THE INSTITUTE OF MANAGEMENT SCIENCE

COLLEGE ON MANAGERIAL PROBLEM SOLVING

NEWSLETTER

Jerry Smith, Editor Vol, 4, #4 December 1990

I first want to report the results of the election for College Board membership that was conducted through the previous edition of the Newsletter. As you may recall, five candidates were nominated for three Board positions. All five nominees had outstanding credentials and received considerable support. However, Chris Argyris, Anne Huff, and Warren Lieberman were the three leading vote-getters. I have sent each of them a letter of congratulations. The College is fortunate to have people of this quality on its Board, and I look forward to working with them.

I have also sent letters to Jim Evans and Roger Hall, thanking them for agreeing to be nominated and soliciting their continued active involvement in College affairs. I particularly want to express my gratitude to Roger for his past service on the Board. In addition to having organized College-sponsored sessions at TIMS conferences, Roger has been a frequent source of good advice on what the College ought to be about. I also want to thank Lance Eliot, an outgoing Board member who did not stand for reelection. Lance is a charter member of the College and was the first editor of the Newsletter. I'm sure the full membership joins me in thanking these people for their contributions to the College.

As you will see, about half of this Newsletter is being used to publish a directory of the College membership. This directory does not include the names of people who have joined the College since mid-September as part of their TIMS membership. Otherwise, however, it is believed to be complete. It is certainly worth knowing who we all are, and it is hoped that directory publication will become something of a biannual event.

In this issue . . .

Another noteworthy item in this edition is the "Call for Papers" for the TIMS/ORSA conference to be held in Anaheim, CA on November 2-5, 1991. The College's presence at TIMS conferences has been in decline, but perhaps the promise of southern California in November (Note: This is being written by a Minnesotan during winter) will help evoke more substantial participation. Please mail in a completed copy of the "Call for Papers" by March 22 if you would like to be included in College-sponsored sessions at this conference.

Finally, the two inevitable reminders. 1991 College dues are payable for all who haven't already done so through TIMS or elsewise. And, as always, I would welcome member contributions of almost any kind for publication in the Newsletter. Now that you know who your fellow members are, perhaps more of you will be inspired to contribute.

Submissions to: Jerry Smith, Information and Decision Sciences Dept., Carlson School of Management, University of Minnesota, 271 19th Avenue South, Minneapolis, MN 55455

TIMS College on Managerial Problem Solving

Membership Information:

College membership is open to all. Annual dues are $3 for TIMS members, $5 for others. Persons belonging to TIMS can join the College by so indicating/ remitting when filing their TIMS renewal. Non-TIMS members can join by sending a $5 check (payable to the "TIMS College on Managerial Problem Solving") to the Managing Director. Applications for TIMS membership can also be obtained from the Managing Director. Send to: Jerry Smith, Information and Decision Sciences Dept., Carlson School of Management, Univ. of Minnesota, 271 19th Avenue South, Minneapolis, MN 55455.

ANNUAL REPORT

The College's current membership consists of 185 people. All these members have paid College dues at some time in the past, although a number were not current through 1990, and presumably have not yet paid 1991 dues. The TIMS home office periodically sends out the College membership rolls that it maintains, indicating people who have joined the College directly through TIMS. These people are added to our mailing list and are sent recent newsletters, along with a letter welcoming them to the College. The last membership list we received from TIMS was dated September 19, 1990. Thus, there are likely to be a dozen or so new members, beyond the 185. Nor do we know how many of our existing members have paid their 1991 dues through TIMS. In any event, the College appears to have a stable membership base in the 150-200 person range, a base which can be increased through a modest marketing effort.

As regards finances, the situation is similar: The available information suggests that the College is financially healthy. The TIMS home office handles virtually all of our financial activities, periodically advising us of our account balance. As of September 19, 1990, this balance was $767.10, as compared with $448.17 on 9/30/89. TIMS does not routinely identify the total dues income we receive or the administrative expenses they charge us. In other words, we get a one-line balance sheet, but no P&L statement. The College's increasing account balance derives from the fact that our major expense--Newsletter copying and mailing--is being borne by the Information and Decision Sciences Department at the University of Minnesota. We should not plan on receiving this "free ride" in perpetuity. For the College to be truly self-supporting, it may be necessary to institute a modest increase in the annual dues rate. Relatedly, College management is open to suggestions as to how the College might start using its financial resources to promote our mission.

BRITISH APPROACHES TO PROBLEM STRUCTURING:

A BOOK REVIEW AND DISCUSSION

Rosenhead, Jonathan (Ed.) (1989) Rational Analysis for a Problematic World: Problem Structuring Methods for Complexity, Uncertainty, and Conflict. Chichester, UK: John Wiley. 370 pages.

Reviewed by Jerry Smith

This is the continuation and conclusion of a book review and discussion initiated in the last issue of the Newsletter. That issue included a description and assessment of three of the six problem structuring methods discussed in Rosenhead's book: Strategic Options Development and Analysis; Soft Systems Methodology; and The Strategic Choice Approach. After a discussion of the remaining three methods, I will conclude with some general comments on problem structuring.

Robustness Analysis

Per Jonathan Rosenhead, Robustness Analysis "provides an approach to the structuring of problem situations in which uncertainty is high, and when decisions can or must be staged sequentially. Its characteristic thrust is to identify decisions early in the sequence that will keep open a range of options for the future" (p. 194). The future, or important parts of it, is inherently beyond our powers of prediction. Consequently, in initiating a planned sequence of actions, it is important that initial alternatives be evaluated in terms of the flexibility they preserve for future choices. This is achieved through assessment of a decision's robustness, defined as "the number of acceptable options at the planning horizon with which it is compatible, expressed as a ratio of the total number of acceptable options at the planning horizon" (p. 200). Thus, robustness becomes a criterion for selecting alternatives, robustness not being outcome goodness per se, but the relative proportion of good outcomes in the total set of possible outcomes for that alternative. Robustness can be assessed vis-a-vis one or more potential futures, conceivable states of the system at the planning horizon.

Procedurally, Robustness Analysis has close parallels to decision analysis. Problems are structured in terms of decision nodes, alternatives, contingencies, and outcomes. Outcomes are classified by rough degree of attractiveness (as from "desirable" to "catastrophic"). A tree-like representation connects alternatives with the outcomes to which they can plausibly lead. Robustness scores and "debility" ratings (reflecting exposure to undesirable outcomes) can be calculated for each decision alternative under each imagined future. Representation in a robustness or debility matrix helps one to compare alternatives and make a judgmental selection of the most attractive. Thus, one would tend to favor the alternative that has the highest access to desirable end-states and the lowest exposure to undesirable outcomes. This basic procedure can be embedded within a more encompassing methodology which provides aid in specifying pertinent constraints, alternatives, resources, cause-effect dynamics, environmental states, and possible futures.

Assessment. While the strategy of preserving flexibility is applicable to many kinds of problem situations (e.g., "least commitment" approaches to planning and design), Robustness Analysis is intended solely for sequential decision problems, those centering on a staged sequence of choices. Far more than the methods discussed previously, it owes much to traditional MS/OR problem solving philosophy and techniques, especially decision analysis. It is arguably a complement to, rather than a replacement for, decision analysis. For while robustness is a useful criterion for evaluating options in a sequential problem, it is hardly a substitute for more fundamental assessments of an outcome's goodness or utility, or of the likelihood that particular end-states will result from a course of action. Like decision analysis, this technique could be faulted for assuming knowledge, but only weakly supporting its generation. Robustness

Analysis assumes that one can identify all alternatives, possible futures and outcomes, and their desirabilities, but it provides little substantive aid for the identification process. In sum, Robustness Analysis is likely to be a useful tool for the analysis of multi-stage decision situations, but it is not a general problem structuring technique.

Metagame Analysis

Metagame Analysis was developed in the 1960s for use in high level governmental policy making. It has since been applied to corporate management. Per Nigel Howard, the technique is used for "analyzing processes of conflict or cooperation between actors" (p. 240). Two or more actors are each regarded as having one or more policy options. Each feasible set of actor-option combinations constitutes a scenario. Since actors can select different policies over time, many sequences of scenarios are possible. The intent of Metagame Analysis is to assist a client's selection of policies by identifying pertinent scenarios and the threats and promises that can be used to achieve desired outcomes. Thus, analysis can point out infeasible scenarios, the scenarios desired by other agents, possible compromise scenarios, and potential conflict points that an actor can use to threaten others. Application of Metagame Analysis is facilitated by CONAN, a computer program which provides a range of computational aids.

The process of Metagame Analysis includes the dynamic evaluation of plausible sequences of moves and countermoves, or scenario chains, as well as the static assessment of particular scenarios. Dynamic analysis traces out sequences of actor moves and countermoves, identifying their likely outcomes and searching for sequence variations that lead to desirable conclusions. Static analysis centers on the assessment of threats and promises, "the basic pressures that actors can exert on each other in the given situation" (p. 248). A scenario is chosen and analyzed for stability. One then identifies all unilateral improvements that actors and subsets of actors could make from the scenario. Questioning of the client will reveal sanctions that can be used to deter the unilateral improvement of others. This enables construction of a strategic map representing the threats and promises by which actors can try to stabilize the situation at preferred scenarios.

Assessment. Metagame Analysis has obvious origins in game theory. However, it is less driven by the quantified value of outcomes and apparently includes no counterpart to the probabilistic mixed strategies of its game theoretic parent. On the other hand, it seems much better adapted to dynamic analysis, the assessment of extended move-countermove sequences. Also, Metagame Analysis is more realistic psychologically. Rather than assuming that all players are perfectly informed about outcomes and the preferences of others, this technique helps one to predict outcomes. And Howard's account includes an in-depth discussion of how to use deceit and other stratagems to make threats credible to others. As a problem structuring technique, Metagame Analysis is limited to situations in which multi-agent interaction is the defining issue. Though it is not a general structuring technique, it is likely to be useful within its domain of applicability.

Hypergame Analysis

Another offshoot of game theory, Hypergame Analysis was developed, primarily by Peter Bennett, in the early 80s. The defining characteristic of the technique, vis-a-vis other game-based approaches, is its emphasis on the differing views or problem representations that can be held by different actors in a multi-agent situation. In part, these varying perspectives reflect the fact that agents have multiple individual agendas which go well beyond the situation at hand. Hypergame Analysis starts from the traditional game theoretic representations--matrices, trees, and tableaus--adopting these to its purposes. Each agent or player in a situation is assumed to have a set of strategies or action alternatives, the choice of strategy for each player defining an outcome of the game which yields some measure of value or utility to each player. Since the hypergame approach assumes that each player can perceive the game (i.e., available strategies, resulting outcomes, and relevant preferences) differently, its representation depicts different games for each player. Game tree representations are helpful in showing sequences of choices, and tableaux--much like those used in Metagame Analysis--can be used to represent even more complicated situations.

The basic hypergame framework has been extended "to allow for more radical differences in play-

ers' perceptions" and "to consider systems of linked interactions, rather than just isolated hypergames" (p. 301). In the former, one allows for disagreements as to who the relevant parties are and who is responsible for certain actions, representing situations in which actors have fundamentally different world-views. The second extension is responsive to the fact that "actors are often involved in many related decisions, each having a bearing on choices in the others" (p. 302). A method called Preliminary Problem Structuring helps identify and represent the many interactions and "games within games" that constitute a hypergame situation. The concept of a decision arena is used to specify the contents--each agent's options, preferences, beliefs, strengths, weaknesses--influencing the interaction. These tools are embedded within a broader, more eclectic, decision aiding methodology that is "mixed-scanning, iterative, and piecemeal" (p. 308).

Assessment. The hypergame approach, even more than Metagame Analysis, is a self-admitted descendant of game theory. The discussion chapter begins with a description of game theory, illustrated by the "prisoner's dilemma," and the technique adopts the basic game theoretic problem representations. However, even more than Metagame Analysis, Hypergame Analysis goes beyond its game theoretic origins in trying to deal with the complexities of real world problems. Its focus on the divergent perceptions of different actors is valuable. Even more so the explicit recognition of the interconnectedness of multiple game-like decision situations involving an extended set of agents. The realization that a person's response to one situation will be conditioned by the many other actual and anticipated concerns on his/her agenda (e.g., Will this send the wrong signal to Personnel?) is an important step towards realism. As with the other techniques, Hypergame Analysis is primarily applicable to situations involving conflict and cooperation among multiple agents. However, especially through its extensions, this method seems responsive to the many complexities that such situations can present.

General Discussion

Rosenhead's introductory and concluding chapters usefully frame the six techniques presented in this book. As he points out, the official MS/OR paradigm is built around a mathematical modeling approach to problem solving. Consequently, as critics like Ackoff have argued, MS/OR tends to be technique-driven, applicable only to the relatively small sets of problems fitting its techniques. The structuring methods presented in this book reflect efforts by British researchers to construct an alternative paradigm for the field, one that sacrifices narrow mathematical rigor for increased relevance to real world problems.

Assuming a goal of being able to respond in a useful and principled way to the full range of real world problems, to what extent has this objective been achieved by research presented in this book and elsewhere? As Rosenhead acknowledges in the concluding chapter, many of these techniques are applicable only to certain kinds of problem situations. Even so, their domains tend to be broader than those circumscribed by classical MS/OR techniques. The most general structuring methods--for instance, SODA--tend, not surprisingly, to be much less powerful. Rosenhead notes that all of the methods make few demands for quantitative data and pursue satisficing, rather than optimal, solutions. In that respect, they are better adapted to real world problem solving than their traditional MS/OR counterparts.

Arguably, the search for better problem structuring methods presumes improved understanding of the kinds of structures that problem situations might possess. As this book indicates, we have a fairly well-developed account of the structural aspects of decision situations: temporal dependencies among sequences of actions, move-countermove dynamics, etc.. But we haven't thought through other kinds of problem situations as thoroughly. Underlying this is the lack of a basic language for characterizing problem situations per se. Problem solving research is replete with talk of goals, alternatives, ideas, options, preferences, conflict, and uncertainty. But there is no coherent conceptualization to order this vocabulary into a set of categories that are necessary and sufficient for representing problems and their structures.

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