CHAPTER ONE

Contributions of Applied Systems Analysis to International Negotiation

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The International Institute for Applied Systems Analysis (IIASA) has been cautiously and erratically inching its way into the world of negotiations. In some sense, the very creation of IIASA in 1972—or, going back five years earlier, the spawning of the idea for an IIASA-like enterprise—was in itself a move in the negotiating game of world diplomacy. It was an attempt to build a bridge and ease tensions during the Cold War: a confidence-building measure. The negotiations over the charter of IIASA dealt with a myriad of questions: should the enterprise have a central facility with in-house researchers, or should it be a loose federation, like the Club of Rome? What should be the governance of the institute? Its location? Its finances? Its membership? Its languages? Its research agenda? Its publications? Its policy regarding censorship, if any? The balance between its methodological and applied research? Its form—governmental or nongovernmental?

The negotiations were not isolated—they never are—from the roller coaster of external political events of the Cold War. But somehow the founders persevered and twelve representatives from twelve different countries agreed among themselves and convinced their constituencies back home to ratify the agreement. No representative was completely happy about all aspects of the agreement. On balance, it was a compromise; in the calculus of each country, accepting the charter was better than failing to reach any agreement. A modest amount of logrolling among issues was necessary to craft an acceptable compromise.

The two dominant negotiating players were the United States (represented first by McGeorge Bundy and then by Philip Handler) and the Soviet Union (represented by Jermen Gvishiani), and separate coalitions formed around each of them. But there were subcoalitions on some issues (such as location) that crossed East-West lines. Most substantial concessions were granted in informal meetings, outside the formal conference meetings.

When writing the charter was undertaken, several rough proposals (position packages) were floated around, and the process was quite confusing. Finally, the representatives agreed to have Sir Solly Zuckerman play the role of facilitator-mediator. Besides hosting and moderating formal meetings, his task was to fuse separate proposals into what can be thought of as a single negotiating text—a working shadow of a charter that started off with a lot of fancy boilerplate but also many unresolved parameters. The negotiators then nudged some of these in the direction of their preferences until the working charter became acceptable to all. It was a consensus process except the location decision, which required a vote. But everyone agreed that nothing is settled until all is settled.

One vexing issue was the name of the institute—or perhaps instead of "institute" it should be "center" or "centre" or "congress" or something else. In the first organizational meeting in Sussex, England, in 1967, we called ourselves "The Center for the Study of Problems Common to Advanced Industrialized Societies." But gradually doubts were raised. Are the problems common? What is an advanced society? Do we want to study, do research, or suggest prescriptive advice? For a year or so we discussed the "No-Name Center or Institute" or the "Bundy Institute" in the West or the "Gvishiani Institute" in the East. Gradually, a consensus emerged: we wanted to carve out some activity that belonged to the (set) union of such disciplines as operations research (operational research, as the British would have it), management science, policy analysis, cybernetics, systems dynamics, and systems analysis. Several negotiators were especially keen about global modeling as done by the Club of Rome, but others were vociferously opposed. The small problem of a name became our big problem for a while. There were cultural differences in emphasis, and the problem was exacerbated because such words as *cybernetics* meant one thing to the negotiators from the East and another to those from the West. We kept returning to the titles "Systems Dynamics" or "Systems Analysis," but these titles raised questions: Should we include in our purview the cardiovascular system or other bodily systems such as the brain, or the dynamics of the solar system? No: we wanted to study and understand dynamic, interactive systems involving people, systems that humans could influence for the benefit of humanity.

In the early sixties, I wrote a book called *Applied Statistical Decision Theory* (Raiffa, 1961) and hesitatingly suggested to the founding negotiators the title "Applied Systems Analysis." That caught on because no one had a previous conception of what it really meant. It was what I call "creative obfuscation," a technique that was used at several junctures in the writing of IIASA's charter.

Another example of creative obfuscation: since we got hung up on the term *advanced societies,* we substituted the term *modern societies,* and again no one really knew what that meant. After the charter was finally agreed upon by the negotiators, but before it was signed, Zuckerman asked a specialist of the Quai d'Orsay to check the "legalese" of the document, and back came the very natural inquiry, "What is meant by *modern societies?"* That held us up another three months. The problem was trivial, but it was a classical case of psychological entrapment: because it is trivial, why shouldn't the other side give in and adopt the interpretation?

What is applied systems analysis, broadly interpreted? It definitely cannot be defined operationally by saying, "It is what IIASA does!" because some would argue that "It is what IIASA *should* do!" As a first attempt at characterizing applied systems analysis, we could say that it is applying systematic analysis to complex societal problems with the intention of better understanding them and their outcomes.

Hugh Miser, one of the editors of the two-volume set by Miser and Quade, *Handbook of Systems Analysis* (1985, 1988), which really describes what applied systems analysis is, says in a letter to IIASA director Robert H. Pry dated August 10, 1988, "In the early days of systems analysis, all the elements of this threefold character were very much alive, albeit often in somewhat precarious balance. Lately, however, as institutional structures kept analysts at a distance from the realities of the problems they were treating, almost all attention has been focused on the descriptive aspect (witness the repeated emphasis on 'modeling'), with only a modest effort devoted to the prescriptive aspect, and often none at all to the persuasive aspect. This imbalance has dogged IIASA's work from the beginning."

IIASA'S RESEARCH AGENDA

In the literature documenting successful uses of operations research in real applications, the point is repeatedly made that communication channels have to be established early and kept open between the analyst and client. In the case of IIASA, if applied systems analysis is to be used in a prescriptive or advisory function, one should identify the client, and this presents a problem. It is important that analysis done under the auspices of IIASA not be used to benefit one nation over another, nor should IIASA preferentially select which country it should try to help. Early on, even before the charter was signed, the founders discussed two types of studies: universal and global.

Universal problems, such as transportation, education, and waste disposal systems, are faced by every nation separately. By examining universal types of problems in one country, one might gain techniques, models, and insights that could be transferable to another country. By contrasting how several countries

each handle a common problem, one might be better able to give particular advice to each country. The trouble is that the representatives of country *X* become a bit impatient when the institute spends too much of its money on the problems of country *Y.* It is just easier not to try to give prescriptive advice to anyone and play with these universal problems in the abstract. The real-world problems may motivate the abstraction, but then the abstraction lives on.

Global problems are those that cannot be resolved by a single nation separately; for example, human beings' effect on the climate, acid rain, and management of large international river systems. Here again, it is hard for IIASA to come close to its clients. Analysis should not be used by IIASA to help one country to gain an advantage over another. So IIASA's tendency is to work on background modeling of the natural science phenomena. Thus IIASA expands a prodigious amount of effort in modeling a river system or developing a descriptive (predictive) model of acid rain, but it does not itself get involved in the negotiation process among nations. It remains a comfortable distance away from the decision makers.

These problems were discussed at length by the founders of the institute and by each director with the council. It was decided early on that IIASA's existence was precarious enough and that it should not be embroiled in the politics of diplomacy or the web of international negotiations. Over time, each director has tried to move the institute into a more balanced research program that would try to supplement IIASA's forte on descriptive (modeling) analysis with prescriptive (advisory) elements.

Early Interest in a Negotiations Project

In 1980, the council of IIASA formed a Steering Committee on International Negotiation, with distinguished representation from East and West. This steering committee in June 1981 unreservedly recommended that IIASA study the *processes* of international negotiations. The members thought that a research project on negotiations would be most appropriately pursued at IIASA, and they made those recommendations even after deliberating about the potential difficulties and dangers of embroiling IIASA in current political squabbles. They proposed that the conflicts that IIASA might address should involve strong, complex interdependence and interactions that are appropriate for applied systems analysis study. In a given complex international negotiation, the protagonists might welcome this neutral intervention of an analytical group that could structure the scientific facts and model the dynamic interactions of the physical reality. This is a mission that IIASA has performed on such projects as acid rain and the management of large river systems.

The recommendation of the Steering Committee on International Negotiation was partially implemented in the early 1980s; however, the effort did not blossom, because it would require additional funding, and funding became considerably tighter at that time. In addition, those few appointments that were

made in an exploratory negotiations activity did not integrate well with other IIASA personnel. But still, the idea of a negotiations project was kept alive in the council of IIASA.

The PIN Project and Networking

In 1984, a proposal was accepted by the council to start a modest project on the better understanding and improvement of the Processes of International Negotiation (PIN), which would encourage the development of a network of PIN groups in the sponsoring nations of IIASA. The hub of the network would be at IIASA, which would provide loose coordination and dissemination of information. This volume is one product of that combined international effort. In appealing for funding of the U.S. PIN Project through the American Academy of Arts and Sciences, we put our case as follows:

Modern technology, the speed of communications, the interdependence of nations through trade, and an increasing dependence on common natural resources have brought nations into constant contact. Most nations have developed traditions and institutions for the efficient and equitable resolution of internal conflicts, but these arrangements are not mature or robust enough to cope with the complexities of international strife, be it in security matters, in economic issues, or in the control of our global environment. We have to become much more resourceful if we are to cope successfully with the pace of the growing complexities of international interdependence. We now have the technological capacity and the knowledge to improve dramatically the lot of humankind. But, as nations, we have much to learn about how to engage jointly in mutual problem-solving activities and to seek efficient outcomes.

International negotiations are essential mechanisms for the peaceful resolution of disputes and for maintaining stability and some measure of predictability in international relations. The balance between war and peace may be a matter not of the nature of the differences that divide us but of the *process we use to resolve these differences.*

Not enough research on the processes of international negotiations is being done. What is being done is not adequately coordinated and disseminated. Present research efforts are not cross-fertilized: across disciplines, between practitioners and researchers, and across national boundaries.

Regrettably, a lot of profound theorizing by economists, mathematicians, philosophers, and game theorists on topics related to negotiation analysis has had little or no impact on practice. An important question for the PIN Project to answer will be why this is so. An important reason is clearly the lack of effective communication and dissemination of theoretical research results. Such communication could be improved if there were more intermediaries who are comfortable in both worlds and who could act as inventive go-betweens to facilitate the transfer of information that shows how theory can influence practice and how practice can influence the research agendas of theorists. The

information must flow in both directions: many practitioners have developed valid, extremely useful, and often profound insights and analyses, which should help to guide the agendas of researchers in this field.

The U.S. PIN Project

The U.S. PIN Project was organized around separate but interacting task forces: international environmental disputes, international economic disputes, cultural differences, systems analysis techniques (including decision aids) for negotiation analysis, and a training program. The U.S. PIN task force on training was led by Professor Roger Fisher of Harvard Law School and myself. In collaboration with the Program on Negotiation at Harvard, each year in the period 1986–1990, we sponsored an intensive two-week workshop at the Salzburg Seminar designed mainly for young diplomats from many countries. Many of the students of these programs will be the key negotiators of tomorrow's disputes. This program deliberately chooses most of its cases and simulation exercises from contexts other than international disputes. In a given simulation exercise, a team of Israelis and Palestinians may be negotiating with a team of Greek and Turkish Cypriots on a domestic community dispute. It is often easier to comprehend new ways of thinking about the processes of negotiation in contexts other than the ones that you ultimately are most interested in influencing.

A claim is being made that a growing body of theory on negotiations transcends any single context (such as labor-management negotiations or international negotiations) and that diplomats and practitioners in international negotiations could profit from studying this theory. Of course, in any particular field of application a practitioner must know the specifics of that context, but institutional knowledge and methodological knowledge do not always have to be mastered together.

The U.S. PIN Project has also supported the preparation of an expository volume of contributions (Young, 1991) that attempts to communicate to a nonmathematical audience of negotiation specialists fundamental concepts in game theory and decision theory, which are purportedly of relevance to the practice of negotiations.

Some of the resistance against a PIN project at IIASA stemmed from the deeply held conviction that IIASA should have an idealistic agenda: It should not be involved in helping one party of a dispute at the expense of another party. But the advocates of the PIN Project, while agreeing with this idealistic sentiment, disagreed about the implications. They felt, as strongly as I do, that negotiations often result in outcomes that are not jointly efficient, that improvements can be made for all parties. There is a need for a paradigmatic shift of thinking from a zero-sum world to a non-zero-sum world where joint gains are possible. This does not preclude, of course, the presence of competitive elements as well as cooperative elements in real negotiations, but there is a role for analysis that tries to squeeze out mutually beneficial outcomes.

A Context-Free Theory of Negotiations

Negotiations are omnipresent, and we all have been practitioners, even as children negotiating with our parents or siblings. The contexts are diverse, ranging from family disputes to labor-management disputes to contract disputes to environmental disputes to regulatory disputes. One hallmark of systems analysis is to draw analogs from one system to another, to identify what is common and what is special, what works in one system that can be applied (with creative modification) to another system. Well, what is special about *international* negotiations? Before we go too far in specifying differences *between* contexts, we should look at the differences *within* the context of international negotiations. These differences are vast, ranging from negotiations such as the Law of the Sea or the General Agreement on Tariffs and Trade to bilateral negotiations on a single-issue monetary contract.

Usually nations are nonmonolithic: The internal negotiation within each nation has to be synchronized with the external negotiation (but so is the case in labor negotiations or community negotiations). Negotiations among nations are not single shot but repetitive (but so are most commercial negotiations). If negotiations among nations break down, there is often no recourse to a higher authority that can adjudicate the dispute (but a lot of disputes in other contexts, if not resolved, just linger on). Power often plays a dominant role in international disputes (but this is not new in other contexts). International negotiations are often conducted in a fishbowl, and the media interfere in the process of informal, exploratory dialogue (but, once again, this happens in intranational negotiations in many contexts, as well).

The point of this exercise is that there are distinctive features about almost any dispute, international or otherwise, but the further one goes in investigating the essence of a given problem, the more one is struck by the similarities among disputes. There is, I believe, a commonality among disputes that makes it possible to talk about negotiation theory—context-free. Just as in any mathematical system, the study of the pure, abstract system can be enriched by going back and forth between abstraction and diverse real-world realizations. One negotiating context can often best be compared with another context by considering their common abstraction and their differences within that abstraction.

DESCRIPTIVE, NORMATIVE, AND PRESCRIPTIVE ORIENTATIONS

Bell, Raiffa, and Tversky (1989) discuss the distinctions among descriptive, normative, and prescriptive modes of analysis in individual decision making. In the literature, the prescriptive category is usually subsumed under the normative

heading. For our purposes here, it will help to make the distinction more precise.

Descriptive analysis is concerned with how real people behave: how they perceive uncertainties, accumulate evidence, and update perceptions; how they learn and adapt their behavior; how and why people think the way they do. It is a highly empirical and clinical mode of analysis that falls squarely in the province of the social scientist. Descriptive studies of international diplomacy lie in the province of history, political science, and international law. At times, descriptive analyses may involve intricate mathematical modeling and sophisticated statistical analysis. The techniques of systems analysis can be employed in trying to bring structure to confusing empirical data. Scholars can study this domain without trying to modify, influence, or moralize about behavior.

Normative or *abstractive analysis* deals with how idealized, rational, superintelligent people *should* act. The hallmarks of normative analysis are coherence and rationality in terms of precisely specified desiderata or axioms. In economic affairs, there are theories about the idealized entrepreneur, consumer, or investor; there are theories of perfect markets or rational expectation, and of pure competitive equilibrium. The theory of games is a normative model of idealized competitive and collaborative behavior.

There has been a remarkable burst of research activity on the theory of games in the past decade, as measured by papers published in prestigious academic journals, doctoral theses, seminars, and conferences. Many theoretical contributors have increasingly been motivated by topics in negotiation analysis and have enhanced general understanding of these problems, but it is not easy to apply this theory. After discussing some of the distinctions between normative and prescriptive viewpoints, I will indicate why it is difficult to apply game theory prescriptively.

Prescriptive analysis is advisory in nature. As stated in Bell, Raiffa, and Tversky (1989, p. 17), "What should an individual do to make better choices? What modes of thought, decision aids, conceptual schemes are useful—useful not for idealized, mythical, depsychologized automation but for real people? The differences among the three functions—descriptive, normative, and prescriptive—can be illuminated by examining the criteria by which they are evaluated. Descriptive models are evaluated by their *empirical validity;* normative models by their *theoretical adequacy,* that is the degree to which they provide acceptable idealizations of rational choice; prescriptive models by their *pragmatic* value, that is, by their ability to help people make better decisions."

Theory of Games: A Jointly Normative Theory

The theory of games posits a high degree of rationality on the part of all the players in the game. In this respect, it is not a very good descriptive theory. Furthermore, in order for the theory to identify objectively derived equilibria, a

real-world example must be abstracted in a highly artificial, constrained manner. It must build up its logical superstructure on a basis of *common knowledge.* If a player has confidential knowledge, all players must know, *in common,* the probability distribution from which this confidential knowledge was drawn. You, as a player, may not know your adversary's action space or utility structure, but if the situation is to be represented as a bona fide game, these action spaces and utility structures must be drawn from probability distributions that are common knowledge. Because game theory is doubly constrained by mutual rationality and the common-knowledge assumption, it is not widely applicable as descriptive theory or particularly useful as a theory that can be used to give advice to a disputant or an intervener (facilitator, mediator, or arbitrator) in most realistic negotiations. As a normative theory, it can be extremely helpful in guiding descriptive or prescriptive analyses. It can be and has been used in an allegorical sense to get some fundamental thinking straight, to sensitize practitioners to subtle issues. Game theory has been creatively used (prescriptively) to propose dispute resolution mechanisms (for example, intricate auction and bidding systems or dynamic procedures for allocating limited resources), but those cases are not very prevalent (descriptively).

The Asymmetrically Prescriptive-Descriptive Approach to Negotiations

Raiffa (1982) proposes that the techniques of decision analysis be used prescriptively to help a disputant or intervener, treated as a single decision maker, make reasoned choices. Such a decision maker is confronted with a decision problem under uncertainty—the salient difference in the negotiating context being that some uncertainties arise because of deliberate actions of others, all of whom may be thinking what the other decision makers are thinking. But is not this the hallmark of game theory? As I remarked in Raiffa (1982, p. 2):

> The theory of games focuses its attention on problems where the protagonists in a dispute are superrational, where the "rules of the game" are so well understood by the "players" that each can think about what the others are thinking about what he is thinking, ad infinitum. Real cases are of another variety: Mr. X, the vice-president of operations of Firm A, knows he has a problem, but he's not sure of the decision alternatives he has and he's not sure that his adversaries (Firms B and C) even recognize that a problem exists. If Firms A, B, and C behave in thus-and-such a way, he cannot predict what the payoffs will be to each and he doesn't know how he should evaluate his own payoffs, to say nothing about his adversaries' payoffs. There are uncertainties all around besides those that relate to the choices of Firms B and C; no objective probability distributions for those ancillary uncertainties are available. Mr. X has a hard time sorting out what he thinks about the uncertainties and about the value tradeoffs he confronts, and he is in no frame of mind to assess what Mr. Y of Firm B and Mr. Z

> of Firm C are thinking about what he's thinking. Indeed, Mr. X is mainly thinking about idiosyncratic issues that would be viewed by Y and Z as completely extraneous to their problems. Game theory, however, deals only with the way in which ultrasmart, all-knowing people *should* behave in competitive situations, and has little to say to Mr. X as he confronts the morass of his problem.

The Raiffa book (1982) is asymmetrically prescriptive-descriptive: It *prescriptively* applies the techniques of decision analysis for a given disputant on the basis of *descriptive* models of behavior for other disputants. Although the formal theory is based on subjective expected utility theory, the decision analytical insights can often be gleaned without fully formalizing a utility function.

Wise prescriptions should ideally be based on good descriptions. In that respect, good analyses of international negotiations should precede prescriptions for change. Some would argue that it is presumptuous to prescribe how international negotiations *should* be conducted before one has a fundamental understanding of how these negotiations *are* conducted. But how fundamental? The process of understanding is unending, and prescriptive analysis cannot and should not be postponed indefinitely. Indeed, prescriptive orientations often highlight new frameworks for descriptive studies. Description and prescription should mature together.

Analysis of and for Negotiations

The literature is replete with retrospective studies of past negotiations, and some of it attempts to use systematic analysis and modeling to rationalize and understand behavior and strategy. Analyses might examine in what ways real behavior is similar to the idealized behavior of rational actors in simplified, analogous games. Furthermore, game-theoretical reasoning might influence the pattern of empirical research; it might motivate the investigator to pursue lines of inquiry that would not be obvious without the insights from the abstract theory. All this activity can be thought of as analysis *of* negotiations.

Analysis *of* negotiations is descriptive and may draw insights from normative (or abstractive) studies. Analysis *for* negotiations has a different flavor. It is designed to help disputants and interveners (facilitators, mediators, or arbitrators) to do their job better in specific real-world negotiating problems. As I mentioned earlier, IIASA has been engaged in analysis *for* negotiations through its work on modeling of systems. The countries of Western Europe use IIASA's "RAINS" models in negotiating how to control acid rain depositions. Negotiators have used IIASA's models in disputes about the management of international rivers. IIASA's models on the system of production and distribution of food have been employed by some countries in establishing food policy strategies. A Massachusetts Institute of Technology–based model was instrumental in resolving the dispute about deep seabed mining in the Law of the Sea negotiations.

But there is another aspect of analysis *for* negotiations that is different from background modeling of the environment of a dispute. How can analysis be used to help a disputant or intervener choose a course of action before, during, and after a negotiation? Here the paradigm is more decision analytical than game theoretical. For example: What are the alternatives? What are the uncertainties (about physical parameters as well as interests, values, and actions of other disputants)? What actions can be deferred until information is gathered along the way? What are the multiple conflicting objectives? The analyst might wish to model the actions to be taken by others in order to assess probability distributions over these action alternatives. In this regard, the sophisticated analyst should utilize the impressive body of growing literature on behavioral decision theory. The analyst must study how others *do* make decisions in order to decide how he or she should make decisions.

The analyst tries to optimize the client's (utility) payoff. This sounds too asymmetrically competitive an orientation for a noble institute such as IIASA. This would not be the case if the client were the intervener or the creator of the rules of negotiations. But even if the client is a disputant country, very often asymmetrical prescriptive advice in a potential win-win world may be surprisingly cooperative: gain for yourself by being empathetic to the needs of others.

Premediation Analysis

IIASA can suitably do premediation analyses of international disputes that defy conventional resolution, disputes that are so intractable that compromises, if possible, have to be carefully crafted to include balanced, dynamic feedback mechanisms. Such disputes include the Palestinian-Israeli dispute, the Cypriot dispute, and the negotiations about the Law of the Atmosphere. Nations are often reluctant to enter into negotiations partially because they cannot see potential, politically feasible compromises that will be better than the uncertain future of the no-agreement alternative. Any acceptable compromise might have to incorporate adaptive control mechanisms to govern a very complex system of interactions fraught with uncertainties. Feasible solutions of these controversies are not obvious without a lot of deep analysis.

Premediation analysis would include the following:

1. A historical account, from a neutral perspective, of the conflict, including a summary of the perceptions of the parties
2. A study of the fundamental, basic interests as well as operational interests of the parties
3. A predictive (probabilistic) study of how the system might evolve without any agreement

4. A brainstorming-and-devising activity that would generate creative innovations for the resolution of the conflict, including the articulation of visionary potential futures if only the conflict could be amicably resolved
5. The identification of an array of potential, jointly efficient agreements that could be used to lure the official parties into willingness to negotiate
6. A study of how real exploratory negotiations could be broken off, if necessary, without severe penalties (see Raiffa, 1985a)

IIASA might be an ideal environment in which to do such premediation studies.

ANALYTICAL PROBLEMS IN INTERNATIONAL NEGOTIATIONS

Here are some analytical issues that can be most easily discussed in terms of two-party negotiations but that apply just as forcefully in multiparty negotiations. Consider two countries, *A* and *B,* that are engaged in a complex, multiple-issue negotiation. Assume that in a prenegotiation phase the countries have agreed on which issues need to be decided and that they have explored several possible resolutions for each issue but have not jointly agreed on the resolution of any of the issues. To give perspective on this type of negotiation, suppose that there are 100 issues grouped in 4 clusters of 25 each. For example, one cluster might involve economic matters, another governance, another security, and another questions of sovereignty. Each cluster might itself be structured into a hierarchy of issues. Assume that in the prenegotiation phase the parties tried to be creative in identifying clusters of issues that could yield joint gains for both parties. Furthermore, assume that by first compiling the issues to be resolved before specifying strong positions on these issues, the parties have refrained from premature claiming tactics, which often interfere with the attempt to create an agenda with potential joint win-win possibilities.

Synchronization of Internal and External Negotiations

Each party now has some hard internal negotiations to resolve. Let us look at country *A*. An interagency committee is formed with representatives $\{A_1, \ldots, A_i, \ldots, A_m\}$ to guide country *A*'s negotiation strategy and tactics. Representative A_i, who represents some political faction, might in turn engage in subnegotiations with representatives $\{A_{i1}, A_{ij}, A_{ini}\}$. Let us also assume that country *A* is represented by a single external negotiator, A^*, who, of course, may have a team of advisers. We can think of A^* as the agent acting for principals $\{A_1, \ldots, A_m\}$. In the most interesting examples, the principals are not of one mind—each

might be the guardian of some special concerns. In many countries, these internal negotiations are not formalized, and the committee operates on a consensual basis. Hence, when instructions are given to the external negotiator A^*, they take the form of an extreme position that is compatible with the list of each of the principals A_1 to A_m.

Perhaps this internal arrangement has its mirror image in country *B*. It will not be surprising if the opening positions of A^* and B^* (the external negotiator from country *B*) are not compatible. Information, with posturing, is exchanged, and A^* goes back to his principals for new instructions, as does B^*. Back and forth the negotiations go: from external to internal, back to external, and so on. The external negotiations tend to be positional bargaining with little creative exploration by A^* and B^*, because each is hobbled by the constraints of the agent's internally divided factions. If external agents A^* and B^* can miraculously agree on a joint compromise, then the proposed agreement must be ratified by each set of internal principals.

In many cases, the successive sets of instructions to the external agent-negotiators are tightly constructed, with little indication of how trade-offs among issues can be evaluated. "Go back and find out" is the operational strategy.

Mayer (1988) investigates a simplification of this problem in a simulated environment. External agent A^* has just two principals (A_1 and A_2), and the external negotiations involve just two issues (money and time). Principal A_1 is the guardian of issue 1 and A_2 of issue 2. In the laboratory, the team of $\{A_1,A_2\}$ instructs A^* to explore compromises with B^* that balance the interests of A_1 and A_2. Agent A^* is so hobbled by these constraints that he cannot exploit his differences with B^* and achieve a jointly desirable external outcome. Because of B^*'s interests, it may be desirable for the *A* team to agree on an external agreement that unbalances the interest of A_1 and A_2—for example, where A_1 is deliriously happy and A_2 only mildly favorable or even slightly unfavorable. In Mayer's experiments, A_1 and A_2 are not engaged in only one problem but in others as well; agent A^* may choose an agreement with B^* that favors A_1 over A_2 internally, but then A_1, by linking this external problem with *B* with other opportunities, may be able to creatively compensate A_2 in the other side deal.

Creative Compensation

I think international negotiations are often not effectively consummated because of poorly conceived sets of internal negotiations and lack of coordination between internal and external negotiations. A classic case is trade negotiations. Liberalizing trade between two countries may benefit each, but within each country there may be a few large losers (for example, farmers, industrial workers) and a multitude of small winners. The trick internally is to get the winners to compensate the losers so that the losers no longer become a blocking coalition.

There is a strategic game-theoretical problem in trade negotiations that deserves some comment. Even if country *B* does not liberalize is trade policy, it may be in the net interests of *A* to liberalize. But if *A* liberalizes, *B,* as a free rider, also benefits, and it may be in *A*'s interest not to liberalize in order to force *B* to liberalize. Paradoxically, it might also be in *B*'s interest if *A* were to threaten not to liberalize, because in that case *B* could appeal to the small faction of potential losers (internal to *B*) to be less intransigent, or appeal to the potential winners in *B* to override or buy off the losers.

The External Negotiator as Internal Mediator

Now return to the case where the external agent A^* must represent his principals A_1 to A_m. In some circumstances, A^* acts not only as an external negotiator but as an internal facilitator or mediator of the internal negotiations. To forge agreement externally with B^*, A^* may be forced to enter into the internal coalitional dynamics in which subsets of the principals A_1 to A_m form to present common fronts to the other subsets. Of course, this is a dangerous game for A^* to play if he wants to be perceived as an acceptably neutral facilitator of the internal debate.

Negotiations, both internal and external, can be public or private, which complicates matters. For example, internal negotiations of country *A* may be public but those of *B* private. Does this hurt *A*? Sometimes yes, but sometimes the internal posturing of an A_i principal can help make a commitment by A^* more credible. In the U.S.-Canadian trade negotiations, the internal debate in the United States hardened the positions of internal Canadian factions. Delicate compromises might have to be forged, treating the system as an organic whole.

Formalizing Trade-Offs

Let us back up and simplify. If A^* had just a single principal, or if the principals were of one mind, then ideally A^* should be informed as to how country *A* feels about the issues in some coherent detail. A^*'s instructions should include an ordering of preferences for the different possible resolutions of each issue as well as some indication of the importance of the various issues. During negotiations, A^* will be confronted with trade-offs across issues. Would country *A* prefer to move from one level of resolution to another on issue *i* if there were a quid pro quo of a specified movement on issue *j*? If A^*'s instructions specified a complete, coherent set of trade-offs, then he could constructively seek a jointly efficient outcome with his counterpart B^*. If these instructions are incomplete, however, A^* might often have to return to his principal for further clarification, and the process of external negotiation might be cumbersome and uninventive.

It is hard enough for just one principal to articulate a complete, coherent set of trade-offs across issues. This task becomes immeasurably harder if there are several principals at loggerheads with each other. If A^*'s instructions are am-

biguous, if not self-contradictory, then when A^* returns to his principals with a specific vexing trade-off, it might help focus the collective minds of his principals. There is a temptation to suggest to country *A:* "Get your internal act fully together before going external." This advice, however, may be inappropriate if the internal negotiations in the *A* team are too divisive. Some efficiency might have to be sacrificed in the external negotiations for the sake of a modicum of harmony internally.

In deciding on trade-offs between different resolutions on different issues, it is helpful for each country to try to relate these trade-offs to more basic underlying interests. Many resolutions on issues can be thought of as instrumental means toward ends, which are the basic underlying interests. Even though the negotiating parties have to obtain compromises among issues (means toward ends), it may be constructive for them to share openly with each other their basic interests. A fuller mutual understanding of these interests can spark creative ideas for compromise and innovation. Sometimes, of course, disputants may agree on a compromise at the level of issues while they remain totally antagonistic on more fundamental interests. These remarks on means and ends apply equally well to internal and to external negotiations.

Decomposing Negotiations

Return now to the case where the large set of issues can be conveniently partitioned into a few subsets, say, one hundred issues into four subsets of twenty-five each (economics, security, environment, and politics). It might be easier to articulate a coherent set of trade-offs among economics issues than among issues that range across the groupings of economics, security, environment, and politics. Indeed, many of *A*'s principals may be particularly knowledgeable and care only about, say, economic issues. In an extreme version, the grand negotiation might conveniently decompose into four sets of subnegotiations. But they may be tied loosely together in two respects. First, the trade-offs within the subset of economics, for example, might depend somewhat on how issues outside the economic realm are resolved. In more formal parlance, the set of economic issues might not be preferentially independent of the noneconomic issues. Second, the four subnegotiations might be linked together in an attempt to generate joint gains: one party agrees to take a less-than-desirable outcome on economic issues for a quid pro quo gain on security issues, for example.

In commenting on the problem of decomposition of negotiations, let us start off with the simplifying assumption that the set of economic issues is preferentially independent of the other issues in the instructions for both A^* and B^*. It would make sense, in this case, for countries *A* and *B* to break apart the totality of issues and engage in a subnegotiation on the economic issues. (In a similar manner, within arms control negotiations, it may be desirable to negotiate strategic nuclear arsenals separately from conventional armaments.) But it

would not be efficient if the economics subnegotiations tried to resolve independently the economic issues without looking at the grander trade-offs among economics, security, environment, and politics. If countries *A* and *B* attach differential importance to these clusters of issues, then it might be more efficient to seek solutions that do not provide sector-by-sector equity; in other words, it may be desirable to give up some advantage on economic issues to gain some quid pro quo on some other issues. If so, what instructions should *A** give to her subagents who will negotiate on economic matters? Given the trade-offs on economic issues, the subagent for economic issues does not want to come to a definitive compromise with her counterpart from *B* on economic matters. If the economic subagent is dealing with 25 economic issues, there may be millions of possible joint agreements, but most of these are jointly (or Pareto) inefficient. It should be the task of these subagents to share information that could jointly eliminate noncontenders: to identify not a single efficient compromise but an array of contracts that are jointly efficient, ranging from those that are dismal to those that are extraordinarily desirable for *A*. Because we are on the frontier, these will have the reverse preference orderings for *B*. It will be the task of the subagent's coordinator, *A**, in collaboration with her principals, to balance economics and other concerns in order to select an appropriate compromise agreement on the economic issues.

Insofar as the above describes the task for the subagent on economic matters, the nature of these negotiations has a flavor different from most negotiations that are not decomposed in this manner. In negotiations, one usually must be careful to balance the tactics of creating and claiming; one must be careful not to be too collaborative in exchanging information in the pursuit of joint gains, lest it weaken one's claims for an outcome beneficial to one's side. In negotiations that are decomposed into subnegotiations, the purposes of the subagents should involve fewer claiming tactics and more creative exploratory tactics. I think that subagents are not properly instructed to perform this exploratory task. All too often, the subagents try to get agreement on their sector, and this tends to lock in an agreement on the whole without enough logrolling across sectors.

Continuing with the discussion of decomposable negotiations, let me add another wrinkle, briefly mentioned above. It may be difficult for *A**, who must oversee the negotiations in noneconomic matters as well as economic matters, to instruct her subagent for the economics subnegotiations, because the trade-off on economic issues may not be preferentially independent of what is agreed on in noneconomic matters. Readers who are familiar with decomposition techniques in linear programming will recognize both the problem and its potential solution: the process has to be iterative. As the range of possible outcomes on noneconomic matters becomes progressively clear, the trade-offs on the economic issues will have to be modified according to the anticipated outcome on

the noneconomic issues. The rub is, of course, that the process is reflexive. The trade-offs on noneconomic issues might depend on the resolution of the economics subnegotiations. The more tight these across-sector preferences are (that is, the more preferential *dependence* there is), the more iterative the process must be. Indeed, it may not converge. The point is that the process is complex; it should be highly analytical, but it seldom is in real negotiations. The penalty for not doing it right is that we tend to get compromises that are crafted to achieve equity in each sector (such as economics), and not to seek efficiency across sectors. Furthermore, this tendency is amplified because even within a sector such as economics, the same process works: the decomposition *within* economics might elicit the same reactions. In addition, there may be several principals on *A*'s side concerned with economic matters; they in turn will want equity among themselves, and they may not be allowed to use creative side payments from winners to losers. All this tends to limit the scope for really creative solutions.

When we look at the intractability of some festering international disputes (for example, the Arab-Israeli dispute, the English-Irish dispute, the Cyprus dispute) as well as the enormous complexity of the negotiations between developed and developing countries on environmental matters (such as global warming—who will pay China not to use its coal?), agreements, if achievable, may have to be ingeniously crafted and be radically different from the usual conservative, incremental negotiated agreements that we have come to expect. The *process* of conducting these negotiations may be more important in generating solutions than the seemingly intractable differences among the disputants. I contend that good applied systems analysis might yet play a useful role.