GENERIC COMPUTER TOOLS AS AIDS IN NEGOTIATION: THE ISSUE OF USER ADOPTION

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ABSTRACT: Negotiating groups can use generic computer tools to aid decision-making and problem-solving activities in negotiation management. In attempting to create, apply, and evaluate such computer tools, the authors have had to address the issue of user acceptance. This paper reviews the basic framework of negotiation management and locates the issue of user acceptance within that framework. Focusing on system dynamic simulation models as tools for negotiators, the paper analyzes the reactions of potential and prospective users.

1. INTRODUCING MODELS AS NEGOTIATING TOOLS

Just as computer tools have come to be recognized as useful aids in the decision-making processes of individuals and organizations [Bui & Jarke, 1986; Jacquet-Lagreze & Shakun, 1984; Gray, 1983; Keen & Scott-Morton, 1978], their role in negotiation and dispute resolution is also coming to be acknowledged [Göltner, 1987; Nyhart & Samarasan, 1987; Jarke, 1986; Nyhart & Dauer, 1984]. As part of a project whose goals include the development and evaluation in context of computer tools for negotiation management, the authors have begun to introduce the use of these tools—both generic and specialized—to negotiators.[1] This paper is about that process of introduction: it analyzes the reactions of potential and prospective users, and speculates on ways in which adoption by the user might be more readily achieved.[2]

Computer tools can be introduced to negotiators in three dimensions.[3] First, the generic principles underlying the use of the tools need to be explained. Each tool also has usefulness as an analytical aid, even if it is used by each side separately. And, of course, there is the possibility of negotiators jointly using computer tools as communication aids.[4]

In motivating the use of computer models by negotiators, the authors have developed generic demonstrations in which a number of computer tools are shown to prospective users. In nearly all instances, the content, *i.e.*, the subject matter of the modeling, is not specific to the potential user's prospective application. Rather, it is intended to illustrate the principles underlying the generic uses of the tool. This kind of demonstration has generally evoked a positive reaction, but in every case the potential user wants to see more.

The next step in the process of introduction is to present the tool as an analytical aid in the context in which the user might use it. This step requires that a presentation be designed with the subject matter of that context in mind.

If the user accepts the use of the tool as an analytical aid, then the next step is to present the tool as an instrument to be used in actual negotiation, *i.e.*, by both sides simultaneously. Cognitively, this step appears to be the most difficult for the user to accept, and the challenge for the advocate is to locate the tool in a role that is perceived as being productive within the domain in which the user perceives breakdowns in negotiation to happen. The ideal setting for such a demonstration is, arguably, in the presence of all parties to the negotiation. Placing this condition on the process, however, is rarely acceptable to the potential user in the initial stages of the process of introduction.

As one might expect, the models that are used in the process of introduction tend to become more and more complex as the process proceeds. And if more than one tool is being considered for use, then the relationships between multiple tools also increase in complexity. This increase in complexity has unfortunate effects: the cost of designing and building the models increases; and prospective users are confused rather than aided by any demonstration of reasonable length.

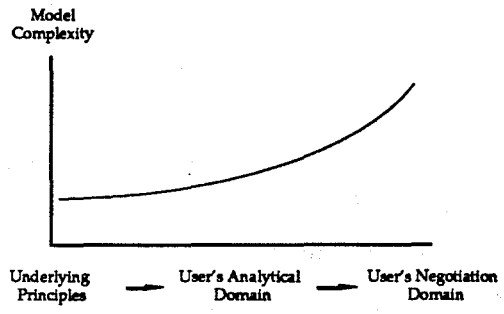

Figure 1: Models that Lack Depth are not Compelling

One 'solution' is simply to evaluate generic computer tools in laboratory settings only, thus obviating the need ever to approach real negotiation problems, but the authors reject this approach as inadequate for two reasons: the intended user, out in the real world, is not convinced any more easily by generic clinical data; and the tool developer loses the opportunity to collect suggestions for improvement from a pool of potential users familiar with the context of intended application of the tool. For these reasons, it is important to be able to demonstrate the use of the tool *in situ*, as it were. This paper lists and explores the problems encountered by the authors in conducting such demonstrations.

2. USING MODELS IN NEGOTIATION MANAGEMENT

The concept of negotiation management is, in essence, the application of computer models and related technology to a collaborative effort at dispute resolution [Nyhart & Samarasan, 1987]. In this paradigm, negotiation is treated as a communicative and knowledge-intensive group problem-solving process. Combining various computer-based modeling techniques and facilitation aids, negotiation management is an integrated framework for dealing with complex negotiations, particularly where:

1. the points of dispute are technical, and involve a high degree of uncertainty;
2. practical experimentation with solutions is too expensive or risky;
3. there is no unquestioned authority to whom the disputing parties all defer;[5] and
4. prompt resolution and a return to friendly, or at least stable, relations, are desired.

In this paper, "complex negotiations" are negotiations among several parties about numerous issues. The issues may be independent, but more commonly they are naturally coupled. They are "technical" in the sense that they spring from specialized scientific or technological controversy. When proposals are made in negotiations over these issues, they cannot easily be tested in the real world. Such proposals may be structurally flawed due to incomplete or inaccurate knowledge, but the flaws cannot be exposed without a careful modeling effort.

If the parties can treat at least the initial stages of their negotiation as a *joint problem-solving effort,* the process of modeling can help them to focus first on the removal of as much of the substantive uncertainty as is feasible. Technology, in the form of computers, computer models, and related tools, can be a very powerful aid in this process. When realistic and efficient solution alternatives have been identified through the building and manipulation of models, then intelligent compromise is possible in negotiation. In this respect, computer models designed for use in negotiation management might provide some sub-set (or super-set) of the following functional capabilities [Samarasan, 1988 a]:

1. dynamic simulation of the process of negotiation;
2. dynamic simulation of the substance under negotiation;
3. channels for communication and experimentation;
4. analysis of similar precedential disputes and negotiations;
5. risk and decision analysis;
6. provision of expert knowledge and guidance;
7. enhancement and optimization of settlements;
8. modular links to a variety of additional tools; and
9. system-wide model configuration management.

In addition, more specialized tools might enable negotiators to interactively model the structure and economic implications of systems with hierarchical structure [Hagen & Samarasan, 1989], and provide

them with customized data base management facilities and graphical data display features [Samarasan, 1989; Dickson, DeSanctis, & McBride, 1986]. The authors' primary goal is to understand the use of such computer tools in negotiation, by creating, applying, and then evaluating the tools in context.

An important part of the concept of negotiation management is the joint use of computer tools by all parties to a negotiation. Models ought to be located in the middle, among the parties, accessible to all, and used in common. Arguably, computer models are as useful in improving communication among the parties as they are in aiding the parties' analytical efforts jointly and severally. This view of the relationship between modeling and negotiation is best explained in the context of the authors' understanding of the model-building process.

The process of building models—computer simulation models, in particular—can be understood in five parts: problem definition, conceptualization, formulation, validation, and analysis.[6] In the problem-definition phase, a modeler delineates the scope of the model to be built, usually concentrating on some problematic aspect of the real world. Once the boundaries of the desired model are established, the modeler moves on to conceptualization, where the inner structure of the model is laid out broadly. Detail is added in the model formulation phase, when variables are selected and equations are written to relate them. Next, the model is validated, by testing various input values to see if they generate realistic results—to the extent that they do, the model is said to be valid. Finally, the model is used in analysis to test possible options or courses of action meant to correct the initial problem. To the extent that the model is valid, its reactions provide a guide to the likely reaction of the system being modeled, and thus a guide to the choice of policy options.

As soon as one recognizes that "the modeler" is often a group rather than an individual, then the line between modeling and negotiation is blurred. Negotiation management, with its emphasis on joint problem-solving, explicitly uses the process of model-building as a locus of interaction among the parties. Of the five phases of modeling described above, at least three—problem definition, conceptualization, and validation—include a large subjective component. In these phases, model-building involves the communication of assumptions and the sharing of information. In particular, negotiators can use models to make explicit the following goals [Samarasan, 1988 b]:

1. enunciate and improve the mental models that they are using unconsciously;
2. discover and resolve contradictions that are implicit in their assumptions about the problem;
3. provoke and test new hypotheses about system structure;
4. reveal the likely substantive outcome of various policy and settlement proposals;
5. validate and guide the search for further information before coming to settlement;
6. capture the relevant state of knowledge in a form that is suitable for subsequent use; and
7. communicate the basis of a settlement to interested parties.

These advantages are amplified if the models that are developed and used can be understood at more than one level of complexity. Different audiences have different requirements, and explanations that are rigorous enough to convince technical experts are usually too complicated for non-experts.

When the system being modeled is of even the slightest complexity, members of a group engaged in modeling learn from each other, and the group itself learns as a whole [Senge, 1985]. Often, these gains in learning and in improved intuition can be achieved with models of surprisingly low sophistication.[7] Therefore, models used for communicative purposes need not be as—and may, in fact, need to be less—complex and detailed than has been typical in uses of systems dynamics modeling to date: for example, in support of adversarial positions in litigation where the primary goal of the modeling effort was to provide effective analysis.

On the other hand, simple models intended primarily for communication may well be linked to other more technical models meant for detailed analysis. In many cases, the substantive issues in a negotiation are not sufficiently understood and cannot simultaneously be modeled simply and accurately. The natural or perceived hierarchy of complexity and detail in a particular substantive area may be intimidating. In other cases, several separate models might exist that each describe some of the issues, but cannot automatically be used together to form a comprehensive picture, because of vastly different underlying assumptions or motivations. In order to make the best use of available skills and information, these models ought somehow to be linked, through *zooming* and *bridging*.

Zooming refers to a vertical movement through the hierarchy of complexity, whereas bridging refers to a horizontal link between hierarchies dealing with parallel complexities in different substantive contexts [Straus, 1986]. The ability to zoom is important because it allows modelers and model-users to specify their requirements in convenient levels of detail. And the ability to bridge effectively between different substantive models is useful because it allows facilitators, negotiators, and their expert advisors to relate issues to each other, thus compensating for narrow specializations. Given certain advances in computer software technology, linking between models can be dynamic, such that models are run in parallel on one or more computers, and call upon and provide information to each other as necessary [Samarasan, 1986].

The use of computer models by a group of negotiators makes explicit the role of information in the decision-making procedures adopted and used by the group. The authors suspect that an increase in the flow of information used and traded by negotiating parties will increase the effectiveness of negotiations in which such tools are used. Effectiveness, in this context, is defined in terms of efficiency, feasibility, and legitimacy. Whether these attributes lead to a meaningful sense of effectiveness, and whether the use of computer models enhances effectiveness in that sense, are questions to be tested empirically. The authors believe that it is important to advance theory, technology, and practice in this regard. Negotiations occur at critical periods throughout all voluntary relationships, both forward-looking, such as in the negotiation of contracts, and backward-looking, such as in the resolution of

disputes. And to the extent that "negotiation is a metaphor for life," qualitative improvements in the character of negotiations among parties may also be carried over to other relational instances. Therefore, if the use of computer models can improve the quality of negotiation, it becomes important to study the issue of user adoption, and to understand when the use of models is appropriate and acceptable to the parties.

3. UNDERSTANDING THE ADOPTION OF COMPUTER TOOLS

As discussed in Section 1, negotiators often do not adopt computer models readily as tools in a particular negotiating context. While initial interest is surprisingly widespread, there is a tendency not to integrate the use of the computer into the negotiation process or use it to its full potential. Presumably, if one could list specific advantages of computer use and cite empirical evidence as well, there would be less reluctance on the part of potential users to adopt computer tools. Obviously, it is difficult to collect empirical data on how the use of computer tools affects negotiation if potential users will not test those tools in the first place. Therefore, it is important to understand how potential users view the adoption of computer tools.

The adoption of a model as an aid in negotiation and dispute resolution depends on both the construction of the model itself—the heuristics, algorithms, and relationships that the model uses to process inputs—and on the interaction between the model and its users [Clements & Sossen, 1987]. As to the construction of the model, negotiators have suggested that the following characteristics are (or would be) essential to their adoption of a model:[8]

1. utility of model results;
2. absence of disincentives acting against use of models;
3. lack of bias;
4. protection of confidentiality of proprietary data;
5. consensus as to sufficiency of scientific data and theory embodied;
6. validation of information incorporated from external sources; and
7. possibility of independent model validation by user.

And as regards interaction between model and user, the following criteria for adoption were suggested:

1. accomodation of a range of user options;
2. no supplanting of human decision-makers; and
3. user-friendliness in the form of good documentation and comprehensibility.

While these concerns are natural and difficult enough to address, it is clear in the authors' experience that there are other equally legitimate reasons for non-adoption. These reasons are manifold, but they can be

understood as relating to: (i) users and the dynamics of negotiation; (ii) the context of negotiation; (iii) the nature of modeling tools; and finally, (iv) the processes surrounding the use of modeling tools.

Users and the Dynamics of Negotiation

Experience suggests that negotiating parties are sometimes just not ready to settle. They may perceive it to be advantageous to stay in court or to let a matter remain unresolved for the moment, in which case the use of *any* settlement tool is irrelevant. Sometimes the delay is tactical, as when one side involved in a lawsuit waits for related decisions in other jurisdictions to influence the other side's outlook on its own negotiation prospects. At other times, the delay serves more mundane functions: attorneys and other proxies incur high initial costs and therefore tend to prolong negotiations to recoup those costs.

In other cases, the parties may believe that only a limited number of issues exist to be negotiated, in which case the use of the computer is seen as 'overkill.' The idea of discovering or creating more issues—a process that is facilitated by the computer—is not necessarily an attractive one. Vastly preferring the familiar over the novel, negotiating parties may see the use of the computer as a risky proposition, and may not be prepared to share—or to divulge—such information as is available and would be called for by the use of computer models.

Choice of Context

The working hypothesis has been that the use of computer tools would be most acceptable to parties involved in complex negotiations. Therefore, the negotiation contexts in which potential users have been approached have all been fairly complicated. They have revolved around points of dispute that are technical and issues where the parties face a high degree of uncertainty. These very complexities may 'up the ante' and inhibit the willingness of parties to experiment with computer tools. On the other hand, simple negotiation contexts—involving, say two parties and one issue—are usually treated distributively, and the computer's ability to aid in problem-solving is irrelevant.

The Nature of Modeling Tools

It may be over-ambitious and inappropriate to seek to address many kinds of negotiation with a set of generic tools. Negotiators have, in fact, expressed more willingness to consider and use tools that are designed specifically for their problem domain. When asked what computer tools would best aid them, negotiators have sometimes eschewed such generically useful functions as simulation and decision analysis, requesting instead tools that help them in the management and display of specialized data that

are particular to their negotiation context. Possibly, the more sophisticated kinds of tools are perceived to be discrete technical "gadgets" adjacent to the negotiation process, and are thought to be more of a distraction than an aid—so much so that, even in the best of cases, computer tools are often seen as an improvement and not a necessity.

Sometimes, models are built to perform well in very specific areas, but are inflexible and fail when negotiators require different areas or modes of analysis. If models are difficult to adapt, then they are less likely to be adopted as tools.

To the extent that models are difficult to build or adapt, computer modeling is expensive. Furthermore, computer software designed for one type of computer may be difficult to recreate on other machines. Potential users may thus be discouraged by the perceived cost of modeling, in terms of both time and material resources.

Finally, tools that are perceived by negotiators to be inaccessible or too complicated for the problem at hand will be ignored out of distrust, disinterest, or disdain.

The Process of Using Models in Negotiation

Potential users may be reacting to—and resisting—not computer tools themselves but the process of use in which the tools are embedded. This process, as set out in Section 2, has features that may be objectionable to potential users: (i) it depends on the inter-dependent use of multiple models and programs rather than on the use of single tools, and therefore appears complicated; and (ii) perhaps as important, the process is defined by joint use of the modeling tools, which assumes a certain level of trust among the parties.

Sometimes the way in which computer tools are introduced to potential users can be a problem. Users are less enthusiastic about computer tools if they are required to use those tools by institutional fiat than if they come to the tools of their own volition.

Finally, thoughtful users might object to the use of computer models, if they perceive that these tools only serve to shift the locus of distributive bargaining without transforming it. After all, it has happened that negotiators have to spend their energies debating the relative merits of each others' models without coming any closer to resolving the underlying conflict.

4. DIRECTIONS FOR FUTURE WORK

If the effectiveness of computer tools as negotiation aids is to be tested *in situ*, negotiators first have to agree to use the tools. Gaining user acceptance for such experiments has proved to be difficult. In

this paper, we have tried to give a sense of some of the difficulties. We conclude the discussion by speculating on useful short-term and long-term directions. Operational solutions are required in the short run to encourage user adoption, thus generating empirical data to serve a long-term research agenda.

Some of these reasons for the non-adoption of computer tools are in the nature of negotiation and will be difficult to resolve. For example, if negotiators are simply unwilling to settle, then no computer tool that aids joint problem-solving is relevant.

On the other hand, some reasons for non-adoption are quite easily addressed. If a scheme that contains multiple, generic computer tools is too complex or abstract, potential users might be tempted to start with one tool that is expressly designed for their problem domain. If the concept of joint model-building is objectionable because it requires too much trust, computer tools could be introduced to the parties privately before they are used in negotiation. Once parties recognize that they each hold information that would make joint analysis more reliable than analysis done in private, they might be more amenable to a joint modeling effort. And if computer tools are perceived as being too intimidating, negotiators can be provided with simpler 'front-end' programs that guide them and introduce them to the use of the tools.

In the long run, of course, it is important to formulate criteria for user adoption of computer tools as aids in negotiation. If the use of computer tools can be shown to encourage integrative bargaining and joint problem-solving, and if integrative bargaining is more effective than other bargaining styles, then one might expect the use of computer tools to be integrated into negotiation. The observations and explanations proffered in this paper can form the basis for further negotiator interviews and questionnaire research along these lines.

NOTES

[1] The Project on Modeling for Negotiation Management is a multi-disciplinary project based at the School of Engineering and the Sloan School of Management at MIT. The primary goal of this eight-year Project is to put the power of the computer directly in the hands of negotiators and third-party facilitators. To achieve this goal, investigators are:

1. articulating a new computer-based framework for negotiation and facilitation;
2. developing and adapting a range of generic negotiation management software tools;
3. testing the capacity of the framework and tools in real-world applications;
4. studying the impact of the framework and tools on theory and practice;
5. instructing potential users in the concepts and uses of the tools; and otherwise
6. propagating the application of the concepts and tools in the resolution of conflict.

The Project is described in more detail in Section 2 of the paper.

[2] Viewed from the other side, the process of introduction is one of gradual user acceptance.

[3] The set of tools from which these are drawn is described in Section 2.

[4] The sequence outlined in the text is merely a convenience, and not necessarily a rule to be followed strictly—all three discussions in fact take place in parallel, and can lend substance to each other.

[5] The importance of this particular criterion is emphasized by a game-theoretical demonstration of when and how cooperation emerges among self-serving parties when there is no central authority to intervene [Axelrod, 1984].

[6] These five parts often overlap or cycle in iteration. Seldom does model-building proceed in a simple linear sequence.

[7] The model is often seen as a "transitional object," rather than as an end in itself.

[8] These observations are recorded in a series of interviews with participants in an environmental negotiation [Clements & Sossen, 1987]:

> First, there must be some incentive to use the model; it must provide some utility to the users. Utility means that the benefits derived from the model's output exceed the costs of using the models. The model must also be free of ... disincentives .... It must be unbiased; that is, the model's assumptions must not favor any party. Also, the model must protect the confidentiality of the participants' proprietary data. ...
>
> A second class of issues relates to the credibility of the model. There must be consensus as to the sufficiency of the scientific data and theory embodied in the descriptive modeling components of the system. Lastly, all parts of the system that incorporate information from external sources should be validated before the model is presented to the users. Moreover, the construction of the model should permit users to validate the model independently. ...
>
> Perhaps the only issue on which there was accord was the appropriate role for the model in the negotiating process. Models should provide a range of options for the resolution of the conflict; under no circumstances should they supplant human decision-makers. We speculate that at a subliminal level, negotiators suffer from the common fear of replacement by a machine. ...
>
> A second, obvious set of characteristics fit the rubric of user-friendliness: good documentation and comprehensibility. User-friendliness is particularly important in the negotiation context because integrative bargaining relies on developing trust and communication among the parties. Arm's length dealings through a modeler can interfere with this process. Further, negotiations become progressively more difficult as the number of parties climbs.

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