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Making a difference on the ground: the challenge of demonstrating the effectiveness of decision support

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Abstract Decision support has become a popular concept, especially in the context of climate change. Government agencies and researchers increasingly recognize that they should provide it, and resource managers and policy-makers increasingly need and demand it. This demand will only grow as climate change progresses. Those who will attempt to meet this growing demand will need to demonstrate "effectiveness". This editorial raises a number of critical questions that need to be answered in the course of evaluating whether decision support is effective. The answers, if carefully considered early on, may help to design processes that may in fact produce more useable products, facilitate their use, and ultimately create intended and desirable outcomes.

Decision support is one class of science-policy, science-management, or science-stakeholder interactions. Since its relatively recent rise in popularity in the climate arena, it has come to mean almost anything that somehow links the research sphere with the practice realm—processes of interaction, different forms of communication, potentially useful data sets or models, reports and training workshops, data ports and websites, engaging any level of governance, at any stage in the policy- or decision-making process. This grab bag of definitions and meanings may be confusing or irritating, but is hardly surprising, particularly in multi-disciplinary areas. Fashionable ideas and concepts—just think of "sustainability"—have always been used to ride waves of interest, be part of important discourses, exploit grant opportunities, or meet sponsor requirements. They are also notoriously difficult to interpret, measure, track, and evaluate.

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Romsdahl and Pyke, in their essay on decision support in this issue, just as the review panel of the National Research Council that evaluated the U.S. Climate Change Science Program's (CCSP) progress to date (National Research Council 2007), deplore the general lack of progress made so far by federal agencies in developing, providing, and evaluating decision support—after all one of the program's key strategic goals (Climate Change Science Program and Subcommittee on Global Change Research 2003). At a time when awareness of climate change impacts and future projections is high among citizens, managers and policy-makers, and readiness to invest in mitigation and adaptation actions is increasingly evident, it is indeed a bad time to be behind the eight-ball on climate-related decision support.

Thus, a constructive push is warranted, though it would be unfair to say that CCSP agencies and leaders are unaware of the need or not struggling to meet it. Prominent calls have been put forth for the establishment of a national climate service (e.g., Miles et al. 2006) and federal agencies are discussing various forms of such a service at present. Others call for reforms of the IPCC to move toward providing and evaluating such decision support (e.g., Visbeck 2007). Another NRC panel is currently working to develop guidance on decision support in response to several CCSP agencies' request.[1] These efforts have been occurring alongside the less visible, less easily tracked in-house discussions and small, but important efforts within various federal agencies on providing decision support.

On the optimistic assumption that funding for decision support (and related social science research) were to increase, and agencies took to heart their charge and the advice of the NRC, what difference would these efforts make "on the ground"? To attract sustained financial, political and social backing, decision support will have to demonstrate its effectiveness. Romsdahl and Pyke clearly recognize this challenge and call for ongoing monitoring of decision support activities and results (outputs and outcomes) and for the removal of bureaucratic obstacles to such evaluation. But how would we know whether decision support was really "effective"?

This editorial leaves aside for the moment the many questions one might ask regarding why people differ in their understanding of what decision support means, what types of decision support federal agencies may provide, and how, and focuses instead on the question of "effectiveness." Of course, it is artificial to separate these questions as answers to the former directly affect the latter. My intention here is to turn the direction of influence around and argue that critical thinking about the question of "effectiveness" may reveal some answers to the"what" and "how" questions and even some of the reasons for why providing decision support is such a step child of research and government activity.

1 Decision support in the cross-hair of diverse discourses

To cast the question of effectiveness in an appropriate light, it serves to briefly locate thinking about decision support in the broader, long-standing discourses that do (or should) inform it. Examining the "practice" side, there are pragmatic and

[1]The author is a member of this NRC panel; for more information, see the NRC's Project Summary webpage: http://www8.nationalacademies.org/cp/projectview.aspx?key=48846, last accessed 12/08/08.

theoretical discourses about effective institutional arrangements and appropriate forms of governance, and within that, the proper roles that technocrats (scientists and technical experts within government agencies or companies) and "the public" might play in a democracy where an increasingly distant cohort of scientists and government agents informs and makes decisions about increasingly global, complex problems. Related here are discourses on participatory processes in conflict resolution around controversial risk assessment and management issues (e.g., Krimsky and Golding 1992; National Research Council 1996; Beierle 1998, 2004; Markus et al. 2005).

Exploring the "science" side, the field of social studies of science critically observes, evaluates, and questions the role of science in society (including in environmental policy- and decision-making) at this time in history (Gibbons et al. 1994; Lubchenco 1998; Gibbons 1999; Nowotny et al. 2001; Slaughter and Rhoades 2005). It examines the relative merits and limitations of both technical expertise and lay knowledge, including the importance and constraints on integrating traditional ecological, local, and native knowledge into scientific efforts and decision-making (e.g., Jasanoff 1990; Lee 1993; Berkes 1999; Folke 2004). This literature does sometimes, but not necessarily overlap with that borne of practical experience among scientists and others who have become engaged with practitioners and stakeholders in the management of natural resources or development efforts (see the review by McNie 2007). Both offer insights on the meaning and practicalities of knowledge co-production and interactions at the science-practice interface (e.g., Guston 2001; Jasanoff 2004; Pohl 2005; van Kerkhoff 2005), and illuminate the emergence of knowledge systems in support of sustainability science and decisions (e.g., Cash et al. 2003; Clark et al. 2004; van Kerkhoff and Lebel 2006), including effective social learning, the design and functioning of adaptive management systems, or the design of forecasting, research, and assessments processes that maximize the usefulness of their outputs in decision-making at various scales (e.g., Callon 1999; Rayner et al. 2005; Farrell and Jäger 2006; Stringer et al. 2006; Pielke 2007; NRC 2008).

Even just this rudimentary context suggests that any notion of "effectiveness" is—whether formally acknowledged or not—deeply rooted in fundamental philosophical, political, and social concerns. It is therefore never unproblematic or value-free but necessary to ask: Who asks the question of whether something is effective? What is to be evaluated? Against which criteria is effectiveness to be evaluated, and who sets them? What explicit goals or implicit ends are to be reached, and when can success or failure be judged?

2 The bumpy ride on the decision-support bandwagon

Despite the recent rush to jump on the decision-support bandwagon, these questions have been neglected by many. If they were seriously considered, they would lead directly into the ongoing and far-from-settled debates over (1) where to draw (and how to maintain) the boundary between science and policy or management, and (2) the relative merits of participatory versus technocratic processes involved in decision support: should the technical assessment or input into and decisions over complex issues be broadly democratic and inclusive, or essentially in the hands of technical experts (e.g., National Research Council 1996; Cooke and Kothari 2001;

Oliver 2002; Gethmann 2005; Heinrichs 2005; Hickey and Mohan 2005; Kasperson 2006)? What types of input into the decision process are needed (or desirable)? Which and how much information is "good enough" for consideration? What trade-offs are being made by scientists leaning over to the world of practice, and which by decision-makers who include or exclude certain inputs?

The resulting debate hinges on issues of relevant, legitimate, and credible knowledge, fairness, adequate representation, and other concerns such as time, cost, skill, capacity, and logistical practicalities. Process and anticipated outcome concerns intermingle and are hardly separable. Frequently, the debate is polarized over the question whether broader, more inclusive (participatory) processes are necessarily a good or desirable thing at all, and if not, when, toward what end, under what circumstances, in what form, and with which participants. Normative/rights-based arguments, substantive or effectiveness-related arguments, instrumental/efficiency-related arguments and process arguments are pitched against each other in these discourses (e.g., Fiorino 1990; Mayoux 2007). In trying to assess effectiveness then, these value-laden and often unspoken underlying assumptions and concerns must be recognized and taken into account.

3 Decision support goals and desired/desirable outcomes

Effectiveness of any decision-support process can only be measured against a stated goal or set of purposes that the process is meant to achieve. Ideally (but frequently not available) there should also be some qualitative or quantitative assessment of the pre-existing conditions (the baseline prior to the decision support effort), against which the impact of the process can be assessed.

The literature distinguishes three sets of general decision support goals:

- Establishment of, or improvements in, the *process* of communication and interaction between scientists and decision-makers (and affected or interested stakeholders);
- Delivery of specified direct *outputs* or products in timeframes, formats, and through channels that are declared, deemed, designed, or hoped to be useful; and
- Accomplishment of wider and/or longer-term *outcomes* as a result of the above processes and products.

Building on Fiorino (1990), and the deeper underlying arguments mentioned above, one can alternatively categorize decision support goals as follows:

- *substantive* goals—the decision support process produces substantively relevant and important information for consideration in decision- and policy-making processes, and/or substantively changes future research agendas and assessment foci or procedures;
- *normative* goals—the decision support process advances democracy and citizenship, and the active engagement and fair inclusion of stakeholder in the decision process; and
- *instrumental* goals—the decision support process enhances legitimacy and ultimately leads to better outcomes in society and/or the environment.

Using these two sets of categorizations, a matrix of decision support goals or benefits can be constructed. Table 1 lists a variety of these goals in each section of the 3x3 matrix, but should not be considered comprehensive. It simply gives order to the many goals or benefits one may envision resulting from decision support.

There is a bias in the goals listed in Table 1, namely the consistent framing of the goals as an enhancement or improvement. This brings out an important issue affecting all goal statements and subsequent evaluations: a particular goal is always in *someone's* interest, and quite possibly contrary to that of another. Thus the question must always be asked "*whose goal*?" (Gethmann 2005). For example, the framing of an issue mobilizes certain stakeholders, while a reframing may alter the set of constituents and interests groups and hence change power relationships, possibilities for coalition-building, and the potential for conflict or compromise (Moser and Dilling 2004, 2007). Direct involvement in an assessment process can increase credibility in the eyes of participants, yet outside observers may see the credibility compromised by input from lay, non-technical stakeholders (Moser 2005; Mitchell et al. 2006). A policy change may benefit some, yet disadvantage others. Greater citizen mobilization may be welcome to some, yet a threat to others, and so on.

The positive framing of goals contains another, potentially misleading, bias. It may imply that decision support processes (and related stakeholder engagement), if implemented professionally and effectively, will always lead to such positive goals, yet several are far from guaranteed, such as cost effectiveness, efficiency, time savings, professional advancement, and conflict reduction.

While many studies have explored and evaluated the achievement of the goals listed in Table 1, none has ever tried to achieve or assess them all at once. Rather, existing studies tend to emphasize either the process or the output/outcome goals, sometimes one to the exclusion of the others. Newig (2007) and others (e.g., Mitchell et al. 2006) argue that process is essential for achieving intended outputs and outcomes; the reverse was also found to be true in the first U.S. National Assessment of the Potential Consequences of Climate Variability and Change, where on occasion the excessive attention to process delayed the production of promised outputs, resulting in the loss of confidence in the process or progressive loss of some actively engaged stakeholders (Moser 2005).

Clearly, then, if the goals of decision support are not stated explicitly at the outset, subsequent evaluation of whether or not they have been reached is virtually impossible. Similarly, if the goals are not jointly negotiated by the scientists and decision-makers and stakeholders involved, the decision support process can be severely undermined. At the same time, stating the goals upfront will affect those involved in a number of ways. For example, explicit goal setting can:

- set clear expectations for the process, the outputs, and the wider outcomes;
- help potentially engaged participants assess for themselves the value of engaging in, and the likelihood of success of, the process;
- invite some individuals into the process while (potentially) disengaging others;
- begin to define the role of participants in the process;
- place significant performance pressure on the initiators of the stakeholder engagement process;

Table 1 A matrix of possible decision support goals

	Process	Outputs	Outcomes
Substantive	Enhanced mutual understanding of abilities, constraints, concerns, issues	Change in understanding and perceptions of issue	Greater balance of social values/concerns and technical input into decision-making
	Satisfaction with process and one's role and performance in it	Greater usefulness of information	Capacity building on specific technical skills
	Co-production of knowledge	Identification of research gaps	Greater self-confidence
	Greater salience, credibility of issue or information	Identification of monitoring needs	Better understanding of the scientific and policy processes
	Overcoming of linguistic barriers	Identification of policy and enforcement needs	Greater professional satisfaction
	Reframing of an issue	New access or enhanced accessibility to information and data	Professional advancement
	Use and augmentation of each person's skills and strengths	A tangible result (e.g., the requested information, a report, forecast, model)	Culture change in academia and world of practice regarding working together
Normative	Enhanced democratic process	Integration of different ways of knowing	Political re-enfranchisement
	Greater inclusiveness	Place-based mobilization of stakeholders	Greater government/ industry accountability
	Better representation of diverse views and interests	Coalition building and partnerships	Increased trust in government/industry
	Empowerment	More ethical, socially sensitive, democratically arrived decisions	Greater equality

	Perception of greater fairness	Empowerment	Increased capacity to actively participate in democracy
	Sense of mutual respect		Greater social capital
Instrumental	Greater buy-in in policy	Less conflict	Improved state of natural resource
	Greater legitimacy of research/ assessment agenda or policy goals	Sounder basis for decisions	Improved state of environment or species
	Improved collegial interaction	Greater cost-effectiveness	Reduced vulnerability (i.e., decreased exposure, and sensitivity, plus greater coping capacity)
	Improved public communication and outreach	Greater efficiency	Improved measures of economic performance
	Greater motivation to participate in future decision support and stakeholder engagement processes	Increased (likelihood of) information use	Enhanced commitment to institutions, issues, missions, and goals
		Management changes (incl. institutional, legal, strategic, operational, financial and personnel)	Improved agency responsiveness
		Greater productivity	Better morale
		Policy changes	
		Improved enforcement	

(Examples drawn from Arnstein 1969; Fiorino 1990; Beierle 1998; Rowe and Frewer 2000; Ewing 2003; Moser 2006; Newig 2007)

- provide an important benchmark against which progress can be measured and demonstrated, and
- backfire if stated goals are not achieved (e.g., cessation of financial support; future disinterest of those initially involved).

These reasons may be suggestive of why some—against the better advice offered by researchers and practitioners across the board (e.g., Creighton 2005)—prefer to keep the intentions and goals behind a decision support and engagement process vague, do not capture baseline conditions, fail to rigorously assess effectiveness over time, and hence hinder learning of important lessons.

4 Challenges of evaluating decision support effectiveness

Measuring effectiveness involves a number of important considerations, of which the clear identification of goals—as described above—is just the first step. The next step is to operationalize the selected goals by identifying conceptually valid and empirically measurable metrics. For example, if "reduced vulnerability" is the desired ultimate outcome for decision support in the face of climate variability and change, then a number of measures for its underlying components—exposure, sensitivity, and coping capacity—must be identified. If, alternatively, "less conflict" around a certain decision is the goal, the number of public complaints, legal cases, or shouting matches in public hearings may be indicative metrics.

To demonstrate the impact that a decision support process has on decision-making and decision outcomes, as well as on future research agendas and assessments, it is critical to have a baseline against which the impact can be measured. Such a baseline is not always available, but sometimes can be approximated in hindsight, for example through people's surveyed perceptions of change over time, archival data, or time series. More problematic even is the demonstration that a particular decision support process is causally linked to a measurable output, much less made an incremental different to an observed change (outcome). As Clark et al. (2006) argued, it is difficult in most instances to demonstrate with hard evidence that science has had any influence on decisions and policies; the causal link to decision support processes may be even more difficult (but see Newig 2007).

Similar to asking "whose goals?" are being pursued, measuring effectiveness also requires asking "who evaluates?" In principle, three sets of actors could evaluate a decision support process: (1) anyone of those involved (scientists, decision-makers, stakeholders); (2) the organizers/initiators or leaders of the process (not necessarily the same as those in (1)); and (3) an uninvolved outsider. Each has its value, offers distinct and important insights, and also its limitations. Typically, resources for evaluation are too scarce for all three to assess a process and its outcomes. It is important, therefore, if only one or two approaches are used, to recognize the relative advantages and potential biases that can color each of these sets of actors' views, and hence the overall evaluation. Moreover, these viewpoints will be strongly affected by the 'atmosphere' that prevailed during a decision support process. For example, stakeholder evaluations of conflict-laden, distrustful processes may overstate the negative, while organizer/leader evaluations may overstate the positive outcomes. An uninvolved outside evaluator may be more neutral, but not obtain deep insights or have sufficient access to the involved actors and information.

Techniques commonly used to obtain information depend obviously on the goals and metrics, as well as the resources available to conduct evaluations. Each, again, entails advantages and disadvantages. They can range from in-depth interviews, to surveys, to a mix of workshop discussions, surveys, and debriefings, to the collection of quantitative (time series) data on any number of outcome variables, to even conceptual evaluations of processes using generic criteria of success.

Finally, as many evaluations of the effectiveness of a process are begun post-hoc, the question of timing also arises. How late is too late for an evaluation of effectiveness after a decision support process has ended? Memories fade, views on a process may change over time, records and documents may get lost, lessons may become less relevant, and so on. At the same time, while process evaluations can be conducted immediately, outputs and outcomes—some of which may be very significant—may not be available or detectable immediately because they take months or years to transpire (as will often be the case with climate variability and change). By contrast, beginning a decision support process with an assessment of baseline conditions (e.g., information needs) to better inform subsequent follow-up evaluations may be challenging because it may raise expectations too high, relationships may be too young to place great demands on them; there may still be a lack of trust to share information and viewpoints freely, and so on. It is advisable therefore to realistically determine when certain decision support goals are best assessed. Staggered assessments of different goals may be a useful approach.

5 Conclusion

In conclusion, decision support, just as the measurement of its effectiveness, requires careful planning, critical evaluation of the approaches, benefits and drawbacks, ample forethought, and adequate resources. To provide decision support and to assess its effectiveness "on the ground," is not value-free or without consequences. Thus, as much as researchers, agency staff, or outside observers may call for accountability and express interest in learning from decision support efforts to improve them, there are nontrivial risks that one takes in making explicit the process and output/outcome goals of decision support, tracking the impacts, and publicizing the level of achievement. A clear understanding of the essential role of learning by all parties involved, including their employers, sponsors, funders, and external observers, and a clear policy of refusing to punish early mistakes (e.g., through withdrawal of financial support or professional demotion) will go a long way to minimize the risks involved in working toward greater decision support effectiveness. Perhaps then the only bigger risk remaining, especially in times of rapid climate change, is not to attempt it.

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