NEGOTIATION AS DISCOVERY AND DESIGN

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ABSTRACT: The use of computer tools to aid decision-making and problem-solving activities suggests a view of negotiation in which parties collaborate to improve the quality of the information and knowledge on which they base their joint decisions. In this view, negotiation is characterized as a process of *discovery and design*. The effectiveness of negotiation is defined in three dimensions: *legitimacy, feasibility, and efficiency*. Computer tools are discussed in the context of *information strategies*, or ways in which negotiators use information in their efforts to 'discover and design' solutions.

1. COMPUTER MODELING AND NEGOTIATION

Given the apparent difficulty of resolving human conflict, one is grateful that agreements are ever achieved at all, for our lives would be "solitary, poore, nasty, brutish, and short" if they were not. The *synthesis* of an agreement—finding a mutually acceptable solution through negotiation—appears to be at least as important and difficult a process as the analysis that helps parties shape their bargaining tactics and competitive strategies. In this context, the art of negotiation can be understood as the ability to resolve a dispute without resorting to the naked and violent use of power. As such, it is an intensely human process.[1] Yet, there are times when computer tools can be useful in the process—not to dehumanize it but to provide analytical and synthetical capabilities where appropriate.[2]

Indeed, over the past two decades, there have been numerous experiments in which computer tools have been applied to problems of complex negotiation and group decision-making with varying degrees of success (see, for example: Nyhart, 1988; Klykov, 1988; Clements & Sossen, 1987; Psaraftis, 1985; Nyhart, 1984). Computer models have offered various capabilities, including dynamic simulation (Kreutzer, 1985; Senge, 1985; Cooper, 1980; Levin, Roberts, & Hirsch, 1975; Forrester, 1969), statistical correlation and profile analysis (McGovern, 1986), and game-theoretic cost-allocation (Sebenius, 1981). As several observers have pointed out (Nyhart & Dauer, 1986; Kraemer, 1985; Sterman, 1985; Greenberger, Crenson, & Crissey, 1976), it is possible to state some ideal conditions for the productive use of such computer models in resolving disputes and controversies:

1. the use of models has to be accepted by all parties;
2. the models have to be understood at some level by all parties; and
3. the parties ought to feel a sense of ownership of the process in which models are used.

Together, these conditions argue that negotiators should not be mere consumers of model output, but should play an active part in the development and use of appropriate models, preferably in a collaborative mode.

There are numerous ways in which negotiators and facilitators can use existing computer tools and techniques to help them in their negotiations (see Nyhart & Samarasan, 1987). Nevertheless, a review of the available means of dispute resolution in the law and in common practice reveals that, although some inroads are being made in innovative jurisdictions (see, for example, McGovern, 1986), no widely adopted processes of dispute resolution explicitly engage the computer. It appears that the computer, especially in the form of the joint use of computer models, is not easily introduced into the panoply of existing dispute resolution processes, for several reasons (Samarasan, 1987):[3]

1. existing processes are designed to cope with a more or less adversarial relationship among the parties, whereas an effective joint modeling effort requires communication, trust, cooperation, and the sharing of substantive information;[4]
2. practitioners of dispute resolution—attorneys, mediators, arbitrators, judges—are often computer-naïve and under-estimate the usefulness of computer tools, especially when they perceive these tools to threaten their established roles (Clements & Sossen, 1987);
3. there is a perception that "timing is everything" in negotiation, and that the use of a computer will interfere with this timing;[5] and finally
4. even though—if not because—it broadens considerably the scope of a negotiator's actions, the use of the computer is perceived to be unnecessary: after all, no existing dispute resolution mechanism attempts to address—and therefore no new process needs to address—such a wide range of functions.[6]

Presumably with these conditions in mind, recent writers have approached the effective application of computer models in negotiation and group decision-making on three fronts: (i) general principles (Shakun, 1981; Straus & Bazerman, 1985; Straus, 1986; Samarasan, 1986); (ii) specific computer methods and system architectures (Steeb & Johnston, 1981; Ezrol, 1987; Göltner, 1987; Stefik *et al.*, 1987; Göltner, 1988; Roe, 1988; Samarasan, 1988); and (iii) practical guidelines for the use of specific modeling tools in particular negotiation contexts (Raker, 1987; Lando & Tong, 1988; Lee, 1988; Nyhart & Samarasan, 1988; Samarasan & Messina, 1988). All three of these elements—principles, tools, and practical guidelines—are included in *negotiation management*, an emerging framework that emphasizes the important role of information and knowledge as resources in negotiation (Nyhart & Samarasan, 1989; 1987).[7]

Negotiation management is a framework built around the use of generic software, designed to aid the processes of collaborative group decision-making in complex multi-party, multi-issue negotiation.[8] In these kinds of negotiations, there is a need for a process of dispute resolution through which the full potential of the computer can be harnessed.

For example, a group of negotiators might seek consensus on the substance and process of their discussion by working directly on the computer, either by themselves or with the help of a neutral facilitation team. Substantive issues might include agreement on the sources of data and models to be used, the choice of parameters to represent the issues under negotiation, and on the values and relative importance to be assigned to those parameters. And procedural issues might include protocols for the sharing of information, for the validation of particular models and substantive conclusions derived from them, and for the design of group decision-making procedures that effectively utilize the information made available by the models. Not all models forwarded for use in such a joint modeling effort will be worthy of the consideration of the group, and criteria will be needed for the acceptance of models. Two sources of ideas in this area are the work of Nyhart and Dauer (1986) on the use of scientific models in dispute resolution, and of Raiffa (1982) on the questions posed for organizing the taxonomy of disputes. Both have consequences for the appropriate and effective use of models in negotiation management.

2. THE USE OF SIMULATION MODELS IN NEGOTIATION

The negotiation management framework acknowledges the importance of simulation modeling in negotiations where the expected behavior of a complex system is at the heart of one or more issues. In such negotiations—and the category ranges from the establishment and management of joint ventures to arms control to global schemes for abating industrial pollution—it is important to manage the process of model-building so that it does not get out of hand. Models that are constructed must be validated so that they can be used to reliably guide action. The different ways in which models and modeling affect decision-making must be explicitly recognized. And the goals of the modeling effort must be understood in terms of real benefits that can be derived from it.

Managing the Process of Modeling for Negotiation

The process of building models—computer simulation models, in particular—can be understood in five parts: problem definition, conceptualization, formulation, validation, and analysis.[9] 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.

When negotiations involve complex technical issues, negotiating teams typically include both expert technicians and policy-makers.[10] If computer models are used in negotiating these disputes, the normal pattern has been that the policy-makers are insulated from the modeling activity, either by choice or by circumstance. Expert technicians from the various teams, who are there solely for the purpose of the modeling exercise, conduct a discussion usually within a professional or disciplinary framework, and then either agree or do not agree on a set of models and simulation results. The modeling exercise is then declared to be over, the technicians return to their respective contingents to advise their policy-making colleagues, and the negotiation begins in earnest.[11]

In the best case, policy-makers take the outcome of the technicians' modeling exercise at face value, and proceed from there. In the worst case, they completely ignore the use of models except where such use reinforces their pre-conceived negotiation strategy. In either case, the use of computer models is less than maximally productive. It can also be dangerously misleading, because technicians are no more capable of ignoring their self-interest than are policy-makers. The false aura of objectivity that surrounds this version of computer-assisted negotiation only corrodes the credibility of computer modeling in the long run.

The real benefits of modeling can only emerge if negotiators actively use modeling capability to improve their understanding of the issues, and then apply this improved understanding to their handling of the negotiation. As long as models are presented as technical and specialized objects not for the consumption of negotiators, the use of models in negotiation only adds another point of contention, or subtly shifts the locus of a conflict without helping to resolve it. Therefore, negotiators must be included in the various stages of model-building.

Working on their own, non-expert negotiators would not likely be able to develop models that are valid from a purely technical point of view, whereas expert technicians would not necessarily be able to develop models that are useful for decision-making purposes. Clearly, models are necessary at least two levels of abstraction are necessary if complex negotiation is to be based on a set of valid computer models *widely understood* by the parties. If it is important in particular cases that the course and outcome of a negotiation have to be explained to constituencies absent from the negotiating table, a third level of abstraction may be required as well.

Model management concepts can help coordinate the dynamic linking of models in two different modes. 'Zooming,' the functionality provided by the first mode of linkage, refers to vertical movement through the hierarchy of model complexity. In any given area of expertise, a hierarchy of simulation models usually exists in the form of an inverted tree, with highly aggregated models at the top, and very finely detailed basic models at the bottom. The tree structure is propagated because each model contains many variables and sub-routines, each of which could itself be the subject of a model, at a level of greater detail. The ability to zoom up and down along this hierarchy is important because it allows modelers and model-users to specify their requirements or queries in convenient levels of detail.

The ability to zoom is useful because it simplifies negotiator access to both models and information. Often, negotiators are not expert modelers and need easy access to any modeling involved. One way to ensure this easy access is to provide simple and user-friendly modeling software. With guidance, negotiators can use this software to jointly construct simple but useful models. When linked to more rigorous models, these simple models provide a easily accessible front-end to the model tree, and help negotiators obtain access to information at particular levels of detail.

The ability to zoom has other implications as well. In their analysis of the uses of models in dispute resolution, Nyhart and Dauer (1986) present a scheme in which they identify three process tools, each a variation on the uses of models in conflict management: (i) ordained models, where the models used in the process are not primarily developed by the parties; (ii) model-building, where the parties build the models themselves; and (iii) non-model alternate dispute resolution, where the use of models is not at the focus of the process. By making it possible for negotiators to build simple models as a front-end to technically better models, the linking of models of varying complexity provides a fourth alternative in this scheme. Negotiators can save time and effort by using pre-built and pre-tested models, and yet achieve a sense of ownership over the process by writing their own front-end model scripts.

One way to obtain simple 'front-end' models is to derive them from more detailed ones using various model simplification techniques. These techniques might include (Samarasan, 1988):

1. translating the original computer model into a more accessible simulation language;
2. reorganizing the model to obtain a more modular and easily perceived structure;
3. removing extraneous variables and insignificant feedback loops;
4. aggregating fine-grain variables;
5. linearizing or constraining the range of key variables;
6. using modal analysis to remove variables while retaining selected behavior modes;
7. using causal-loop and policy-structure diagrams in simplified explanations; and
8. using qualitative explanations at higher levels of abstraction.

If equivalent—or almost equivalent—simplified models can be found using these techniques, they can be used as a quick and convenient search-and-evaluate space for acceptable solutions. Solutions found in this way can then be checked against more detailed models.

A second mode of dynamic linking between models might be called 'bridging.' It refers to horizontal movement between parallel hierarchies of models in different substantive contexts. Complex negotiations are usually multi-disciplinary—the use of many different substantive simulation models may be called for, and these models may be of different types. In most cases, sufficiently many models will exist in all categories, and will be known to the parties, so that they may select for use in negotiation the ones that are most relevant to their situation. Typically, however, each of these models would have been developed in isolation by expert technicians in a particular field. Many model types would be involved, each qualitatively different from the others because of the use of different modeling techniques: statistical regression modeling; systems dynamics; linear programming and optimization; probabilistic game theory; queueing theory; the list goes on, each technique ideally suited for some substantive contexts and inappropriate for others. Not only would the various models require training and knowledge to understand and manipulate, but they would also not necessarily be compatible with each other because of the use of the different modeling techniques and different levels of description.

The ability to bridge effectively between different substantive models, whether or not they are built by the negotiators themselves, is useful because it would allow facilitators, negotiators, and their expert advisors to relate issues and interests to each other, thus compensating each for their narrow specializations.

Models that are dynamically linked through zooming and bridging could be made in some sense 'aware' of the models that surround them. For example, before beginning a series of simulation experiments, negotiators might specify certain global phenomena or effects they are looking for or seeking to avoid in the simulation. While they then make changes in a particular local model or sub-model, an intelligent model management system would keep them aware of (i) the global prerequisites for and (ii) the global consequences of their various changes. In this way, parties could achieve a better understanding of the substantive system or systems over which they were negotiating.

Model Validation

As with all uses of computer simulation models, one of the more contentious issues arising from the use of simulation models in negotiations is that of model validity. Often, especially if they are already engaged in an adversarial process, parties spend as much time and effort debating the validity of other parties' models as they do actually trying to reach settlement. This exercise has been called, not entirely humorously, "advocacy science" (Susskind & Cruikshank, 1987), and more pointedly, "the battle of the printout" (Straus & Bazerman, 1985), in which computers and computer models are used to confuse, and even to bully one's negotiating counterparts. Since such a battle only adds to the cost of negotiation, negotiators should understand how they can avoid it without having to automatically accept the validity of all models brought to the negotiating table.

The simulation model is a tool, and not an end in itself. There are two extremes to be avoided. On the one hand, if negotiators throw "perfect" models back and forth at each other, the gap between them only widens. On the other hand, if negotiators are jointly obsessed with the crafting of a "perfect" model, they will blindly model away all real physical and political constraints. The resulting model will be uselessly utopian.

A useful concept in the validation of simulation models is that of reference behavior. A simulation model is usually built to study a problem. One does not, properly speaking, build a vaguely generalized 'model of a system.' The simulation model is more appropriately a tool focused on those aspects of a system that are problematic and for which data exist. Modelers would like to use the tool to test various plans of action and thus find the one plan that best suits their purposes. In order to do this, the model that is used must be 'accurate': it must be as faithful as possible to reality (*i.e.*, to the reference mode or data) in its representation of the behavior of those parts of the system that contribute to the modeler's original problem. How faithful, or how accurate, a simulation model needs to be is not a matter of science. It is a judgment to be made by the modeler. Depending on the circumstances and the amount of data available, more or less effort may be appropriate.

Computers, Communication, and Learning

In the discussion above, we argued that computer simulation models are useful in negotiation because they can provide information to negotiators. This is not to say, however, that the interaction between model users and modelers, or among model users for that matter, takes place purely on an objective level.[12]

In the seventeenth century, two schools of thought dominated the debate on how the mind constructs models. One, identified with Leibniz, held that ideas are a sufficient basis for modeling. The human mind, it was argued, contains innate, discoverable knowledge, and this knowledge can be used adaptively to make predictions. Most mathematical and scientific models built today are still rational and deductive in this way. Proponents of the Lockean school, on the other hand, placed all their faith in data gathered empirically. Generally, these empirical inductivists held that truth resides in the data, or must be derived inductively therefrom. Eventually, of course, Kant settled the debate to the satisfaction of most philosophers, holding that theory and data are inseparable. Theories that we carry around in our heads—our mental models—affect our perception of the data that we gather, and, in fact, our choice of what data to gather in the first place.[13]

More recently, Popper set out what has come to be called the hypothetico-deductive method, in the light of which model-building can be seen as a dialog between creative and critical elements. Creativity helps in choosing a question to ask, in coming up with a model in the first place: here is where ideas fit. Once a question is framed, it becomes clear what data ought to be collected and examined to validate the model. The data are then analyzed critically, to either confirm or refute the initial model: here is the place for facts. In either case, the result of the analysis is a modified model—either corrected or refined. The model-building process is thus one of negative feedback.

Presumably, the role of models in negotiation is more complicated. Habermas (1967) points out that the traditional approach to modeling is concerned primarily with the physical sciences, and needs revision when applied to the social sciences.[14] Of course, there are serious philosophical questions to be asked about how—or even whether—we humans absorb and exchange information during our negotiation episodes. No matter whether we choose to define information socially or mathematically or thermodynamically, the cognitive import of our chosen definition and its relationship to our individual conceptions of reality—our mental models of the world and our place in it—remain virtually unknown, and possibly unknowable. Does agreement come about in and of itself or is it a product of a particular creative act? Do our purposively active wills lie behind every negotiated settlement? At this juncture, we do not touch even glancingly on these basic ontological questions, primarily because there are insufficient data on which to proceed.

On a more mundane level, the introduction of the computer into negotiation processes affects patterns of communication. In the first place, the very act of joint computer modeling brings negotiators together and enhances the opportunities for exchange. Moreover, research on structured communication in small groups has shown that structural elements exert a strong influence on the nature of communication (Shimanoff, 1984). In the context of computer-aided negotiation, these structural elements might include pre-defined pathways into the various tools and models for individual and group experimentation, diary or logbook facilities, model management facilities, automatic protection of sensitive data and knowledge, and privileged access for neutral parties. With these and other structural interventions, the computer mediates the question of who speaks to whom, when, how often, and for how long, through the use of what media and according to what decision rule. None of these interventions are trivial in their effect on the balance of power or influence in negotiation.

Other non-simulation methods of facilitating and enhancing communication can provide negotiators with more than simple channels for exchanging views and information. For example, the *Colab*, an experimental meeting room, provides an environment for the use of several related computer tools for meeting enhancement (Stefik *et al.*, 1987). Among these tools are *Boardnoter*, an electronic sketch-board, *Cognoter*, a system that facilitates electronic brainstorming, ordering of ideas, and evaluation of alternatives, and *Argnoter*, a computer tool that automates the documentation of proposals, arguments, and evaluations. A different approach—the *Planning and Decision Laboratory*—is outlined by Nunamaker, Applegate, and Konsynski (1987). In this metaphor, decision-makers are gathered in a room equipped with workstations and related hardware. Four software tools—*Electronic Brainstorming, Stakeholder Identification and Analysis, Issue Analyzer*, and *Enterprise Analyzer*—are used in conjunction with a knowledge base to guide the group in making a decision. Obviously, such approaches to group planning and computer-supported cooperative work hold great promise, especially for groups of negotiators who are already engaging in integrative negotiation.[15]

Computers can also enhance learning in powerful ways. In particular, consider how the use of appropriate computer models can help negotiators understand variables that are qualitative or only vaguely defined. A computer program that simulates the process of negotiation (Samarasan, 1987) could enable negotiators to explore various conceptions or norms of fairness, expressing each one as a group decision-making criterion. The program could then show the kinds of group decisions that would emerge if a particular norm were adopted. By running simulations of this kind, negotiating parties would be better able to communicate their ideas of what constitutes 'fairness,' and then use the simulation results to design group decision-making processes that are mutually acceptable.

To take an example from the system dynamics literature, consider that the process of joint model-building is recognized as a powerful tool in improving understanding and achieving consensus (Senge, 1985; Cooper, 1980; Forrester, 1969). This process—the use of models as transitional objects—can be regarded as coextensive with the concept of "attitudinal restructuring" as articulated by Walton & McKersie (1965). Of course, system dynamicists are accustomed to computer models in which qualitative variables play a major role. A simulation model of political stability, for example, might easily include such qualitative—some would say speculative—variables as:

1. `Perceived_Level_of_Corruption_in_High_Places;`
2. `Attitude_Towards_Compulsory_Military_Service;`
3. `Attitude_Towards_Military_Intervention_by_Country_Y;`
4. `Willingness_to_Negotiate_with_Party_Z;`
5. `Nationalistic_Feeling;`
6. `Economic_Optimism;` and even
7. `Effect_of_Nationalistic_Feeling_on_Economic_Optimism.`

Such variables can play an important role in a dynamic model of political climate, even if they are only defined quantitatively as simple scalars that vary—probably non-linearly—from 0 to 1. The power of this simplistic and intuitive "0 to 1" approach is that it encourages users to be specific about factors that they would otherwise not even attempt to analyze. We believe that, as long as one can see and change the assumptions that are made in the estimation of these factors, it is better to include them in a model than to ignore them.[16]

As an aid to—and a medium for—communication and learning, the use of computer models can have many effects on the quality of negotiation, none of which are straightforward. Greenberger, Crenson, and Crissey, for example, make the perhaps ominous observation (1976) that:

> ... [a] formal model of a given reference system is another system expressed in a formal language and synthesized from representations of selected elements from the reference system and their assumed inter-relationships. ... [Formal models] invite examination and revision, but in so doing, they provoke debate and disagreement. ...

The use of models in negotiation management can as easily surface problems as it can facilitate their solution. But in a complex negotiation, when there are few alternatives, the use of models can perhaps help explicate matters without raising expectations that it provides 'right' answers.

Benefits of Using Simulation Models in Negotiation

Having examined various aspects of computer intervention, it is useful to ask what the benefits are of using computer simulation models in negotiation management. We believe that the joint development and use of a simulation model by the parties holds at least four important advantages: (1) it allows the parties to focus on the issues and inter-relationships rather than on their positions; (2) it exposes unrealistic private assumptions; (3) it fosters a good working relationship among the negotiators; and (4) by asking "What if ... ?" questions, by performing comprehensive sensitivity analyses, and by conjuring up relevant scenarios and pursuing them through simulation, negotiators can enhance considerably the level of understanding with which they approach substantive questions.[17]

3. A NEW VIEW OF NEGOTIATION

To see negotiation as comprising separate phases of problem-solving and competitive bargaining is to be trapped in a dilemma. Instead, negotiation can be viewed as a process of discovery and design, especially when it involves the resolution of complex issues. This metaphor sheds more light on the use of computer tools to enhance the effectiveness of negotiation.

The Negotiator's Dilemma

Simulation models that represent the substantive points in controversy have frequently been used in policy-making (for examples, see Holling, 1978; Kraemer, 1985) and, less frequently, in negotiation (see Greenberger, Crenson, & Crissey, 1976; Sebenius, 1984). But as pointed out earlier, most examples of the use of simulation models in negotiation have been part of an adversarial approach.

We believe that the use of computer modeling to support adversary contests is a step in the wrong direction. Typically, each party secures or commissions a detailed model that uses its assumptions and illustrates its point of view favorably. The locus of conflict between the parties is simply transferred to the model domain where, unfortunately, the stakes are increased—reputations are placed at risk and costs escalate—because of the pseudo-scientific nature of the models and the often unwarranted invocation of rationality and correctness.

Because adversarial approaches assume a distributive flavor, they are not conducive to the effective use of computer models in negotiation. Each party tries to maximize its share of a fixed sum of available payoffs, with the result that what one party wins, the others lose. To support its modeling effort, each side has to obtain a large amount of information, some of which could more inexpensively and more reliably be provided by other parties. Positional bargaining tends to drive the modeling effort, so that models are often made to generate results that support a stated position. Even if parties do not engage in active manipulation, model results that do not support an argument are sometimes ignored or hidden.

The dominant view in current negotiation theory contrasts distributive bargaining with integrative bargaining (Walton & McKersie, 1965), a process (Lewicki, Weiss, and Lewin, 1987):

> ... by which parties attempt to explore options to increase the size of the joint gain without respect to the division of payoffs. The key to this process is openness of communication in order to maximize information about one's own and the other's needs and perspectives, to facilitate discovery of joint gain options.

In the original descriptive formulation due to Walton & McKersie, each of these two bargaining styles was presented as a distinctly observable phenomenon.[18] Raiffa (1982) builds a prescriptive analytical framework out of this essentially descriptive paradigm. Lax and Sebenius (1986) then reformulate this framework to show how analysis is useful in "creating and claiming value." It would appear that the tension reported by the latter, between "creating" and "claiming" value, is identically the difference between integrative and distributive bargaining. One possible explanation for this tension is that it results from the too-literal transformation of the original descriptive model into a prescriptive one.

Many writers have espoused the integrative bargaining model, pointing out that the integrative approach offers significant advantages over the distributive:

1. settlements are achieved more often;
2. settlements are often achieved in less time;
3. settlements are more acceptable to the constituents and constituencies of each side;
4. settlements are longer-lasting; and
5. the relationship between the parties is enhanced rather than eroded.

If parties value different aspects of the settlement differently, and if their thinking style predisposes them towards the visualization of trade-offs and joint gains, then integrative bargaining can be used to maximize joint utility (Fisher and Ury, 1981).

But others suggest, largely on theoretical grounds, that it has its limitations (see, for example, Bartos, 1970; Thomas & Killman, 1974; Myerson, 1979; Lax & Sebenius, 1986). Furthermore, some writers have argued that the joint use of computer models in any attempt at integrative negotiation is problematic (Kettelle, 1986; Lax, 1987). Moreover, recent empirical work using a data base of negotiating attorneys has shown that neither integrative nor distributive bargainers can lay exclusive claim to effectiveness in negotiation (see, Williams, forthcoming). It would appear, then, that the relationship between effective negotiation and the integrative/distributive paradigm is a complex one. Adopting a purely integrative bargaining style (or a purely distributive one, for that matter) clearly does not preclude ineffectiveness.

In response to both the theoretical and empirical objections, the concept of "mixed-motive bargaining" (Lewicki, Weiss, & Lewin, in press; see also Susskind & Cruikshank, 1987; Greenhalgh, 1986; Lewicki & Litterer, 1985; Axelrod, 1984) has been proposed, and can be understood as one possible solution to the so-called "negotiator's dilemma" (Lax & Sebenius, 1986). Unfortunately, the resulting prescription—to adopt situational or contingent bargaining strategies that are integrative or distributive as appropriate—this prescription is not in an optimally useful form. First, it is an ad hoc formula that, by definition, does not make a clear prescription according to general rules. Second, its effectiveness has still not been empirically established (Lewicki, Weiss, & Lewin, in press). But more fundamentally, it requires that negotiators move between negotiating styles that are cognitively very different (Lorenz, 1966). Although there is some evidence that such a wholesale movement is possible (see Wehr, 1985, for instance), these latter results are largely based on simulated negotiation games, and it remains unclear whether they generalize to real-world negotiations over real stakes.

A New Metaphor

We believe that integrative bargaining is perceived to be inadequate because it is often co-opted into a "create and claim" framework, which calls explicitly for the parallel use of other approaches (Lax & Sebenius, 1986; Lewicki & Litterer, 1985). In this framework, integrative bargaining is perceived to be appropriate for the "create" phase, whereas distributive bargaining is seen as somehow more practical in the "claim" phase. Negotiators are supposed to watch carefully the tension between creating and claiming value, lest they create value and someone else makes off with it. An 'us-and-them' orientation is perceived to be necessary, and is built into the framework.[19]

An alternative model of negotiation—or at least an alternative metaphor—can be conceived on the basis of the collaborative use of computers and other information tools. Negotiators and facilitators come to the table each with their own collection of information: assumptions, facts, interests, and positions. They are collectively surrounded by even more information that is available or retrievable in some sense. Computers and related technology can provide them with tools to help them evaluate and manipulate the available information. Instead of placing negotiators within a framework where their task is to "create and claim" value, one could ask them to 'discover and design' solutions.

When negotiation is viewed as a process of discovery and design, then the interests of all members of the negotiating group are more likely to be seen as co-equal by each negotiator—or designer—and these interests can be treated as constraints in a joint design problem. This view of negotiation does not simplistically prohibit distributive bargaining, nor does it ignore the "claim" phase of earlier models. It comprehends the whole of negotiation. But if there is an 'us' and 'them' in this picture, it is less intrusive: the process of 'discover and design' is an inherently collaborative one.[20]

Similar frameworks have been applied in non-conflictual situations. For example, Holling (1980) describes the use of a model-based workshop for environmental assessment, policy-making, and planning. Fleissig (1986) addresses the problem of designing the urban environment, and highlights the "negotiation" aspects of what is normally considered a "planning" problem. Building on these ideas, the 'discovery and design' model of negotiation differs from them in two ways:

1. it suggests that all negotiation is negotiated design, whether or not the object of negotiation is explicitly a design project; in other words, achieving a negotiated settlement requires abilities that are, in other contexts, called design skills; and
2. it suggests that computer tools can play an important part in negotiation, enhancing analytical capabilities to aid discovery and synthetical capabilities to aid design.

We believe that the 'discovery and design' model suggests a systematic means of improving the quality of negotiation: it uses the special capabilities afforded by computer tools to create an environment conducive to the application of integrative methods. These methods would go beyond bargaining, to what might be called "integrative thinking," a systemic approach that would examine interdependencies and synergies, rather than parties' roles in isolation (Samarasan, 1986). Integrative thinking implies integrative bargaining, but not vice versa: the one is a world-view, while the other is merely a strategy.

Effective Negotiation

Given this brief sketch of the 'discovery and design' model, it seems reasonable to ask about its potential prescriptive aspects. How can this model help us better understand and approach effective negotiation?

	Process	Outcome
Legitimacy	Fair, with opportunities for genuine participation	Takes concerns of all parties into consideration
Feasibility	Can be implemented given political constraints	Can be implemented given physical constraints
Efficiency	Low transaction cost	Approaches Pareto-optimality

Figure 1: Primary characteristics of effective negotiation process and outcome

Effectiveness is measured by the extent to which an objective is met. We suggest (i) that the objective of negotiation is to solve a set of underlying substantive problems as efficiently as possible while maintaining—if not improving—the relationship among the parties; (ii) that effective negotiation is characterized by three attributes: legitimacy, feasibility, and efficiency; and (iii) that both the process and outcome of negotiation can be evaluated in terms of each of these three attributes (Figure 1).[21] We argue that these attributes are independent and can be evaluated separately.[22] For example, parties might use a legitimate process to arrive at a legitimate but completely infeasible outcome.[23] Or a majority might arrive very quickly—and therefore efficiently—on an impractical settlement using a process that is of questionable legitimacy.

Legitimacy has to do with the parties feeling or perceiving that their rights have been respected. Parties have expectations about the legitimacy of both the process and outcome of negotiation: relevant attributes include fairness and a sense of ownership.[24]

By definition, legitimacy is a subjective characteristic, and can only be evaluated by the parties themselves.[25] Nevertheless, we believe that the use of computer models can contribute to a sense of legitimacy in at least two ways. The collaborative use of computer models generally in negotiation involves the parties in a joint learning process. If parties cooperate to build models and then use these models to investigate or develop settlements, they derive a better idea of each other's needs and a greater sense of ownership over the process of negotiation (Clements & Sossen, 1987; Kraemer, 1985).

Legitimacy also requires that the means of arriving at a decision be acceptable to all parties. Fisher & Ury (1981) emphasize the importance of agreeing on ground rules for negotiation. Susskind and Cruikshank (1987) argue that the choice of decision process should be made with regard to the concerns and attitudes of the parties. When a group can step back from the heat of negotiation and focus on process issues, the question of legitimacy can more easily be addressed if negotiators have access to a computer modeling tool that simulates—and thus allows them to jointly design and select—mutually acceptable negotiation and group decision-making rules or norms before they begin negotiation in earnest (Samarasan, 1987).[26]

Feasibility, the second attribute of effective negotiation, is a more practical concern, and has to do with the possibility of successful implementation. A feasible process is one that usually leads to settlement; whereas an infeasible process—using a vote in a bilateral negotiation, or using the courts to resolve siting issues—is one that most often leads to stalemate. A feasible outcome or settlement is one that, when implemented, solves the underlying substantive problem without unravelling.[27] How can the use of computer models contribute to feasibility?

If negotiators have built valid computer simulation models pertaining to the substance of their negotiation, they can perform sensitivity analyses on these models to test policies and settlements. Suggestions or proposals that do not produce the expected or desired effect when tested in the model will probably also fail if actually implemented.[28] Clearly, the parties never actually know whether a negotiated outcome is going to turn out to be feasible or not, but they can approach feasibility by selecting outcomes that are *more likely* to be feasible. Enhancing negotiation in this way is particularly important when scientific or technological uncertainty threatens to dominate the agenda.

Efficiency, the third and final attribute of effective negotiation considered here, has to do with reducing waste. A process is efficient if it minimizes the transaction cost of negotiation, measured in units of cost or time, whereas an outcome is efficient if it approaches Pareto-optimality. How can the use of computer models contribute to increasing the efficiency of negotiation?

In complex negotiations, there are usually multiple sources and varieties of scientific, technical, and economic data that need to be considered and managed. And because of changing technological and political structures, many negotiations result in temporary solutions and become continuous or periodic institutions. Computer and communication technologies have the potential to greatly improve the cost-effectiveness of such negotiations. Furthermore, these technologies also make it possible for parties to quickly and effectively share information about underlying interests and priorities with each other and with third-parties, steps that Susskind and Cruikshank (1987) argue are necessary if Pareto-optimal solutions are to be obtained.[29]

To summarize, our argument in this section is two-fold: (i) effective negotiation is characterized by three attributes: legitimacy, feasibility, and efficiency; and (ii) the collaborative use of computer models can enhance each of these measures of effectiveness.

Information Strategies

As suggested by Lewicki, Weiss, & Lewin (in press), a good prescriptive model of negotiation is one in which some major part of the variance in effectiveness can be controlled by the deliberate actions and behaviors of negotiators. Only under this condition can a model truly be said to be prescriptive. We believe that it is possible to develop an information-oriented prescriptive theory which offers useful advice as to effective negotiating styles. If, as discussed earlier, empirical research shows that both integrative and distributive bargaining styles can be effective, then effective negotiators must have something other than bargaining style in common. What actions might both groups be using to enhance their effectiveness? What styles and approaches do effective negotiators have in common?

We believe that answers to these questions can be framed in terms of *information strategies*, or the ways in which negotiators use—obtain, evaluate, share, and trade—knowledge and information (Samarasan, 1989) in their efforts to 'discover and design' solutions.

Various authors have argued that the increased exchange of knowledge and information leads to improved outcomes (Patchen, 1970; Pruitt & Lewis, 1977; Susskind & Cruikshank, 1987). Observation of the use of computer models in negotiation is an ideal way in which to test this hypothesis, because negotiators' interactions with computer models will make clearly visible the differences in the way they treat the various categories of knowledge and information embodied, manipulated, and delivered by these models. And since these strategies can, in general, be practised with or without computer software, an auxiliary hypothesis might be that the use of computer software enhances some or all information strategies.[30]

Four key components of information strategies are (Figure 2): (i) process variables, (ii) information variables, (iii) task variables, and (iv) tool variables. Depending on the configuration of the negotiation process, the available information, and the tasks at hand, negotiators can select appropriate tools to help them reach agreement. The various coordinating schemes that negotiators might use to relate these variables form what we call information strategies.

Process variables include specifications of the parties affected by or involved in the negotiation.[31] These parties may be individuals or groups, and may form coalitions whose compositions change over time. Issues in the process are points of controversy or matters that need resolution. Interests are the concerns that underlie the stated positions of each party.[32] And constraints include the obvious parameters—limits on time and resources available to the negotiators—and some less obvious ones—group decision-making norms, individual utility functions, and constituent pressures, for example.

Information variables include types, or such categories as facts, beliefs, assumptions, perceptions, models, and messages.[33] Information sources are another variable, and can include negotiators, their constituents, or their technical staffs; other negotiating parties; neutral parties, observers, facilitators, mediators, arbitrators, or judges; and sources exogenous to the negotiation. Moreover, information comes at a price, and parties must balance the cost of obtaining information against the expected reliability over time of that information.[34]

Task variables specify the various obstacles to agreement and suggest means of overcoming them.

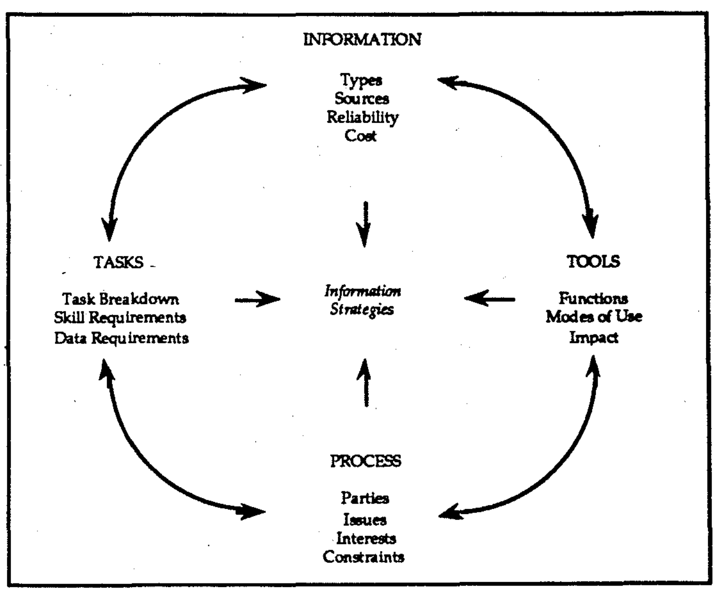

Figure 2: The development of information strategies

The primary task variable is, of course, the initial task breakdown itself: ill-defined problems are usually difficult to solve. Each class of problem that is identified will require for its resolution a set of skills, problem-solving methods, or analytical disciplines, and a complement of data, and these have to be identified as well.

Tool variables describe aids that are available to the negotiators. At the lowest level, tools, computerized or otherwise, have functions, and these need to be catalogued and correlated with available skills and data. In addition, a given tool may offer more than one mode of use. For example, a tool may be used in formulating a problem more precisely or in evaluating proposed settlements; it may be used jointly with other parties or privately; and it may be used directly by negotiators or it may be used by technicians who then advise the negotiators of their findings. Furthermore, the use of any particular tool probably has implications for the nature of the negotiation process. For example, the use of computer tools can affect the timing and cost of negotiations, and it may affect the relationships among the parties.

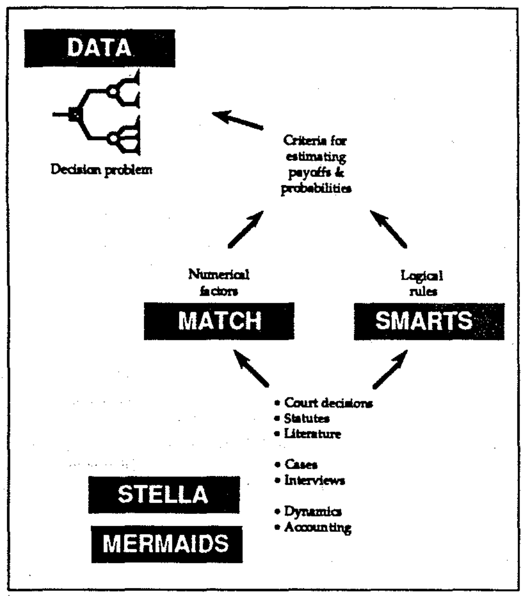

Figure 2: An information system design developed for the negotiation of insurance claims—black boxes highlight names of various generic computer modeling tools

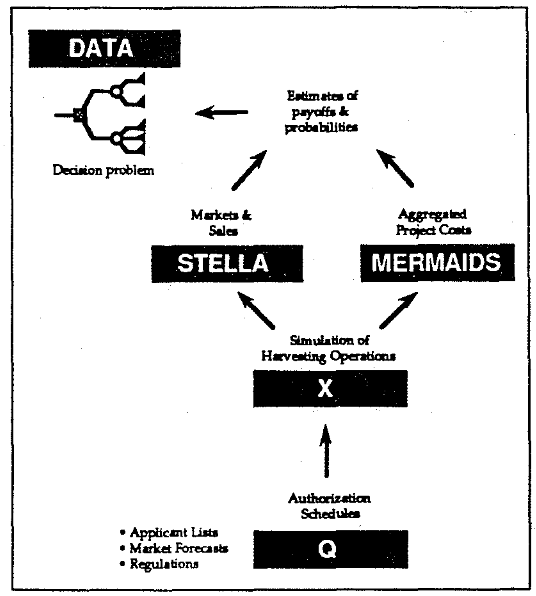

Figure 3: An information system design developed for the negotiation of mining permits—black boxes highlight names of various generic computer modeling tools

To conclude the discussion, we present in Figures 3 and 4 two examples where we have applied the foregoing analysis to real-world negotiation problems and prescribed the use of a number of computer modeling tools.[35] The first example is based on a negotiation between an insurance provider and its insured. The second example considers a negotiation between a regulating entity that controls access to a natural resource and interested parties who apply to the regulator for permission to harvest the resource. Various computer modeling tools are highlighted in the diagrams: (i) MERMAIDS, a tool for building hierarchical models of the costs of and returns generated by various components of a project;[36] (ii) STELLA™, a language for building simulation models to describe and analyze the behavior of time-varying systems;[37] (iii) MATCH, a program that helps the user find cases or records in a data base that match a given profile to an arbitrary degree of accuracy; (iv) SMARTS, a simple expert system shell; (v) DATA™, a program for building decision tree models to guide decision-making under uncertainty;[38] (vi) Q, a shell for building simulation models to describe and analyze a queued production authorization process; and (vii) X, a shell for building simulation models to describe and analyze the day-to-day operation of an engineering project.[39]

NOTES

1 We speak here of power defined broadly, the bases of which include rewards, coercion, legitimate power, referent power, and expertise (French & Raven, 1959). Lax and Sebenius, in their discussion of "powerology" (1986), list various sources of power that are defined culturally: choice of attire, meeting place, size and composition of entourage, and even access to the supernatural. We believe that most forms of power depend ultimately on violence, and that a process that is "intensely human" must by definition tend towards the non-violent. A more cynical—and perhaps less meretricious—point of view is that all human interaction depends ultimately on "the naked and violent use of power."

2 The word "synthetical" is used here to mean "blending," "combining," "consolidating," "joining," "merging," or "uniting" (see Nyhart & Samarasan, 1987).

3 This issue, paraphrased in terms of user acceptance, is taken up more fully in a parallel paper (Nyhart & Samarasan, 1990).

4 For reasons that will become clearer in the course of the discussion, the author believes that the adversarial use of computer models—the way they are typically used in litigation support, for example—is inadequate, if not irresponsible.

5 It has been argued, for example, that the timing forced by the use of a computer model was critical to success in a widely cited example of the use of computer models in negotiation—the negotiations surrounding the United Nations Convention on the Law of the Sea (see Antrim, 1985; Sebenius, 1984).

6 In fact, we submit that few practising negotiators even recognize some of these functions to be within their prerogative, purview, or responsibility.

7 The following excerpt (Pascall, 1985) serves well as a cautionary note on the use of the term "negotiation management":

> The prevailing ethic of modern American defense is the 'managerial' view ... which assumes that organizing for conflict is similar to organizing for other human activities. ... That mentality leads to tactics based on over-simplified, abstract models; to an emphasis on machinery rather than on men and strategies; and to a tendency to neglect those human elements which, throughout history, have often determined the outcome of conflict.

8 The tools of computer-supported cooperative work (CSCW) are related, no doubt, to those of negotiation management. In fact, we observe that the former comprise a sub-set of the latter, because developers of CSCW tools tend to treat groups as if their members all shared a common set of goals *priori*. This assumption is sometimes accurate but, more often, it overlooks the "negotiation" aspects of what are normally considered "planning" problems (see, for example, Fleissig, 1986; Zartmann, 1977; Walton & McKersie, 1965).

9 These five parts often overlap or cycle in iteration: seldom does model-building proceed in a simple linear sequence.

10 The words "expert technician" and "policy-maker" are not used in any but the most literal sense.

11 This description is not meant to apply to the use of computer models in non-negotiated dispute resolution. In the court-room, for example, technicians are often called as expert witnesses for one or both sides. They do not converse directly with one another, nor do they engage in negotiation. Instead, they each try to convince a third party—the judge or the jury—of the soundness of their individual arguments.

12 One might argue that the conception of computers as providing "information" to users is a shallow one. In this argument, computers are seen to do more than simply provide information. This argument depends, obviously, on a particular view of information, in which it is assumed that all information exchange is objective. Our view of information is less specific: we do not equate information with fact. To paraphrase McLuhan (1965), experience, rather than understanding, influences behavior. Information is experienced before it is understood.

13 As Bierce (1911) could have explained to Descartes, *cogito cogito ergo cogito sum*.

14 In doing so, he builds on Wittgenstein, Gadamer, and Chomsky, and formulates a methodology for theoretical work in the social sciences.

15 However, Kay (1987) cautions that there is only limited utility to the use of unstructuredgroup planning techniques:

> "Group Think" ... just doesn't work. ... Most people are so happy when they have an idea that they want to do something about it, the Hollywood syndrome. Most ideas are bad, even by smart and creative people. That is why brainstorming is usually terrible. If you have fifty bad ideas on the board, it is not going to help you to select one of them. It's like cable TV, thirty-five channels of bad stuff.

16 There are, of course, more sophisticated ways of dealing with qualitative variables, but, arguably, they are less effective because they require data that are far more difficult to collect reliably and cost-effectively.

17 In this way, computer simulation models can provide negotiators with what Wheeler (1987) refers to as "prospective hindsight."

18 Actually, Walton and McKersie identified two other negotiation phenomena as well: intra-party bargaining and attitudinal restructuring.

19 Reich points out that an 'us-and-them' approach to life is counter-productive (1987):

> ... The most complex questions about our place in a changing world ... are reduced to a blunt and binary choice between toughness and charity toward 'them.' ... This narrow spectrum of choice – assertiveness versus accommodation, discipline versus conciliation – bounds our political debates, limits how problems are defined and solutions weighed, and blinds us to a subtler set of options. ... The common error of both variants is the rigid delineation of 'us' and 'them.' ... The tension between a basic stance of accommodation or one of confrontation excludes the middle ground of negotiations and collaborations that both assert 'our' interests and comprehend 'theirs.' ...

We agree with him.

20 All negotiation is negotiated design, whether or not the object of negotiation is explicitly a design.

21 Earlier formulations of this concept referred to "negotiation quality," in terms of "efficiency" and "accuracy" (Samarasan, 1986); and to "effectiveness," in terms of "agreeability" and "feasibility" (Samarasan, 1988). A similar formulation (Susskind & Cruikshank, 1987) characterizes "good outcomes" in terms of "fairness, efficiency, wisdom, and stability."

22 Attributes are said to be independent if knowledge of the state or level of one attribute provides no information about the state or level of any other. The use of independent attributes is more tractable analytically.

23 In the same spirit but on a very different level of analysis, Hart (1961) draws a distinction between the validity and efficacy of a system of laws.

24 In the law, the requirement of "due process" is an attempt to provide parties with both fairness and a sense of ownership, among other things. That parties view these attributes as rights is a matter of history: as Socrates pointed out, the duty of a judge is "not to make a present of justice, but to give judgment."

25 Referring to fairness as a characteristic of good outcomes, Susskind and Cruikshank (1987) argue:

... it is more important that an agreement be perceived as fair by the parties involved than by an independent analyst who applies an abstract decision rule. If the involved parties think a given process has been fair, they are more likely to abide by its outcome; if they do not, they will seek to undermine it.

To object that one is only dealing with the perception of fairness rather than with "fairness itself" is to misunderstand the nature of fairness.

26 Agreement on ground rules for negotiation—achieved with or without the aid of a computer—is reminiscent of a social contract. Two interesting antecedents in the philosophy of the law: (i) Hart's analysis of the validity of a legal system (1961) touches on the application of abstract "rules of recognition" in selecting valid—or legitimate—bases for laws; and (ii) Rawls' theory of justice (1971) takes an even more explicitly contractarian approach: it suggests that principles of justice are best understood as those principles selected *a priori* by parties placed in an initial situation that incorporates certain procedural constraints on arguments—the so-called veil of ignorance—designed to lead to an original agreement on principles of justice.

Some would argue that the courts provide a standardized, more predictable, and therefore fairer alternative to *ad hoc* decision processes. We do not accept the terms of the comparison. The purpose of negotiation is to solve a problem as creatively as possible, whereas the purpose of the court system is to solve a problem when all else has failed. Fairness can have different meanings in the two situations.

27 A feasible outcome is one that is robust with respect to uncertainty, *i.e.*, with respect to change. Thus, an outcome that is feasible must be stable with respect to small changes in its environment.

28 The ability to make such judgments is what Wheeler (1987) refers to as "prospective hindsight."

29 A result that suggests otherwise is due to Myerson (1979): fully honest revelation of private information by individual bargainers and Pareto-efficiency cannot simultaneously be achieved.

30 Another hypothesis might be that the availability of computer tools encourages negotiators to more explicitly consider issues of information strategy—after all, when you have a shiny, new hammer, everything begins to look like a nail.

31 In complex negotiations of the sort we are considering in this paper, the process usually extends over a considerable period. At any given time, therefore, some affected parties may not be at the negotiation table.

32 The difference between positions and interests is arguably a matter of degree. For example, Fisher and Ury (1981) treat them as poles, and Zartman (1986) interpolates with the concept of the "formula." More recently, Göltner's analysis (1988) spans the position-interest continuum with four concepts: it starts with "categories" of the basic elements under negotiation, *i. e.*, with positions; formulates "comparisons," or tests, to compare elements in these categories; creates "rules" by combining the comparisons; and then evaluates settlement proposals against these rules to check if "interests" are satisfied.

33 Messages, in turn, include all overt communications among the parties. These take many linguistic or conversational forms, including assertions, requests/questions, and promises/commitments (Ehrenfeld, 1990; Winograd & Flores, 1986; Searle, 1979; 1969).

34 Similarly, they must also weigh the cost or benefit of sharing or revealing information.

35 We present and discuss these examples of system design less cryptically elsewhere (Samarasan, forthcoming).

36 MERMAIDS is more fully discussed by Hagen and Samarasan (1989).

37 "STELLA" is a trademark of High Performance Systems, Inc., Lyme, New Hampshire.

38 "DATA" is a trademark of TreeAge Software, Boston, Massachusetts.

39 Q and X are more fully discussed in Samarasan (1990).

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