (MacNaughton 1996).[29] These situations—particularly when they are seen as urgent, requiring near-term decisions or actions—may be among the few in which groups may force themselves to confront uncomfortable decisions and make trade-offs that impinge upon their core values. However, if the urgency attendant to a strict, fast-track

schedule seems manufactured or groundless, then participants have no particular incentive to make a decision. Continuing difficulty in reaching agreements on cleanup may be a diagnostic of situations in which constituents perceive that there is no true urgency or importance attached to the decision they are being asked to make.

Distinguishing Features of PACT

Several notable features of PACT distinguish it from other approaches to societal acceptability or decision making about controversial technologies.

- PACT distinguishes between acceptability and deployment. As discussed earlier, acceptability is a necessary but not sufficient condition for deployment.
- PACT is comprehensive. Instead of highlighting a single dimension such as perceptions of a technology, PACT emphasizes four dimensions. The framework focuses on how constituent, technology, and context dimensions interact to affect decision-oriented dialogues. This comprehensiveness presents its own challenges, but it leads to a richer, more complete picture of the interactions we wish to study. PACT is built on the premise that societal acceptability of innovative or controversial technologies is situation dependent. That situation is not defined by the technology or the decision-making process or the power structure of a community or demographic composition alone, but rather by the combination of such factors as they influence one another (Van Liere and Dunlap 1980).[30]
- PACT emphasizes interactions among constituents. It recognizes that the stances that parties take in decision-making contexts affect and are affected by other parties. Past interactions, beliefs about others' motivations and goals, and reactions to others' statements and actions can have powerful influences on willingness to participate in the mainstream decision-making process and to negotiate once at the table.[31]
- PACT acknowledges that there are many kinds of communication that can affect acceptability and views decision-oriented communication through multiple lenses. For instance, PACT does not highlight risk, risk perceptions, or risk communication as discrete dimensions influencing societal acceptance. Risk permeates PACT, but the kinds of risks considered go well beyond human health and ecological consequences to include economic risks and risks to constituency groups' stability, power, and image. Furthermore, PACT does not view the interactions among constituency groups—the dialogue—solely through the lens of risk communication.
- PACT incorporates change over time and does not treat acceptability or the factors that influence it as static.

Future Plans

This article has described the first steps in developing PACT as a robust framework that is theoretically sound and practically useful for understanding how dialogues among constituents affect the acceptability of the technology under consideration. We presented a broad overview of the framework, discussed a few of the important elements, and highlighted its distinct features. The next stage in the development of PACT is to use the framework to guide empirical data collection and analysis, in the process refining the framework.

We will limit this application to specific decision-making contexts, although we can use PACT to address any of the range of formal and informal venues through which the dialogue process occurs. Each venue, such as public meetings or local dialogues carried out in newspapers, has its own culture and, therefore, would require somewhat different research conventions. In the next phase of PACT research, however, we have chosen to focus on data about one particular formal venue for dialogue among constituency groups—DOE's site-specific advisory boards.

DOE's twelve site-specific advisory boards (SSABs) are federally chartered, which means that the groups have the legal authority to advise a federal agency. Each SSAB has its own charter, so that the groups in different locations are not simply replicas of one another. Furthermore, the twelve groups are associated with different DOE sites, each of which has a different composition of constituents, site and contamination characteristics, and history. The SSABs constitute public groups according to our earlier definition (a formal intergroup mechanism for reaching acceptability decisions that will be deemed as the public position). SSABs have become an important mechanism through which DOE seeks public approval for a number of its site-specific decisions. Because of the asymmetrical impact that constituency groups have on acceptability, approval means the absence of opposition—at a minimum, something other than a negative binary response ("no way"). In focusing on acceptability, we are less concerned with obtaining data on approval for decisions about which technology to use than with data on the serious consideration of technologies such as GEMs. Operationally, then, approval means that no party with absolute blocking power opposes the consideration (and, therefore, potential deployment) of the technology. It remains a matter of empirical observation to see whether parties who do not or think that they do not have that blocking power either participate at all or persist in their participation.

SSAB meetings, in effect, become the stage on which the acceptability drama unfolds. Because GEMs do not appear on the horizon for real-world remediation application, we will rely mostly on data about—discussions of—other hazardous waste remediation technologies, including other bioremediation technologies, if possible. We will analyze these dramas to learn how multiparty dialogues are structured, who the players are, how they represent their positions, and how, over time and through interactions with other players, those positions change along the decision-rule continuum. We also plan to use the SSAB meetings (observed through videotape or audio recordings of past meetings, tracking issues over time) as a platform from which to gather other kinds of data. As examples, we will investigate involved constituents with regard to their involvement in the SSAB meetings to gain information about the parties, the issues of greatest concern to them, their goals and typical strategies, and their perspectives on other parties participating in the SSAB meeting and in the dialogue process. In addition, analyzing the involved individuals and groups will help us determine whether our observations and interpretations of SSAB meetings mesh with their understanding of the situation, providing a ground-truthing mechanism. Exploring and refining PACT through an analysis of SSAB interactions allows us to apply PACT as a tool for simultaneously taking panoramic and telescopic views to understand the determinants of public acceptability of controversial technologies like GEMs. In turn, this understanding can inform the larger discussion about the roles of participation and science in technology-oriented decision making.

NOTES

1. These parties include what some have termed internal and external stakeholders. Internal stakeholders are those individuals and constituency groups whose personal or organizational livelihoods directly affect or are affected by the decision at hand (e.g., agencies or organizations responsible for the wastes or remediation, researchers, technology developers). External stakeholders are those other individuals or groups who have an interest or stake in the decision outcome. External stakeholders include such groups as civic and religious organizations or environmental groups and may include local groups as well as regional or national groups.

2. As examples, see Boulter (1997); Burger (1988); Fischhoff, Watson, and Hope (1984); Hansson (1989); Urban and Hoban (1997); Slovic (1987, 1997); Slovic and Fischhoff (1980); Slovic and Layman (1991); and Starr (1969).

3. See Davies, Covello, and Allen (1987); Golding, Krimsky, and Plough (1992); Hance, Chess, and Sandman (1991); Kasperson (1986); Krimsky and Plough (1988); and National Research Council (1989).

4. See Fisher, Chitose, and Gipson (1994); Mayo and Hollander (1991); Otway and von Winterfeldt (1992); and Stern and Fineberg (1996).

5. As examples, see Clarke and McCool (1985) and Lowi (1979).

6. As examples, see Keeney (1992); and Kempton, Boster, and Hartley (1995).

7. As examples, see Bingham (1986); Crowfoot and Wondolleck (1990); and Nieves et al. (1992).

8. See Brown, Duguid, and Haviland 1993; Carnes et al. (1996); Syme and Eaton (1989); and Wiedemann and Femers (1992).

9. As an example, see Tonn, English, and Travis (2000).

10. We have attempted neither to represent all relevant literature in this article nor to present the literature independently. Instead, we cite parts of the literature that have particular relevance for our work.

11. Throughout this article, we use the terms *public acceptability* and *social acceptability* interchangeably. Furthermore, we use the word *acceptability* (and not *acceptance*) deliberately, to imply a willingness to discuss seriously. Our approach therefore is process—rather than outcomes—oriented.

12. In the decision-making context, general public opinion may be relevant only to the extent that it is effectively channeled—perhaps through organized constituency groups—to influence the decision-making process or its outcomes.

13. These dialogues embody communication—its substance, modes, and effects—in the context of site-specific decision making. In this sense, we build on but go beyond those forms of risk or science communication that focus on accurate conveyance of technical information through one-way or interactive processes.

14. Parties external to the public group range from neighbors or coworkers to other community groups to national advocacy groups to news media.

15. For practical purposes, the negative binary position is of primary interest for this analysis. However, if a proponent of a technology is viewed as adopting a positive binary position—there is no information or position so extreme as to dissuade them from wishing to deploy the technology—that stance may lessen the willingness of other parties to bargain.

16. Evans and Durant (1995) found that education leads to more consistent attitudes toward science and more discriminating attitudes toward specific areas of research; however, more education does not lead to more support. Martin and Tait (1992) found that education does not change attitudes. Similarly, Yount and Horton (1992) found that the amount of factual information brought to bear did not change environmental attitudes. See also Drell and Metting (1996). Perhaps these situations are analogous with long-term educational campaigns that may improve people's knowledge but that have limited effectiveness in producing desired behavioral changes (e.g., AIDS prevention, safety belt use, cigarette smoking). However, some unfamiliar technologies that meet with initial resistance, such as microwave ovens, become widely adopted over time as the technology, its costs, and consumer knowledge improve.

17. Hoban (1995) noted that movement into the risk arena may be a way for an interest group to gain notoriety and acquire resources. Moore (1993) stated that many times environmental groups will use an issue to take positions for the debate of environment versus economy; the issue itself is used as a positioning technique rather than an issue of primary concern to the group.

18. The strategy of maximizing one's own self-interest narrowly and with determination, however, may not always be the most effective strategy. For instance, Painter (1988), influenced by game theory, asked, "In maximizing one's self-interest, how is it possible to consider the idea that one might choose to act in the public good, or in the community's interest?" The answer, based on Axelrod's (1994) work, was that "a player who in an opening move acts generously and on a responding move acts cooperatively . . . will outscore any other strategy, given time and averaging" (p. 169).

19. Our approach is highly applied and avoids a formal game theory. At later stages of model development, we plan to explore the more robust properties of our framework. For example, one

might explore the dialogue process experimentally, as a sequential ultimatum game in which parties propose take it or leave it offers and opponents can either accept or reject the offers.

20. For any public group in which members serve as representatives of others, the legitimacy of the representatives and groups can be questioned. Not only can questions of legitimacy affect the acceptance and sustainability of decision outcomes, but they also can influence public-group dialogues.

21. See, for example, Abrams et al. (1990); Moscovici and Néve (n.d.); Rambo (1970); Sherif (1935, 1937, 1948); and Witte (1987). Furthermore, MacNeil and Pace (1973), in results comparable to autokinetic effects studies, found that "individuals who held high status responded to . . . social clues . . . more efficiently" (p. 1275).

22. See, for example, Floyd, Germain, and ter Horst (1996). In analyzing twelve forest resource management cases, the authors found that as the distance increased among the shared values—biocommodity, geocommodity, use amenity, preservation amenity—the less satisfied participants were with the process and with the results. Furthermore, as that distance increased, there also were increases in the time required for decision making and in the dissolution of the group.

23. Examples are as follows:

Axelrod (1994) found that the dominant value groups include "economic," "altruistic," and "biospheric"; these groups will affect ecological decisions.

Eagly and Kulsea (1997) presented an overview of theories of attitude/attitude change, effective alteration of environmental attitudes, and embedding environmental attitudes in broader/deeper values.

Floyd (1993) discussed how different value sets affect land management conflict. The "dominant social paradigm" envisions humans as primarily self-interested wealth maximizers, and the "new environmental paradigm" stresses concern for the social and environmental impacts of growth and participatory decision process.

Grube, Mayton, and Ball-Rokeach (1994) stated, "Belief system theory defines the value system as a relatively stable hierarchically organized set of beliefs that certain ideal modes of conduct (instrumental values) are preferable to other modes of conduct and that certain ideal end states of existence (terminal values) are preferable to other end states of existence" (p. 155). Value self-confrontation is the presentation of feedback and interpretations of values, attitudes, and behaviors: if self-confrontation is in accord with an individual's self-concept, self satisfaction occurs; if not, significant value, attitude, and behavior changes may result.

Lach's (1996) introductory article stated that environmental conflict does not fit into the traditional sociological theories (collective behavior, class struggle, and resource mobilizations). Rather, Lach suggested, the "new social movement theory suggests that environmental conflict is fundamentally a cultural-ideological clash that affects both personal and social identities" (p. 216).

Simmons, Binney, and Dodd (1992) found that valuing a clean environment is part of a complex of values. The authors also discussed efforts to induce self-confrontation through media presentations.

Spangler (1980) described attitudinal patterns about technologies—their innovations, adaptations, and deployment policies—as "syndromes." He noted that the different syndrome patterns among individuals and groups reflect societal divisiveness about technology issues.

Stern, Dietz, and Kalof (1993) categorized value structure as egoistic values, altruistic values, and biospheric values. The authors reported that "women have stronger beliefs than

men about the consequences for self, others, and the biosphere" (p. 322). In addition, Stern and Dietz (1994) found that studies indicate that positive environmental acts are higher in those with biospheric or altruistic values and lower in those with egoistic values.

See also Keeney (1992); Kempton, Boster, and Hartley (1995); and Seligman, Syme, and Gilchrist (1994).

24. Power, authority, and trust not only influence the dialogue process but also influence the degree to which participants agree that the choices posed must be "cruel."

25. This view contrasts with a typical economic analysis that would assume marginal damages from contamination are small with small amounts of contamination and increase as contamination increases.

26. See the following examples:

Druckman, Rozelle, and Zechmeister. (1977) identified three factors that affect the way values and interests interact: salience of the link between the two sources of conflict, relative intensity, and the relative importance of each source.

Kristiansen and Zama (1988) found that "while people with different attitudes may hold different values, they also refer to different values to justify their attitudinal positions" (p. 254).

MacNaughton (1996) said that "value systems are not negotiable" and that efforts "to persuade [parties] to abandon [core values] . . . may be interpreted as disregard or disrespect, making the dispute resolution process more difficult" (p. 5).

Painter (1988) indicated that "negotiation cannot resolve conflicts of values. . . . It isn't values that are ever on the table for distributive justice—it is self-interest. No one willingly surrenders his values" (p. 168).

Regal (1997).

Tetlock (1986) found that "by directly measuring the value priorities of individual respondents, and by experimentally controlling the values brought into conflict through question selection, it was possible to achieve much stronger tests of the hypothesis that complex trade-off forms of reasoning are most likely to emerge in policy decisions that activate important, and approximately equally important, conflicting values" (p. 826). Furthermore, he found that (a) policy preferences were predicted by knowing which conflicting values were held more dearly and (b) the complexity of reasoning about policies was predicted by knowing how people ranked the importance of relevant values separately and in relation to one another.

Thompson and Gonzalez (1997) distinguished conflicts of interest from ideological conflicts. Some values are "sacred." Some groups label their values as being sacre when they are not as a strategic move. Values are one of the biggest obstacles in negotiation. A potentially useful strategy for facilitating negotiation is to reframe the issue from a political, environmental, or social one to one of economics and cost-benefit analysis. The idea is to make it clear that trade-offs are inevitable.

27. Considerable work on this issue has been undertaken by Paul Slovic and his colleagues (e.g., Kunreuther, Desvousges, and Slovic 1988; Slovic 1987, 1997; Slovic and Fischhoff 1980; Slovic, Fischhoff, and Lichtenstein 1985; Slovic, Flynn, and Layman 1991; and Slovic , Layman, and Flynn 1991). Examples of other relevant efforts are Starr (1969) and Turner and Wynne (1992).

28. Much literature focuses on risks and perceptions of risk. See, for example, the following:

Boulter (1997) listed as influences on perception of risk: familiar versus unfamiliar, knowable versus unknowable, nonmemorable versus memorable, nondreaded versus dreaded, voluntary versus nonvoluntary, diffuse versus concentrated, controlled versus uncontrolled, and natural versus technological risk.

Hansson (1989) offered the following dimensions of risk comparisons: character of negative consequences, control and free choice, individual and collective perspectives on risks, large disasters and probability, decisions under uncertainty, and the availability of knowledge.

Kasperson (1980) proposed that rating of risks has to do with availability and representativeness.

Urban and Hoban (1997) presented voluntariness and familiarity as factors of risk, as per Slovic and his colleagues. But they added an additional factor: natural.

29. MacNaughton (1996) indicated that people need a believable schedule by which to work and that they need sufficient time to carry out the processes.

30. These authors showed how little factors such as demographic composition of a community affect the predictability of environmental concerns.

31. See, for example, the following:

Lange (1993) said that disputing groups interact by "mirroring and matching . . . each other's sgtrategies" (p. 241) and that "political communication campaigns may result more from a logic co-created with the competing candidate or group than the audience or other exigencies" (p. 254).

Ross and Ward (1995) found that past negative interactions constitute a barrier to dispute resolution.

Slovic, Fischhoff, and Lichtenstein (1979) said, "Once formed, initial impressions tend to structure the way evidence is interpreted" and "people's beliefs change slowly and are extraordinarily persistent in the face of contrary evidence" (p. 37).

Wondolleck, Manring, and Crowfoot (1996) found that personal familiarity contributes to the success of the dispute resolution process.

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