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On Integrating Knowledge Utilization With Knowledge Development: The Philosophy Behind The MAPS Design Technology[1]

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A philosophy of science is discussed that distinguishes knowledge development from knowledge utilization. As an integrating link, a technology is defined as a sequence of decision and action steps that seeks to create purposeful change based on whatever knowledge is available currently, subject to ethical considerations. The MAPS design technology is described in this vein, and a number of applications and research studies are summarized to suggest how this technology is being developed and utilized.

The Philosophy

A number of norms have developed in the social sciences that seem to emphasize a particular type of scientific progress: knowledge development rather than knowledge utilization (19). Descriptive theory, basic research, experimental studies, hypothesis testing, and simulation (knowledge *development* activities) are deemed more "scientific." As a result, they are more rewarded than normative theory, applied research, field studies, program evaluation, and applications (knowledge *utilization* activities). While it would be difficult to prove such assertions, reliance can be placed on several factors. They include the types of articles accepted in the prestige journals, the reward structure in universities (e.g., salary, promotion, and tenure decisions), and the informal peer group networks that tend to ascribe "contribution value" to social scientists.

There are a number of reasons why the evolved norms seem to encourage this emphasis. Experimental studies to develop knowledge are highly structured, controllable, and more precise than applying knowledge in diverse organizational settings with uncontrollable factors and many sources of variance and action. Thus, the "closed" laboratory is viewed as more scientific and subject to understanding than the open, dynamic, complexity of real organizations. Similarly, methodologies such as case studies, clinical observation, and consulting are viewed as not replicable, as unique to the observer or consultant, and therefore not scientific. Acclaiming the hard, physical sciences as the epitome of science in general has certainly contributed to some of these beliefs (17), as well as the psychological types (cognitive styles) of individuals who enter scientific fields (9,19).

Furthermore, applying knowledge to organizations raises ethical issues, more so than in laboratory settings. Although individuals can get "hurt" in

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laboratory experiments (16), in real-world applications greater numbers of individuals are involved. These individuals are often unaware, uninformed, and involuntary participants in the "application." If scientists leave their laboratories they had better be confident in the application or "external testing" of their theories or they may be in danger of hurting many people, and should be held responsible. This ethical danger and its potential consequences may motivate social scientists to leave the application of knowledge to those more willing to accept the responsibility (e.g., managers or management consultants).

Some of these reasons for avoiding knowledge utilization may be quite rational. However, knowledge utilization can be undermined by the norms or criteria in use (14). Unless these norms and criteria are challenged and changed, knowledge utilization is likely to remain as an ad hoc or chance occurrence. For example, it is sometimes said that theories should not be utilized until they are sound and valid. This attitude becomes a further rationalization for undermining knowledge utilization if one remembers that no theory is ever completely accepted or 100 percent valid. An existing theory has simply not yet been rejected. Thus, waiting for the ultimate theory or knowledge to be fully accepted, proven, and valid before it is utilized, is assuring that knowledge utilization will not take place.

Finally, it might be argued that *knowledge development cannot take place without knowledge utilization*. Experimental studies testing specific hypotheses under controlled conditions foster *internal* validity (2). That is, most alternative sources of explanation can be discounted so that the hypothesized cause of the phenomenon is still plausible. But, experimental studies cannot address *external* validity (2). That is, the hypothesized cause which has failed to be rejected may not generalize to real organizations but may be specific to subjects in laboratory settings. The only way to examine external validity is to apply the hypothesized knowledge under real, ongoing conditions where randomization may not be possible (for practical and ethical reasons), and where organizations can be affected severely by the field study (application). Thus, if knowledge development is defined as requiring both internal and external validity, efforts to develop knowledge by internal validity methods alone become quite narrow and misleading. This suggests that ultimately social science is only concerned with knowledge that is "true" in the laboratory! To foster external validity, and to make knowledge development relate to the real world, some social scientists will have to go into the field to complete the research process — to provide a sequencing of laboratory *and* field studies. But will such field work and knowledge utilization activities be rewarded and encouraged? Are not most of the empirical studies reported in prestige journals those that concentrate on internal validity? This brings us back to the problems and issues I raised at the outset.

Technology: The Integrating Link

There is an apparent need to not only legitimatize the importance of knowledge utilization but to suggest how knowledge development and utilization are interdependent. The concept of "technology" is proposed as a framework for distinguishing, and at the same time integrating, the two knowledge perspectives.

A behavioral science technology is formally defined as a step-by-step sequencing of decisions and actions which, as a total "package," brings about some planned and purposeful change in an organization or social system. Further, these decisions and actions are guided by substantive knowledge (theory) of how these decisions and actions can best be made, *based on what is currently known*. Naturally, the particular collection and sequencing of various decisions and actions is subject to interpretation. Under such circumstances, different scientists would develop different technologies. But as long as an ethical debate or code of ethics could reasonably justify the limited use of one or more of these technologies (21), field studies can further test, refine, and select among these different technologies. Such technologies *would also be modified as underlying theories are altered*.

Given this approach, it is necessary to distinguish a "technique" from a "technology." A technique is a single method, device, or procedure that may be the focus of a change effort. For example, T groups, flexitime, behavior modification, job enrichment, and management by objectives are some of the techniques that behavioral scientists have developed or used. The pure technique (i.e., the "core"), however, is not planned, implemented, and evaluated by itself. This is the technology — the whole package of step-by-step methods from "beginning to end" that bring about change. Thus a technology is much broader than a technique, as shown in Figure 1.

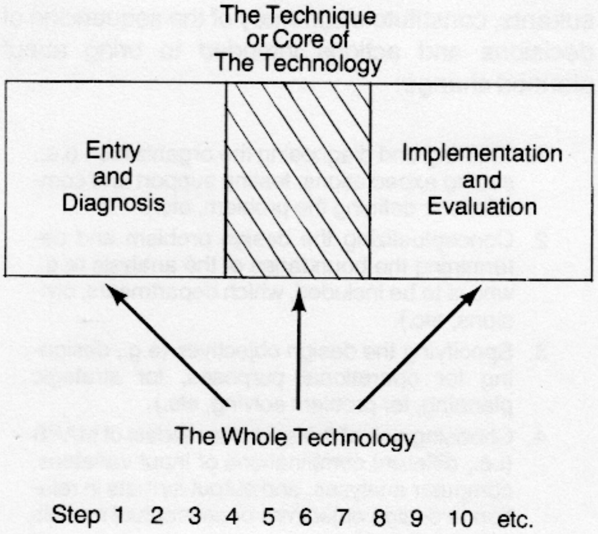

Figure 1
Technology vs. Technique

For example, an organization development (OD) technology may be formulated around the technique of a T group, but the technology first involves entering the organization, testing commitment, making certain diagnoses, and planning and scheduling T groups. The process then involves actually conducting T groups, and evaluating whether various improvements took place in the organization as a result of the activities. *Every technique proposed in the behavioral science area presupposes a whole set of supporting methods to apply the actual technique properly in any complex organization*. At a minimum, "entry and diagnosis" should be conducted before the pure technique is considered, and "implementation and evaluation" follow once the decision is made to use the technique (7). In cases where the change effort is not successful, it may be more the technology as a whole that was not applied appropriately (earlier or later steps of the technology) rather than the particular technique in focus.

A technique and its effects can be tested in a laboratory setting in its "pure" form. This is because the experimental method is best at reductionism; isolating and examining the well-defined parts of a total phenomenon under controlled conditions. The other parts, not currently of interest, are "randomly distributed," or removed from the situation, or ignored (19). Using the example of T groups, a number of experimental studies have been done to develop a knowledge base of what happens in the T group by varying the composition of the group, the style of the trainer, the length of the sessions, the issues that get discussed, etc. A technology, however, is a holistic entity, and in applications of the technology it is not at all clear which parts or steps produced the observed effects on the organization. If the OD technology did not seem to help the organization, was the T-group activity not conducted properly? Or was it that top management never supported the idea of T groups and therefore made it difficult for the learnings of middle managers to become manifested in the organization? Therefore, even if the parts of a technology can be studied in a laboratory, knowledge utilization requires that the whole technology be applied in organizational settings even if the effect of the parts cannot be easily distinguished. It is unrealistic to apply the pure technique to an organization and expect clear-cut results because the other implicit parts (steps) of the technology greatly affect what will happen. These other steps cannot be randomly distributed, removed from the situation, or ignored. To do so would turn the organization setting into a modified laboratory which would defeat the whole purpose of going to the field in the first place.

To further illustrate this distinction between techniques and technologies, consider the following. Pinder (21) has concluded that the accumulated knowledge of motivation theory may not be ready for application (for organizational change) even though field studies (for validity purposes) are clearly needed. In his summary of the mixed predictions of theories and mixed results from applications, however, it seems evident that he focused on the technique rather than the techology, as did the authors he cited. One can conclude, alternatively, that it is not primarily the technique of MBO or job enrichment that is underdeveloped. Rather, it is the step-by-step procedure that first prepares the organization for change, tailors the technique to the unique circumstances of the organization, implements the "prepared" technique in a carefully planned manner into the mainstream of organizational life, and then monitors and adjusts the implementation based on feedback and evaluation as the process evolves. I do not think that the *implicit* technology operating in the cases that Pinder cited gave the *explicit* techniques a fair test. Instead, more is known about the pure motivational techniques than the full technologies of planned, motivational change because the scientific norms have emphasized knowledge development rather than knowledge utilization.

The Philosophy and Technology Of MAPS

I will now summarize the substance and development of the MAPS (Multivariate Analysis, Participation, and Structure) design technology. It will demonstrate that not only can knowledge utilization be pursued jointly with knowledge development in general, but that the evidence to date suggests that MAPS generates sufficient confidence from its applications that the ethical use of MAPS can be supported.

The Steps of the Technology

MAPS was suggested initially by Kilmann and McKelvey (8) to redesign the subunits of organizations and was then developed into a formal design technology by Kilmann (7). Essentially, using questionnaire data on members' task and/or people preferences, MAPS can form tasks into task clusters and people into people clusters. Then each people cluster can be assigned to a task cluster resulting in alternative organization designs (e.g., departments, divisions, teams, etc.). MAPS is intended for a wide variety of design objectives. In essence, MAPS is meant to be applicable whenever the issue emerges of how to best mobilize human and technological resources to address organizational objectives and problems.

The MAPS design technology consists formally of as many as 12 distinct steps. It starts with the identification of an organization problem that can be defined vis-a-vis organization design and proceeds to the evaluation of whether a new implemented design actually improved organizational effectiveness. These 12 steps, conducted by organizational members with the aid of behavioral science consultants, constitute a summary of the sequencing of decisions and actions intended to bring about planned change:

1. Entering and diagnosing the organization (i.e., setting expectations, testing support and commitment, defining the problem, etc.).
2. Conceptualizing the design problem and determining the boundaries of the analysis (e.g., who is to be included, which departments, divisions, etc.).
3. Specifying the design objectives (e.g., designing for operational purposes, for strategic planning, for problem solving, etc.).
4. Choosing one of the scientific models of MAPS (i.e., different combinations of input variables, computer analyses, and output formats in relation to design objectives or conceptual models of the problem).
5. Developing the task and/or people items for the MAPS questionnaire (i.e., tasks to accomplish, people to work with on the tasks).
6. Responding to the MAPS questionnaire (e.g., the extent to which each respondent would like to work on each task, and to work with each other respondent, both on a seven-point Likert scale).
7. Analyzing the design data from Step 6 via the MAPS computer program (i.e., using multivariate statistics to generate alternative organization designs by showing which group of people should work on which cluster of tasks).
8. Selecting a MAPS design (i.e., choosing one of the several designs that can be generated in Step 7 via a dialectic debate).
9. Implementing the selected design (i.e., providing resources, authority, policies, responsibility, etc. for members to actually work in a new design; team building and support to help them learn to work effectively in a new design).
10. Monitoring the implementation process (e.g., assessing resistances to change, emerging problems, etc., and then utilizing strategies to best manage the process).
11. Evaluating the results of the design change (i.e., does the new design solve or manage the

initial problem and improve organizational effectiveness?).
12. Rediagnosing the organization (i.e., reinstating the diagnostic process in Step 1).

Steps 5, 6, and 7 constitute the technique part of MAPS or the core of the technology. It is in these steps where the most accepted organization design theories (10, 12, 13, 23) have been interpreted (7, Chapter 1) and then operationalized into a computerized design process (7, Chapter 4). For example, correlational and factor-analytic analyses are used to search for the most important interdependencies among the tasks (from data on the MAPS questionnaire). These interdependent tasks (first reciprocal, then sequential, and lastly pooled) can then be placed within rather than between organizational subunits in order to minimize coordination costs (23).

Steps 1 through 4 and 8 through 12 represent the procedures necessary to apply the technique effectively in a real organization setting. These steps are suggested from organization development and intervention theories (e.g., 1), and have been interpreted specifically for designing organizations (7, Chapters 2, 3, 5, and 6).

Assumptions in MAPS

A number of assumptions are embedded in MAPS. Their appropriateness depends on the particular organization and/or one's basic view of humanity. Specifically, MAPS assumes that Theory Y is a valid, useful, and accurate description of motivational tendencies (7). MAPS assumes that individuals, with the right climate and support, can generate valid and useful descriptions of task (or problem) items. Further, MAPS assumes that people can assess their own preferences and abilities to work on tasks and can select the appropriate individuals they need to work with on the tasks. Incidentally, sometimes it is feared that an individual (an accountant) will choose to work on inappropriate tasks (engineering design) because of a wild preference not based on reality. Experience suggests that this is quite unlikely, and would be done only to sabotage the project or to make fun of the MAPS process. This would occur only if the climate in the organization was not conducive to an open and honest design process. And if the right climate can not be generated, for ethical as well as validity reasons, MAPS would not be applied.

Other assumptions of MAPS concern the validity of using task and people information as the major input to the design process. Objective assessments of ability, expertise, and intelligence are not included currently, nor are age, status, or members' present organizational positions used as design criteria. Maybe the latter are important, but MAPS relies on forming groups based on task interdependencies and interpersonal compatibility, primarily. A number of other assumptions are made about the multivariate statistical methods of MAPS. They include the form of the data and the interpretation of outputs from the design analyses. Research and experience will shed further light on the validity of these critical assumptions.

Applications and Research With MAPS

Five basic types of research methods are used in the social sciences: (a) laboratory experiments, (b) laboratory simulations, (c) comparative field studies, (d) longitudinal field studies, and (e) case studies. The important consideration in these different approaches is to realize that each has its advantages in regard to the ease of obtaining research samples, as well as constraints on internal and external validity (2). Thus to evaluate and develop the MAPS design technology further, it is necessary to apply a variety of research approaches to combine the advantages and minimize the disadvantages of each.

For example, the case study approach is most helpful for investigating complex phenomena that have not been well understood and articulated previously. As a result of the case study (or studies), specific hypotheses may be formulated and tested in a controlled laboratory setting. When some confidence has been developed in regard to a useful explanation of the phenomenon (in the controlled laboratory setting), a laboratory simulation can then be conducted to examine if the same explanation, prediction, or control of behavior also will occur in a less constrained setting. If the various laboratory findings and explanations are still plausible and support some internal validity, the theories (in the form of techniques) may then be investigated in a comparative field setting to test the external validity of the whole technology. Various cycles of such different research approaches would continue, where refinements and modifications can occur at each stage.

What is most important, however, is not the particular sequence of research studies (i.e., first a case study, then laboratory studies, then field studies, then further case studies, etc.), but that some sequence does take place. Both internal and external validity cannot be assessed in one research study nor by one research method (2). By the same token, *knowledge development cannot take place without knowledge utilization*. The development of knowledge, as discussed earlier, necessitates both internal and external validity. Remaining in the laboratory and conducting tight experimental designs does not enable researchers to assess if their hypotheses (and theories) would fail and be rejected in settings other than in the laboratory. External validity, by definition, requires that hypotheses be tested in various organizatonal settings, applying such methodologies as longitudinal field studies. When control groups are not feasible because of practical or ethical reasons, then case studies may be the only recourse to assessing the generalizability of some laboratory-based knowledge.

Table 1 summarizes the key distinctions discussed thus far via a matrix that shows the five research approaches. In each cell of the matrix the relative internal and external validity of each research methodology are suggested. In making the qualitative expectations on internal and external validity, it is also assumed that each research methodology is applied appropriately to maximize its potential advantages and to minimize its disadvantages (e.g., utlization of reliable and valid measures, randomization where possible, etc.).

Also shown in Table 1 are sixteen applications of MAPS sorted into five cells according to the research methodology that was utilized. These sixteen cases are listed in chronological order in Table 2, indicating the organization type, the design objective, the research method applied, and the reference to a more detailed discussion of the study.

Table 1
Research Studies with MAPS

	LABORATORY EXPERIMENTS	LABORATORY SIMULATIONS	COMPARATIVE FIELD STUDIES	LONGITUDINAL FIELD STUDIES	CASE STUDIES
Internal validity	High	Medium	Low	Low	Low
External validity	Low	Medium	Medium	High	High
Studies (from Table 2)	Case 16	Cases 10, 11, 12	Case 3	Cases 1, 4, 6, 8	Cases 2, 5, 7, 9, 13, 14, 15

Table 2

Applications of MAPS in Chronological Order

Case	Organization	Design Objective	Research Method	Reference
1	University (A)	Design new department	Longitudinal Field Study	(15)
2	University (B)	Curriculum redesign	Case Study	(5)
3	Community Service	Design new structure	Comparative Field Study	(6)
4	Industrial (A)	Redesign to reduce conflict	Longitudinal Field Study	(4)
5	Industrial (B)	Task design for MBO	Case Study	(7)
6	Financial	Structural diagnosis	Longitudinal Field Study	(4)
7	Retail	Form teams and goals for OD	Case Study	(7)
8	Public Agency	Strategic planning	Longitudinal Field Study	(18)
9	Scholarly Journal	Diagnose structure of editorial board	Case Study	(11)
10	Eighth Grade Class	Team formation and research	Laboratory Simulation	(7)
11	Executive Class (A)	Problem-solving system	Laboratory Simulation	(7)
12	Executive Class (B)	Issues for management education	Laboratory Simulation	(7)
13	Doctoral Seminar	Write book on MAPS	Case Study	(7)
14	Industrial (C)	MIS design	Case Study	(20)
15	Federal Agencies	Reorganization issues	Case Study	—
16	Research Study	Effects of group composition	Laboratory Experiment	(22)

While some of these studies were carefully planned, an important determinant of the *actual* sequence was the availability of organizational settings or even the unplanned opportunities to apply MAPS. Unexpected application sites, as might be expected, affected the feasibility of the field studies and case studies. Laboratory studies were convenient to arrange because of ample management students at a large, urban university. Consequently, the following chronological order of knowledge development/utilization studies is a result of planning and chance encounters.

The first application (which subsequently led to MAPS) was a longitudinal study in an educational system over a 20-month period, where the predictive validity of the technique (an earlier version) was tested (15). The study found that the best design solution suggested by factor-analytic procedures predicted not only the right substantive theme which was derived by the subsystems, but also predicted with 82 percent accuracy which members would actually select themselves for the evolved subsystems. Considerable predictive validity was suggested because the members never saw the "best" solution of subsystems (i.e., the most member-preferred fit of tasks and people) and the researchers did not involve themselves in any stage of implementation. Basically, the organization members were given considerable freedom by the top administrator in choosing the subsystem they wanted to be identified with, and the members could switch in and out of subsystems while making their final choices over the 20-month period. The only information the members had before they began making subsystem choices were two very different, factor-analytic designs (i.e., a five-cluster solution and an eleven-cluster solution. Both varied considerably from the eight-cluster solution that had the best match of people to tasks.

The second application (5) involved a case study to replicate and examine more thoroughly the effects of factor-analytic designs in a similar organizational setting. The third application was a comparative field study in the same organizational setting (an educational system), to quantitatively assess the effects on an organization using MAPS as compared to control groups not using MAPS. It was during this application that the broader, technological aspects of MAPS were coming to focus and a more elaborate, computerized technique was developed.

The next applications utilized MAPS in different types of social systems. Cases 4 and 5 took place in industrial settings; the former was a longitudinal study (4), the latter a case study (7). Case 6 entailed a financial organization (4). Case 8 was a longitudinal study that involved a large federal agency (18), and case 9 utilized MAPS in a scientific organization via a longitudinal study (11). This set of applications led to the formal 12 steps of the whole technology.

Cases 10, 11, and 12 focused on special-purpose designs in more controlled settings (i.e., laboratory simulations). Case 13 concerned the very specialized application of writing a book (7). Cases 14 (industrial) and 15 (governmental) were continued efforts at case studies benefiting from the more controlled applications conducted previously. Finally, Case 16 was the first laboratory experiment on the technique part of MAPS that concentrated on internal validity (22).

What Was Learned?

Three major themes have emerged from these studies. These themes are more evident when one views the studies as a whole, rather than examining them piecemeal.

The *first* theme concerns the importance of the early steps of the technology, entry and diagnosis. The studies reaffirmed the crucial need for top management support of any technology applied in an ongoing, complex organization — especially a technology that can have a significant impact on the organization. Or, in terms of Argyris (1), valid information, free choice, and internal commitment need to be evidenced, if not fostered explicitly, at each step of the intervention, from beginning to end. Even though members of the organization may limit the likelihood of developing these conditions, it seems that the attitudes and behaviors of top management are the key driving force. Will top management encourage and foster these conditions?

Cases 1, 8, 9, and 14 had the most top management support and as a result seemed to generate the most commitment to the entire MAPS process. On the other hand, cases 2, 3, 4, 5, and 15 had the least support (or even negative support at times) which greatly limited the participation and outcomes with MAPS. In case 5, for example, MAPS was "driven down" to the lowest levels of the organization without anyone from upper management levels participating in the design process (7). The design that emerged from this study was viewed by the organization as an experiment and then ignored. Subsequent interviews suggested the negative effects of this application on the morale of the members who spent many hours participating in what they thought was an important undertaking. Because of such experiences, MAPS is not applied now unless top management support is deemed fully sufficient to permit positive outcomes.

A *second* theme, related to the first, is that both the earlier and later steps of the technology can be more important to the overall success than the statistical technique steps. It was believed initially that analyzing the responses to the MAPS questionnaire and deciding on the particular multivariate statistics to use in formulating alternative organization designs was the central feature of the MAPS design technology. In other words, the technique was the technology. Certainly this is the traditional objective of management science; the quantification of a decision process. Research experience has now suggested that for special-purpose designs (e.g., strategic planning or problem solving), the mathematical parts of MAPS are almost incidental. Commitment, development of task or problem items for the questionnaire, and coping with implementation problems are much more important. Although the various multivariate statistics do sort people and tasks together, the process itself seems to determine more the quality of outcomes in the special-purpose designs. Perhaps the sheer complexity and uncertainty surrounding these special missions makes the *whole design process* more critical than any single, selected design (as with an organic-adaptive organizaton). However, with regard to the more fundamental design efforts (i.e., changing an organization's day-to-day, operational design), the technique part of MAPS becomes more important, especially when the organization's formal design is very much out of line with environmental, technological, and people contingencies (12, 13). But even here, the technique cannot provide its benefits if the broader technological aspects are not conducted properly.

The *third* theme is that laboratory simulations and experiments do not provide much insight or learning about MAPS. The laboratory studies have concentrated on the technique part of MAPS (e.g., the assumptions surrounding the multivariate statistics and the computer suggested designs), rather than the earlier or later steps of the technology. As implied in the second theme, if the broader parts of the technology are often the critical ones, then focusing on the technique and its effects in a laboratory setting may be inappropriate. But can the earlier and later steps of the technology (e.g., commitment and implementation) be brought into the laboratory? I do not think so, because laboratory settings are contrived without real commitments and real stakes, even if "involving games" or acceptable deceptions are employed.

Future Directions

Based on the three themes noted above, the future of MAPS is to concentrate even more on understanding and developing approaches to improve *entry and diagnosis* as well as *implementation and evaluation*. Further work on the multivariate statistics, their assumptions and effects, is not the most important problem. The weakest link in the steps of the technology are more qualitative than quantitative, even though the latter would be easier to investigate. By easier is meant controllable, precise, and subject to examination under laboratory conditions. The more difficult but most appropriate focus should be on those aspects that can not be brought into the laboratory (i.e., the broader technology), suggesting that more knowledge utilization activities are needed in order to enhance knowledge development of the real world. The technique will need to receive further elaboration and refinement only when knowledge of the technology has caught up with knowledge of the technique.

Regarding techniques and technologies in general, it would be interesting if, in the long run, most techniques can be developed and tested rather well in the laboratory. Thus, independent of the particular technique in question, internal validity studies may be sufficient to develop knowledge of the technique. At the same time, it would not be surprising if the broader technology always needed to be developed and tested in the field. Then, whatever is learned about the earlier and later steps of a technology via knowledge utilization studies could be generalized to embody all sorts of techniques with minimum alterations. Perhaps this is the purpose of a theory of intervention (1). It becomes quite necessary to distinguish techniques from technologies in planning research studies (internal vs. external validity) and in appreciating the interrelationship of knowledge development and knowledge utilization.

Finally, it is important to return to the issues raised at the outset and to confront the norms that seem to undermine the philosophy of knowledge utilization proposed in this article. While MAPS has proceeded in spite of these norms (for various reasons), perhaps other behavioral science technologies have not, or at least the possibilities for accumulated knowledge on technologies have been constrained. I hope that raising these normative issues will encourage others to change the constraining norms and put science in its proper perspective: to better manage and solve real world problems and not just laboratory problems. But social scientists know how difficult it is to change an organization let alone the institution of science. Ironically, it may take a systemic change effort with the use of behavioral science technologies to alter such institutional forces and practices!

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