

FITTING DECISION AIDS TO AN INSTITUTIONAL CONTEXT:
METHODOLOGY FOR ORGANIZATIONAL DESIGN¹

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Abstract

Poor fit between a decision aid and its institutional context commonly impedes its successful use. What aid should be used, and how, in a given organizational situation depends on whose interests are to be served-- participants in the organization, "owners" or society at large--and what they care about. What is needed is:

- An analytic framework which associates aid and organizational setting to performance variables (such as the quality of resulting external action and internal organization costs); either directly or through mediating variables (such as aid acceptability). The evaluation logic generalizes personalized decision analysis, but the decision aid itself need not use PDA.
- Procedures for developing input for the framework and for suggesting and validating aids and general precepts, based on decision aider's judgment, on social science theory or on field data.

An evolving methodology has been tested in risk management situations, including retrospective evaluations and participant observation, and illustrative prescriptive hypotheses have been developed, at differing levels of generality. However, prescriptive theory, especially for organizations may never have the universality of descriptive theory, because of unavoidably complex conditioning on circumstances and constituency.

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I. SCOPE

Improving the *institutional* fit of decision aids appears to be the most critical current requirement for the successful application of decision science (Brown 1989b). This paper attempts to develop a methodology for prescribing organizational design oriented toward providing and managing analytic aids for decision making, and its theoretical underpinnings, prescriptive, descriptive and normative.

A. Domain: organizational design for decision aiding.

According to Simon (1973) the central function of organizations is to take purposive action. For example, a company invests to make money; an agency disposes of nuclear waste to protect the public efficiently; the military launches attacks to destroy the enemy safely. Internal measures, including design of the organization, are adopted to make external action more successful (and possibly advance other goals). The use of decision aids such as OR models, personalized decision analysis (PDA), expert systems, decision support systems, is such a measure. But organizational design as it bears on what aids should be used and how needs to be enhanced: adapting the aid to the organization and vice versa.

Organization design issues which themselves are driven by organizational considerations (e.g. the need to "cover your rear" in controversial environmental management) are of particular interest; by contrast to purely technical considerations (e.g. short reaction time in high intensity warfare).

Illustrative issues:

- should any decision aiding procedure be used and of what kind?
- is its role to enhance or to justify decisions?
- where in the organization should it be located?
- who should be involved and how (e.g. through decision conferences)?
- should its use be required/optional/reviewable?
- should it lead to a "preferred" external action (or merely predict option consequences or alert to a danger)?
- should that action be mandated/for information only/disclosed publicly?

B. The Limitations of Substantive Prescription in General.

It is unlikely that prescriptive theory can ever, intrinsically have the unity and compactness of descriptive theory—in whatever field. Though prescription may be clear in any particular situation, it resists generalization because:

- Evaluation of performance evaluation is never entirely user-independent and therefore universal.
- Prescription has to take all relevant considerations into account (whereas description can be partial);
- Appropriate precepts may be highly conditional: "if this, and this, and this, then do that," such that its generality is highly circumscribed.

Prescription for *organizational* action, whether internal or external is especially elusive, because circumstances are more complex, variable and

ambiguous than for individual decision-making. (Who exactly is the actor, and whose interests are to be served, for example?). They also change more from one era to the next. (Precepts like Machiavelli's on the art of government are rarer than Ovid's on the art of loving.) Simon (1987) has observed that "proverbs of administration" come in contradictory pairs (on a par with "he who hesitates is lost" and "look before you leap"). There may only be suggestive regularities, not universal truths.

II. PROBLEM BACKGROUND

A. Research context

1. Acknowledged need. The scientific and consulting communities have noted the need for, and lack of, the prescriptive research proposed, as implied by the following arguments:

- "Organizational foolishness" is prevalent (March and Shapira 1982). Institutions, including governments, are so far from a "rational unitary actor" model as to have risked World War III in the Cuban missile crisis (Allison 1971);
- Decision analysis and management science more generally, have as yet done little to help (Grayson 1973; Ulvila and Brown 1982; Brown 1989b).
- The state-of-the-art is still primitive, though some would dissent (Brown in press; Howard in press).
- Basic research to enhance the art is lacking (March 1981; Simon 1987, 1988).
- The highest priority is prescriptive research, rather than the more common normative and descriptive research which it fuses (Bell et al. 1988; Brown and Vari 1992).
- "The political nature of organizational decision making (is) the cause of the relatively limited adoption of decision analysis" (Thomas 1989).
- Consequently prescriptive research on adapting decision aids to the host organizations is top priority (Brown 1989b).

2. General state of the art. By and large, relevant theory in the literature has been descriptive. Much of it is explicitly organizational, notably by March and colleagues. They have found for example that most organizations are driven by attention allocation rather than optimizing, as in their "garbage can" and "funny soccer" game metaphors (March 1988, 1981; March and Simon 1958; Cohen, March and Olson).

These help understand some of the impediments to effective decision aiding (though it does not stop us from considering what practices would in fact do most to advance the interests of these organizations). Others have made significant contributions to understanding how organizations make decisions, what stands in the way of their effectiveness, and indeed what constitutes effectiveness (Staw 1980; Scott 1981; Levinson 1974; Heller 1988; Hackman and Morris 1975; Goodman et al. 1979; Alderfer 1976).

There is also a rich body of relevant (in principle) descriptive theory in other disciplines: sociology, such as on the relation between authority, interaction and sentiment (Homans 1950); in social psychology, such as Hammond et al.'s (1975) work on social judgment; in administrative science, such as Lindblom's (1979) work on radical vs. adaptive decision making; and in anthropology, such as Radcliffe-Brown's (1952) work on structural functionalism.

Any explicitly prescriptive orientation has usually been aimed at issues other than decision-aiding (Hedberg et al. 1976). These include command structure (e.g. Jacques seminal work on the time span of discretion) and leadership (Vroom and Yetton 1973). Formal models have been developed and studied for special cases. For example "team" theory (e.g., Marschak and Radner, 1972; McGuire and Radner, 1972) provides formal, prescriptive models of the decision behavior of organizations whose members have like interests and objectives—only their information varies. However, members of most organizations that might benefit from decision aids differ greatly.

The literature on prescription specific to decision-aiding appears to be largely limited to: prescriptive asides during a descriptive thesis (Simon 1976, 1979); special-purpose guidelines for limited practical problems such as the design of R&D organizations (Lawrence and Lorsch (1968); implementing decision analysis in business (Brown 1970); or informal tips for management scientists (Ackoff 1969). Decision theorists other than ourselves have made limited efforts to address our objectives directly (Phillips 1980; Horowitz 1989; Andriole in press; Hogarth 1981).

Here is an attempt to pull together a number of long-standing research strands, stimulated by many years of applying decision aids in organizations.

As a consultant to government and business, I have observed and responded to the organizational complications of using decision aids in a wide variety of cases. This has suggested practical insights from lessons learned, including a number of starter hypotheses (Porter 1987, Fiske 1980).

III. APPROACH TO DEVELOPING METHODOLOGY.

A. Broad research thrust

Our approach is guided by a comparative advantage: long experience at the intersection of scholarship and consulting, interleaving the theory and practice of organizational decision aiding. Practice prompts theoretical hypotheses and provides a test bed for validation.

Prescriptive intent. Bell, Raiffa and Tversky (1988) clarify the distinction between descriptive, normative and prescriptive research and Brown (1989b) and Brown and Vari (1992) make the case for the importance and timeliness of the latter. Prescription for individuals is a well-established research field in decision theory and cognitive psychology (von Winterfeldt and Edwards 1986). We now extend it to organizations, and decision aiding in particular, from the perspective their stakeholders, whether "owners", participants or society at large.

Process vs. substance of prescription Learning how to fish is more important than catching fish, though we need to catch a few (i.e. develop actual prescriptions) to make sure we know how. We hope some of these fish will

prove tasty (i.e. interesting and useful precepts), but the main concern is to develop fishing technique (i.e. the methodology of prescription).

Scientific contribution: seeding multifaceted theory. Since useful methodology has to clear all implementation hurdles--logical, psychological and institutional--its development requires dealing with a large number of issues, and pursuing each parsimoniously. The focus is as sharp as more traditional research, but it is on an operational problem, rather than on a disciplinary topic (Brown 1989a). The approach is illustrated by Brown's (1990) work on assessment uncertainty technology.

B. Case-anchored induction

Our primary research approach has been inductive: to exercise methodological hypotheses on current and past decision aiding problems, in order to demonstrate feasibility and relevance. They may suggest or confirm more general hypotheses, which can later serve in a deductive role. The limiting conditions and caveats of individual cases, are relaxed to seek progressively more general prescriptive hypotheses, which can be tested elsewhere. (C.f. Newton inducing laws of gravity from observing falling apples, and later using them deductively).

Illustrative sequence: prescribing a battle aid. A representative example of this research mode is provided by a real consulting case. Navy chiefs were concerned that submarines in fleet exercises waited too long to fire their torpedoes at "enemy" submarines. I was charged with developing decision aids to enable commanders to make better decisions. Decision analysis confirmed that decisions were poor. Typically firing was delayed so long that risk of counter-detection and destruction outweighed improved chance of finding and destroying the enemy on any plausible assessment of probabilities and values.

However, commanders resisted a "better" time-of-fire aid. Probing, through interview and observation, I surmised that the problem was not decision skill but motivation: commanders were evaluated on how accurately they pin-pointed the enemy's location, rather than by whether they would have survived. So I recommended the Navy abandon this type of decision aid, in favor of bringing the reward structure into line with national interest. However, I had no access to those in the Navy with the power to act on this partly for reasons of "turf".

In any case I was not qualified to make a firm prescription on reward structure, a broader issue which depended on more considerations than I was privy to. Nevertheless, I felt able to predict the probable impact of motivational field on the quality of such external time-of-fire actions. In fact, further consideration persuaded me that current practice might not, after all, be harmful. In a real war commanders might be motivated to fire too soon, and their contrary bias from exercise experience might just cancel this one out. In any case, these were hypotheses which could be tested by others through convergent empirical research.

This experience suggested an analytic framework developed below. It also prompted consideration of a more generic prescriptive hypothesis: that conflict of interest might be reduced if local military commanders in general were required to justify critical decisions with analysis which laid bare their value judgments--and perhaps inhibited them from acting on indefensible motives. This hypothesis might be tested through comparable real war case

studies of the Pueblo, Stark and Vincennes incidents, which were free of the artificiality of exercises (analogous to that of laboratory experiments on individual human behavior). This case prompted still more general prescriptive hypotheses about the role of motivational field in the use of decision aids. For example aid designers should address a check list of issues such as: Whose cooperation is needed? What do they care about? How will the aiding option impact it? Etc.

This brief account illustrates how a case study can generate prescriptive, and supporting predictive hypotheses, at differing levels of generality, and suggest directions for validation and further development.

C. Review of cases--retrospective and current:

Studying organizational situations with which I have been involved for other reasons saves incremental effort. Watson and Brown (1978) appraised the value of decision aids they had developed for three organizations previously. Though more time consuming, review of other decision aiders' cases provides important objectivity and credibility. Brown (1970) surveyed twenty such business organizations to study the factors influencing the successful adoption of decision aids.

In addition advantage has been taken of current consulting assignments to do non-obtrusive participant observation of the evolving decision aiding process. For example, the Office of Nuclear Reactor Regulation at NRC is currently considering how to use risk evaluations in granting plant licenses. The main options are:

- To require plants to take specific measures (e.g. shut down if certain equipment is out of service more than 36 hours);
- To allow plants to take any measure if they can demonstrate with Probabilistic Risk Assessment that risk is acceptable (e.g. that equipment outage will not add more than .001% chance of a core melt).

The first option, prescriptive regulation, is favored by being unambiguous to apply, saving NRC effort and facilitating industry planning; whereas the second, performance regulation, may promise better or cheaper public protection. However, it may be manipulable by industry to save cost, and be challenged at adjudicatory hearings (good for the public, bad for NRC).

D. Major live exercise: current parallel project .

We are engaged on a study of Russian and American decision aiding in the Arctic environment, which provides a test bed for some hypotheses like the following.

The use of reviewable rationales such as PDA, for controversial decisions may be suited to the formal regulatory requirements and structured litigiousness of the American system; but not to an anarchic and vulnerable new Russian bureaucracy. In a military context, American battle commanders are required to use a simple form of decision analysis to select among a few "courses of action" to be approved by higher command. This requirement might be even better suited to the more centralized Russian system. However, the course of action may be specified as a "once-and-for-all" commitment (e.g. "attack from the North"). In practice, US commanders can and do commit incrementally

(Brown 1989a) and use on-the-spot discretion to change course if developments warrant. This may not work in an authoritarian Russian culture (Staw 1976).

Historical precedent in decision aiding practice may be a distinguishing setting variable. March and Shapira (1982) argue that an organizational practice is more acceptable when it has become a "standard operating procedure". The cost-benefit analysis of the McNamara era may have smoothed the path for decision analysis in US government more generally; Russia may have no such facilitating precedent.

E. Integration with social science.

Social science cannot yet serve as the primary source of hypotheses, but rather as a help to corroborate, explicate and refine hypotheses generated by direct experience and observation. The fact that a well-regarded recent book of readings on "Organization and decision theory" (Horowitz 1989) makes almost no reference to organization or other social theory literature suggests there is not yet much overlap.

IV. ANALYTIC FRAMEWORK FOR DECISION AIDING PRESCRIPTION.

A. Organizational decision analysis.

The established conceptual paradigm for developing prescription is personalized decision analysis (PDA), which characterizes numerically an individual's options, uncertainties and preferences (Raiffa, 1968), and the preferred choice corresponds to maximum probability weighted utility. Brown (1982) has suggested an adaptation to organizations, which we might call organizational decision analysis (ODA).

However, it is common practice among decision analysts to implement PDA without special adaptation for organizational clients. The fact that there is ambiguity, to say the least, about what exactly constitutes the organizational counterparts of choice, probability and utility is commonly finessed, usually without too much grief, by the analyst imputing his own "reasonable" determinations to the organization; or by taking some individual (e.g. company president) to represent the organization.

Dependence on constituency. The multiple/ambiguous constituency problem is a critical issue, within the broader multiattribute issue (Keeney and Raiffa 1976). Prescription may be radically different depending on whose interests are being served. As Mort Halperin has observed "Where you stand depends on where you sit". The issue may be fairly straightforward for external actions--whether to drill for oil in the Alaskan National Wildlife Refuge will differ if you are an industrialist or an environmentalist. It may be more subtle, but no less critical, in our special domain of internal decision aiding measures. Requiring the executive branch of government to publicly justify its actions with some kind of decision analysis may be appealing to Congressmen wishing to assert their control and the public wanting accountability, but anathema to bureaucrats whose freedom of action it impairs (Porter, 1988).

Decision analysis as an aid. We do not assume that ODA (or PDA) should be used as a decision aid in the organization itself. A Druid community may be well-advised to use chicken entrails as an aid for picking a propitious time for sacrifice--if the Druid culture requires it and little is lost by "irrationality". More seriously, a hurried business layman may prefer the Analytic

Hierarchy Process (Saaty 1978) to decision analysis if any logical disadvantage is more than outweighed by the appeal of inputs easier to provide. On the other hand, the rigorous reviewable rationality of decision theoretic evaluation may make it appropriate for us to evaluate decision aids with for a scholarly audience.

B. Matching aiding options to situations.

Brown and Ulvila (1977) have proposed a general scheme for matching analytic approaches to decision situations, but not specialized to organizational design. It involved mapping a taxonomy of problem situations onto a taxonomy of decision aid performance requirements; and mapping these onto a taxonomy of decision aiding options (including organizational design as a small subset). They illustrated the process with: a simple option of broad interest, viz. how much decision analysis effort (if any) to devote to a decision problem, as a function of its features (not limited to organizational setting); a sampling of matchings for a wider range of options; the prescription of a complete decision aiding strategy in three illustrative case-studies. The basis for all substantive prescriptions was the author's own decision aiding experience. A first step towards adapting this taxonomy matching to organizational issues is described in Brown (1989a), from which the attached table is taken.

C. Evaluation framework.

Within an ODA paradigm Brown (1982) has proposed a special purpose structuring scheme to permit internal actions, decision aiding organizational design in particular, to be evaluated in a given organization context. It models, not necessarily formally, causal linkages between:

- design variables (e.g. nature of aid, how used, organization adaptation);
- setting variables (e.g. nature of organization, external circumstances, culture);
- mediating variables (institutional fit, implementer satisfaction);
- performance variables (e.g. quality of resulting external actions, in terms of performance variables such as; public protection, employee morale, cost, individual effectiveness).
- aggregate evaluation (taking relative importance of performance variables into account).

The attached figure from Brown (1989a) shows an illustrative structure for a risk management case. Note that the appropriate organizational design may depend on setting, mediating and performance variables that are not themselves organizational (e.g. type of business, efficient use of resources and cost respectively).

Although the model should be useful without explicit quantification, causal dependencies between variables can be expressed mathematically, such that the impact of alternative design on aggregate evaluation, given setting can be calculated. In principle, hierarchical regression or influence diagrams, producing probabilistic output evaluation would be appropriate (Shachter

1986). However, in their common forms, these procedures may be impracticably burdensome and perhaps unnecessary. Simpler qualitative algorithms of the type developed by the Russians may prove appropriate (Larichev in press).

Figure

Any attempt at developing a general structure, applicable to a wide range of prescriptions, is likely to be attended by great complexity or large "error terms" if quantified. Nevertheless, the concepts guide our findings, at least informally.

V. SUBSTANTIVE CONTENT OF EVALUATION FRAME.

Any actual evaluation--generic or case-specific--requires explicit or implicit characterization of linkages in the model, which may be descriptive (organizational practice), predictive (what it commonly leads to) or evaluative (relative importance). Issues include: motivational field, "turf" conflict, cultural mismatch, myths of executive certainty, determinants of relative power and standing, and non-rational administrative processes. The weakest form of substance is prioritizing variables in a preset menu, e.g. which mediating or performance variables are primarily affected and which are most important in a given type of case.

A. Predictive building blocks.

To assist in predicting performance given design, empirical default judgments can be developed for pieces of the evaluation frame corresponding to a position on the above issues. Hypothetical simplified examples:

- The Lorsch-Lawrence (1967) theory of integration and differentiation suggests that decision aiding technology is more likely to be adopted in business organizations if an interpretive group with an intermediate orientation is interposed between technicians and deciders.
- Action suggested by procedures (like decision conferences) which centrally involve people who put a decision into effect are more likely to be implemented than by analyses conducted primarily by technical staff.

B. Values

Generalizations about values and their relative importance are constituency-specific. A performance variable like transparency of an executive agency's decision rationale may be of positive value to Congress and the general public, but negative to the agency. (The agency may not wish to reveal that empire building, reduction of "administrative hassle" and other politically embarrassing considerations influence its external decisions). A related common issue is the relative importance of the quality and defensibility of external decisions. (Defensibility may favor a crude mechanical decision rule over the exercise of sound judgment, e.g. a process over a performance based test of regulatory compliance).

Another candidate: "government bureaucracies care more about how an aid affects the rewards of individuals and sub-groups than about the social value of the external actions it aids").

VI. ILLUSTRATIVE PRECEPTS

Here are some representative actual prescriptions, comparable to the "if-then" rules of an expert system, as illustrated in Brown and Ulvila's (1977) general scheme for matching situation and decision aid taxonomies. These precepts may be derived from the two previous steps. The thrust in developing precepts is

similar to that of developing an expert system, with decision aiders initially as primary "experts". In addition to codifying recognition primed decision making (Klein, in press) into decision rules, it is worth delving into the predictive and value assessments underlying a precept.

A. Broad generalizations

The following are illustrative of candidate prescriptive hypotheses which may be broadly applicable (with some indication of supporting argument based on predictive hypotheses):

- Decision aiding technology should generally be offered within an organization by technical staff that reports to whoever makes the decisions. Argument: centralization may enhance the quality of external actions recommended, but render them less likely to be adopted (Brown 1970; Carter 1972; Galbraith 1977).
- Decision aid users should be intimately involved in the decision to implement decision-aid technology and in its development. Argument: it increases acceptance of a decision and facilitates implementation (Adelman 1982; Maier 1967; Vroom and Yetton 1973).
- Decision aids should be designed to be compatible with the decision makers' approach to decision making. Example: Wolek (1975) cites a typical case where a "rational system" for selecting R&D projects was formally adopted but not used because it conflicted with the personal leadership style of the company's president.
- To obtain prediction and value inputs to a decision analysis, an anonymous, mechanized procedure (such as Delphi) is preferred in a politicized public context (it minimizes political heat by appearing unmanipulable) and if the group is heterogeneous in status (it reduces intimidation). Otherwise a more informal, interactive pooling of experts (such as nominal group technique) is preferred, especially, if the experts have access to different sources of information (it enhances quality of external action, by bringing more information into play). (Fischer 1972).
- Qualitative or analog procedures are preferred to those requiring numerical manipulation (e.g. maximizing probability weighted utility) if people who supply the inputs or use the output lack a quantitative culture, except in controversial cases where having a reviewable rationale is overriding.

B. Specific domain: risk management.

Within the more limited domain of risk management and regulation, precepts are likely to be firmer, especially in narrower contexts. The following hypotheses are of increasing generality along the same track.

- When DOE is picking a nuclear dump-site, the agency's interests may be best served by a binding contingency rule, controlled by data not yet gathered. Argument: it promises to reduce political heat when the time comes. On the other hand, society's interests may be best served by delaying commitment until the last minute. Argument: it takes advantage

of important unanticipated developments and so improves the decision (Brown 1978)).

- If industry is entrusted with large budgets to research a major decision--such as the billions earmarked for nuclear site characterization--government should impose an explicit data gathering logic to discipline resource allocation. Argument: it avoids contractors' commercial interests perverting efficient use of scarce public funds (Brown 1992)
- If difficult analytic concepts, such as second order probability, are to be used to aid controversial risk management, thoroughly trained deciders are needed. (Otherwise concepts will be mis- or not applied, even if logically essential, for example in determining when enough supporting research has been done (Brown 1992, forthcoming).
- Government risk regulators should avoid publishing any formal decision rationale before a controversial choice, if avoiding "administrative hassle" and preserving discretion is more important to them than demonstrating accountability to the public (Brown 1991; USDOE 1986).

VII. EMPIRICAL METHODOLOGY FOR DEVELOPING AND VALIDATING PRESCRIPTIONS.

The primary objective is to establish an effective process of prescription, including data gathering and analysis, which will result in useful precepts.

A. Elements of methodology

The approach is plural, in the sense that precepts are developed and convergently validated by a combination of:

- formal or informal implementation of an evaluation framework, whose empirical content may itself be derived from (or tested against) decision aider expertise or social science theory;
- direct development of precepts, distilled from decision-aider expertise or social science theory;
- hierarchical induction from case-specific precepts to increasingly broad generalizations. For example in the sequence of nested risk management precepts in VIB above, each level of prescription might be based on consideration of representative lower level (i.e., more specific) precepts, possibly culmination in universal precepts for general organizations in general (if such exist).

In addition, precepts can be systematically validated with more intensive empirical validation methods. These may be based, for example, on principles for pre-testing unreplicable organizational innovations (Brown and Watson 1977), measuring the quality of decisions after the fact (Brown and Campbell 1990), or "build-test-build-test" formative validation, common in engineering design.

B. Methodology development cycle

There are four phases in the basic cycle of building methodology itself:

1. Available methodology is applied to practical problems, identifying deficiencies and lessons learned;
2. A broad array of supporting scientific hypotheses to address deficiencies of multiple kinds--of logic, data, implementability--are generated;
3. The hypotheses are refined and validated (optional);
4. They are incorporated into methodology upgraded for the next round of application.

My approach has been to focus on the first, second and fourth phases, which can stand alone. Other researchers may be better qualified to pursue the third, more conventional, contribution to science.

C. Complementary research for others

Such narrower research needs may for other researchers to address, i.e. by more conventional convergent, monodisciplinary research, for example the following

Normative. This may include logically coherent ODA paradigms which define and specify the organizational counterparts of personal options, probability and utility. Examples: Keeney's and Kirkwood's (1975) response to Arrow's impossibility theorem, related to group aggregation of individual utilities, Howard's (1975) interpretation of social utility, and Brown's (forthcoming) interpretation of impersonal probability.

Descriptive. This typified by prescriptively relevant organizational theory, such as Cohen, March and Olsen's (1972) garbage can, Allison's (1971) Bureaucratic process models of decision making, Watson's (1977) empirical research on social utility functions, and directed social theorizing and field work generally.

Validation. Implementing and developing validation methods requires major experimentation and monitoring (Levin and Minton 1986). This might involve computerized recording of the use and implementation of aids, and extensive expert evaluations (Adelman et al. 1985).

Surveys. Fieldwork among organizations active in decision aiding, along the lines suggested in Brown (1989b), could establish, for example, the room for improvement in unaided decision processes and the impact of past aiding efforts. Although my colleagues and I we have some experience of this type of research (Brown 1970; Ulvila and Brown 1982; Watson and Brown 1975), it is probably best done by other than decision aiders themselves, for reasons of conflict of interest

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