



A Role for Negotiations in IIASA

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A ROLE FOR NEGOTIATIONS IN IIASA

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PREFACE

This paper presents one concept for the development of the International Negotiations Project in IIASA. It proposes a very special definition of negotiations designed to fit the mission of IIASA as perceived by the author. It is not meant to include the whole program of the project, but only that part which pertains to the transfer of research products into the real world of decision making and negotiations. This report was prepared for the International Negotiations Project in collaboration with the System and Decision Sciences Area in May 1983.

An "executive summary" follows this preface. Because some of these suggestions may, on a first reading, appear to depart from familiar patterns of research at IIASA, there is a fairly long introduction that seeks to show how these suggestions do fit into the goals of the Institute as stated in the CHARTER and the RESEARCH PLAN 1984.

SUMMARY

Negotiations has been selected by IIASA as a principal area of activity because of its importance to world peace and because it provides an appropriate opportunity for applying systems analysis techniques.

It is suggested that there are important differences between adversarial and collaborative negotiating processes and that a special focus of the IIASA Negotiations Project should be on collaboration.

It is further suggested that movement from adversarial to collaborative attitudes could be considered a "paradigm shift" of great importance. Skillful use of computer models and systems analysis could encourage negotiating parties to make this shift by helping them understand the complexity of the issues and through this understanding, discover new opportunities for improved solutions.

But in undertaking this task, attention must also be paid to minimizing the risks that scientists may fear in being diverted from their career paths and the risks that negotiators may perceive from uncertainty produced by new insights.

It is suggested that IIASA products be considered as a collection of tools, not isolated techniques. Negotiators should be shown how to use them selectively and in combination as aids to the total negotiating process. New skills of facilitators are needed to help fit the tools to the needs and preferences of the parties and to assist in communications between users and scientists.

Finally, it is suggested that a core facilitation team, recruited primarily from ARP, be assigned to the Negotiations Project to accomplish these tasks.

I N T R O D U C T I O N

The International Negotiations Project has been selected by IIASA as a principle area of activity. Not only is the subject of extreme importance to the future security of the world and therefore to our NMO's it is also a visible and tangible opportunity to fulfill the mission of APPLIED SYSTEMS ANALYSIS as stated in our title and as implied in our Charter.

There is now need to consider a more precise definition of just what we mean by "international negotiations", and to see how the resulting activities can fit most harmoniously into the total program of IIASA.

It might be useful to start with some pertinent quotations from IIASA documents:

THE CHARTER

P r e a m b l e

Realizing that the spread and intensification of industry through the continued application of science and technology generates problems of an increasingly complex nature in modern societies.

Recognizing that present methods of investigation and analysis should be substantially improved to make them more adequate to predict, evaluate and manage the social and other repercussions of scientific and technological development.

Believing that this aim can best be achieved through international co-operation in the development and application of methods of investigation and analysis which shall make use of computer technology, systems analysis methodology and modern management principles.

A r t i c l e II, Section 3

The Institute's work shall be exclusively for peaceful purposes.

RESEARCH PLAN 1984 (April 1983)

Page 11, Guiding Principles

A strong conceptual and methodological underpinning will always be important to IIASA's program. However, we must make greater efforts to focus on issues and on concepts and methods needed to clarify relevant issues and their possible solutions.

IIASA's Research Projects must identify potential users and target outputs accordingly. IIASA's projects should be initiated and conducted with a clear identity of potential users and clients.

This means seeking ways of developing stronger links between potential users and the Research Projects.

IIASA must enhance its sphere of influence through external collaboration.

Page 87, International Negotiations

Certain structural changes are taking place which are lending an air of urgency to the need to evolve new codes of international behavior and more efficient negotiating processes.

These changes are going to be too large to be handled successfully without proper planning and the necessary structures and systems to facilitate their implementation.

But negotiations can be successful only if all parties accept some common standard transcending their disputes.

It is generally agreed that international economic and security institutions and policies will undergo fundamental changes in the next five years, and that there is currently a lack of diplomatic tools to guide these institutional and policy changes. The need to improve the negotiation process is thus a matter of high priority.

I have started with these quotes for two reasons: they establish policy directions that have already been debated and accepted and they suggest a framework for fitting the Negotiations Project into the overall IIASA mission. Reviewing these quotes again, this time with my interpolations, the following pattern emerges:

From the Charter

- Our technological society has produced problems of such complexity that the present methods of analysis must be improved so we can better manage their social and other repercussions.
- The unique contribution that IIASA can make to this task of understanding complexity and assisting in reaching decisions is through international cooperation in the development and application of methods of investigation and analysis which shall make use of computer technology and systems analysis methodology.
- The Institute's work shall be exclusively for peaceful purposes. (And from this, I interpolate that we should focus on collaborative negotiation rather than adversarial negotiation. More on this idea later on.)

From the Research Plan - Guiding Principles

- There are two distinct but related parts of the IIASA Research plan:
 1. Conceptual and methodological research that is familiar to most academic scientists.
 2. Application of the Institute's research products to help solve real world problems, a task that is unfamiliar to most scientists.
- We must involve users and clients in the applied research activities of the Institute both to get our products accepted and used and also to enrich the research activity itself.

- (And here I interpolate again): We must find better ways for communicating between scientists and users and we must also find procedures for protecting scientists against unwanted distractions and interruptions of the work that is essential for their career development and that is of primary interest to them.

From the Research Plan - International Negotiations

- We must design our products to achieve more efficient negotiating procedures to fit the new codes of international behavior.
- In developing our tools for international negotiations we must also become aware of, and help in the evolution of, common standards which transcend current disputes. (Again an interpolation: one common standard which transcends disputes is a new recognition - perhaps we could call it a "paradigm shift" - that can be expressed in this way: these issues are so complex, and have such long-range and far-reaching impacts, that collaborative efforts to achieve a more complete understanding of these impacts is a more self-serving strategy than taking an adversarial position on an inadequately researched, intuitive perception of self-serving goals.)
- An important contribution to meeting the "lack of diplomatic tools to guide these institutional and policy changes and to improve the negotiating process" can be made by the products of IIASA research. It is therefore "a matter of high priority" for IIASA to expedite the introduction of these tools to the real world through its Negotiations Project. (And an interpolation: To achieve the full potential of this contribution, the IIASA products must be considered as an inventory of new techniques which, in combination with similar techniques available through the IIASA network, can improve the negotiating process. A new skill is needed, one which is already beginning to appear in many research centers: that of matching these techniques, singly and in combination, to meet the needs and preferences of the parties at different stages of their decision-making efforts. This new skill is called facilitation.

To examine further how the above cited broad principles for a part of the Negotiations Project might fit into the IIASA program, the remainder of this discussion is divided into the following sections:

- o What kind of negotiations
- o Why this kind of negotiations
- o How to implement these concepts

WHAT KIND

Negotiations are not an end in themselves. They are only one of a number of procedures that people use to reach decisions. Decisions are the end product, the goal. I have found it helpful, therefore, to think about negotiations as an important stage in what I call the DECISION CYCLE^x.

^x See appendix A for a detailed explanation of the Decision Cycle.

This cycle begins with an awareness of the issue, the formulation of the problems and the desired goals, and then the cycle continues through different stages, involving at various times all those who will actually engage in making the decision or whose acquiescence or disapproval will be necessary to its implementation. The cycle moves on to a decision, its implementation and then a new awareness of a problem or issue and the cycle begins again.

At each stage of the cycle, the deciding parties will use different strategies for considering the problem: everything from individual thinking, group discussions, different forms of communications and report writing, to the newest kinds of systems analysis and computer modeling.

At each stage of the cycle, negotiations can also occur. Typically, this takes place when parties with different interests sit around a bargaining table and seek to obtain the "best deal" for their constituencies. (Bargaining and negotiations can of course also take place at other locations: i.e. in the corridors, but the bargaining table is the focal point for this process.) And again, typically, this is both a verbal and an adversarial process.

There are times in most negotiations, even those that are extremely adversarial and heated, when there are opportunities for more collaborative procedures to be introduced and accepted. This can occur when the parties agree that the negotiations will proceed better, with only advantage for all and disadvantage for none, if there is consensus on problem definition, goals, facts, information, scientific insights, or the like.

With increasing frequency in international negotiations, when such opportunities for collaborative efforts present themselves, the issues are exceedingly complex. Computers, computer models, and systems approaches in general are effective and powerful tools for managing complexity of this kind -- not only those parts of an issue that can be described in mathematical terms, but also with the aid of graphs, visual images, and comparative relationships. If used collaboratively in negotiations, they can have a powerful and subtle influence on the participants that far exceeds the capability of the machine itself. The requirement to agree on the data put in, and on the design of the algorithms, all followed by jointly playing "what if" with different strategies, provides a structure for human interaction that can increase the effectiveness of the negotiating process for reaching consensus, and for reaching it with more logical and less emotional input. Even in situations where subjectivity prevails, emotions can be more constructively channeled.

The use of a model provided by MIT in the Law of the Sea Negotiations is one example illustrating this point.^x

^xFor a full description see: THE COMPUTER AS MEDIATOR: Law of the Sea and Beyond, James K. Sebenius, Journal of Policy Analysis and Management, Vol.2, No.1, 77-95 (1981) C. 1981 by the Association for Public Policy Analysis and Management, John Wiley & Sons. Also, the forthcoming proceedings of session 12 of the April 5-8, 1983 Science Week Symposium of the New York Academy of Science in which Ambassadors Tommy Koh of Singapore and Elliot L. Richardson of the U.S. recount their experience in using the M.I.T. model in the L.O.S. negotiations.

Pulling the above observations together, a definition of these aspects of the Negotiations Project might be:^x

THE IIASA NEGOTIATIONS PROJECT WILL SEEK OPPORTUNITIES TO APPLY THE METHODS OF INVESTIGATION AND ANALYSIS WHICH MAKE USE OF COMPUTER TECHNOLOGY AND SYSTEMS ANALYSIS METHODOLOGY FOR THE RESOLUTION OF PROBLEMS OF A COMPLEX NATURE IN INTERNATIONAL NEGOTIATIONS. WITHOUT LIMITING THE SCOPE OF THE PROJECT, PARTICULAR EFFORT WILL BE MADE TO INTRODUCE AND ACHIEVE ACCEPTANCE OF JOINT AND COLLABORATIVE USE OF THESE PROCEDURES. RESEARCH EMPHASIS WILL BE PLACED ON DISCOVERING WHEN SUCH COLLABORATIVE EFFORTS CAN BE MOST USEFUL, HOW THEY CAN BE BEST INTRODUCED, AND HOW THEY CAN BEST ENHANCE THE EFFECTIVENESS OF THE MORE TRADITIONAL PROCEDURES OF NEGOTIATION.

It might be useful to clarify the above definition by providing a further definition of my special use of the terms: Adversarial Negotiation and Collaborative Negotiations.^{xx}

Adversarial Negotiations: A decision-seeking process when two or more parties wish to achieve goals which they perceive to be in conflict to such an extent that all possible solutions are essentially "zero-sum".

Collaborative Negotiations: A problem solving exercise engaged in by two or more parties whose goals may not be identical but who perceive that they each may benefit more by developing joint procedures for seeking solutions than they could gain by striving to overpower or out-bargain the other. In general, parties who choose collaboration perceive the possibility of a positive-sum result through collaboration and a lose-lose result through conflict.

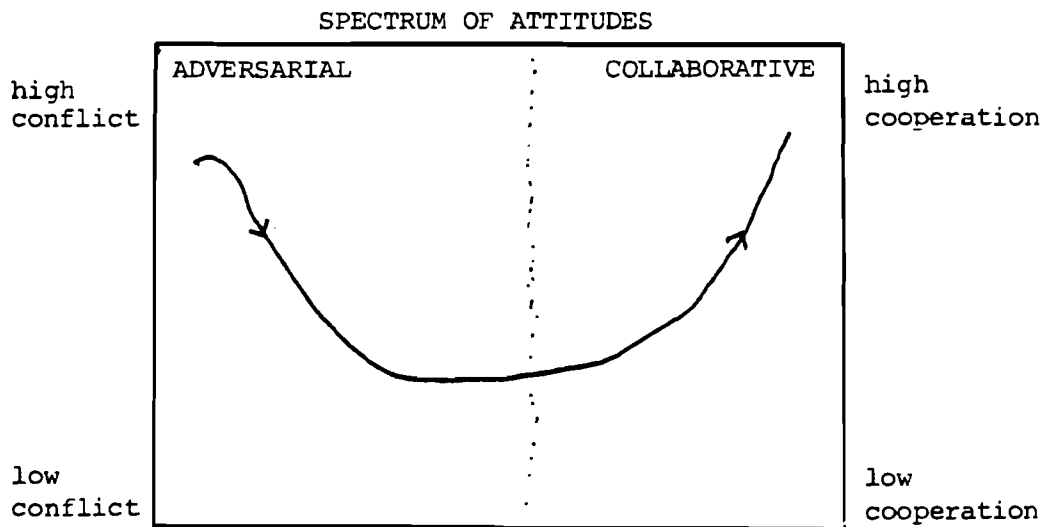
^xFor reasons that are discussed below this paper suggests that IIASA Negotiations Project focus its attention on "collaborative negotiations". "Adversarial negotiations" are overwhelmingly more frequent, and there are many bargaining and mediation techniques that apply to them. Nor am I suggesting that the IIASA Project should not be concerned with them. What I am asserting is that IIASA has a unique opportunity to contribute to collaborative negotiations, through the application of computer-based techniques -- an opportunity that cannot at the present time be duplicated anywhere else.

^{xx}Most negotiators and academics who write about negotiations would include many of the concepts that I define as collaboration in their definition of negotiations. Why I make this distinction will become clear in the next section.

WHY THIS KIND

In actual negotiations, the distinction between adversarial and collaborative procedures and attitudes is not always clear. Even in the most bitter bargaining there are usually moments of collaborative efforts, and conversely, collaborative efforts often encounter moments of sharp controversy. I emphasize this distinction to make a point that is often overlooked -- a point that has special relevance for IIASA both because it is an international organization "whose work shall be exclusively for peaceful purposes", and also because this distinction is of importance in the design of IIASA products for use under live decision-making conditions.

It follows from this consideration that an important goal of the IIASA Negotiating Project is to provide procedures that can be useful in moving the parties towards the collaborative end of an adversarial - collaborative spectrum. Assuming that adversarial and collaborative attitudes and behavior are at the opposite ends of this spectrum, and that between these poles are different levels of conflict and cooperation, then the level of conflict must first be reduced before there will be an opportunity to introduce cooperative procedures that will lead to collaboration. A graph of this concept might look like this:



When designing systems analysis, computer models, and other decision-making aids for practical use, there are different considerations to keep in mind for adversarial procedures than for collaborative. For adversarial negotiations, the data and assumptions will be chosen as they are for legal briefs: to prove a point and win an argument on already determined premises, not to discover new truths or to find new solutions. Information will be shared only to the extent that it helps to "win". A collaboratively built model must be wholly "transparent" to its users, and capable of being changed as new insights and agreements are jointly reached. Different interactive capacities are also needed for a model that will be jointly used by two or more parties in live decision processes. Attention must also be paid to ground rules governing access, confidentiality, and time-sharing.

The reasons for this emphasis on collaborative processes are subtle and potentially of great significance. While this concept is not yet proven or widely accepted, it is at least deserving of serious examination. With perhaps some admitted over-enthusiasm, as I have already suggested, this concept may describe an important and already-in-progress "paradigm shift".

In my experience as a mediator in large-scale environmental conflicts, I have often observed that the self-interest motivated goals of the parties become buried under an over-load of complexity -- and a resulting inability to examine logically the consequences of the choices that were being made, and, consequently, a restriction of the available alternatives to be considered. Under such conditions, no person can sort out all of the possible interactions and seek possible solutions without mechanical aids. And even with powerful aids, and under the best of circumstances, the human mind resists being over-loaded with more information than it can manage itself. Thus a policy-maker's first intuitions are usually based on personal experience and perceived interests rather than rigorous analysis. These first intuitions typically become strong and argument-resistant convictions. When confronted with opposing convictions or evidence, rooted in different experiences and perceptions of interests, there is a tendency to shut-out all incoming and opposing arguments -- simply to preserve sanity if for no other reason. The very survival of individual careers and of institutions may be thought to be threatened by new perceptions and new information.

For these reasons, the collaborative use of computer modelling can also be threatening. Insights may be achieved which were not anticipated and which may run counter to the strongly-held positions of the parties. These new insights may, in turn, soften formerly held positions and suggest solutions for those participating in the exercise which were not anticipated by the top policy makers and bosses who may not be participating. This may introduce an element of uncertainty which many policy makers will not tolerate -- to enter into collaborative processes almost of necessity implies an acceptance of the "paradigm shift" of: I'd rather reach a rationally correct solution than win an instinctively desired (but possibly wrong) victory.

If we are to be successful in introducing the collaborative use of these tools, we must be aware of these understandable concerns and find procedures for diminishing their threats without diminishing their power. This is an important focus of research for anyone engaged in the development of a new and powerful technology, and one which should be given more attention at IIASA.

Nor is the threat posed by collaboration by any means based alone on East-West cultural differences. It applies to an almost equal extent to Western policy makers as well. Furthermore, it has roots in a universal set of academic - practitioner differences. The practitioner's goal is to find an aid to understanding the issue and to move towards a decision, and he doesn't care whether he uses one tool or several tools in combination, nor is he concerned with the particular academic discipline from which they came.

But for the academic, his normal incentives are to work within his particular discipline and to write papers and do research which will improve his career opportunities. The development of collaborative procedures, with rare exceptions, are not on the usual career path. This, too, is a consideration which must be taken seriously, and methods must be devised that will enable scientists to contribute without jeopardizing their own self interest.

To the extent that these observations are correct, it then follows that one of the goals of the project will be to find procedures and techniques for helping shift the parties from adversarial to collaborative attitudes and behavior. An important contribution would be to help the parties understand the consequences of proposed actions with sufficient scientific analysis and clarity which may alter or widen presently held and intuitive perceptions of self-interest. It is the interactive process of seeking such an understanding, even more than the tangible outputs of a model or other computer-based aids that can make the major contribution.

HOW TO IMPLEMENT

From a user viewpoint, the products of IIASA fall under the following very general categories:*

Multi-objective decision making and optimization:

These approaches can be used either by one party or by several parties in "games" to develop solutions based on clearly defined and mathematically expressed preferences and constraints. The computer can be programmed either for finding the optimum solution or for "satisficing".

Scenario analysis:

This is a process for building a description or map of a complex structure to aid in understanding and analyzing its behavior.

Detailed models:

Mathematically constructed representations of complex structures that can show how interrelated factors interact and can also allow the user to observe how changes in one or more factors will affect the entire structure.

Operational models:

Highly aggregated and quickly interacting models that can be quickly constructed in cooperation between model builders and the users. These models reduce complex problems to a manageable size, often with animated visuals, for use in analysis or in live negotiations.

Institutional behavior and comparative culture:

Social science analysis of institutional behavior under different cultural and human environments.

Systems approaches to deal with uncertainty, unpredictability, and surprise:

* A number of attempts have been made from time to time to make an inventory of IIASA research products. I found none that would be helpful to the non-technical negotiator in search of negotiating "tools". I then attempted to develop one myself, but this attempt was unsuccessful both for lack of time and sufficient technical expertise on my part to evaluate what is available. I have found this highly aggregated grouping of IIASA activities of some help in understanding the work now going on ... but clearly its expansion and improvement is a task which urgently needs doing.

It is important to recognize that even when one or more of the IIASA products may be used by negotiators and decision-makers, they will be used only in certain discrete stages of the decision cycle (see Appendix A) and usually not at all times even in those particular stages. There are many aids to decision making that are not based on the sort of systems analysis products that IIASA produces. To become fully effective in the practical world of decisions and negotiations, we must learn how these products can be best used in association with across-the-table bargaining, conferences, planning meetings, and a host of other more conventional processes.

Reminding ourselves again that an IIASA goal is to expedite the transfer of what we develop into the practical arena, it follows that models and other products must be designed with the preferences of the ultimate users clearly in mind. This is a more difficult objective than it may at first seem, and is one worthy of some rigorous research. It goes beyond the concepts usually associated in the computer trade with "user friendliness", because it implies tailoring the product to specific users, not users in general. In trying to grapple with this problem, I have developed a list of questions that need further investigation. They range from such simple concepts as whether an interactive terminal should be placed in the same room as the negotiators, or kept outside; to more complex questions such as how a model can be changed to coincide with the changes in attitudes and perceptions of the users. A sampling of other questions will give some idea of their range:*

When should participants be involved? In determining the design of the model? In deciding on data and other inputs? In deciding upon the algorithms and assumptions? In fine tuning the model before use?

How can models be used to achieve implementation and ratification of the decision? Through the use of repeater terminals and displays during the negotiations, involving the eventual individuals needed for ratification? Getting feedback from such individuals during the discussions?

How to design models to permit retrieval of information that conforms to the kind and amount desired at any particular stage of the discussions?

How to build in an ability to "zoom" from a macro look at the system to a micro look? How to use interactive operating models to link desired data and interactions from different models?

And yet, even if we accept these kinds of questions as proper subjects for IIASA research, we must again remind ourselves that these are not the kind of questions in which most scientists are interested, and of even more importance, not the sort which can advance them in their academic careers. For this task, IIASA needs to develop and encourage new professional skills to perform the tasks of a "facilitator". A facilitator helps manage the decision making process as a neutral, non-authoritative staff assistant to the parties. His focus is primarily on process, not on substance. He differs from the more familiar mediator in that he commences his activities at the start of the decision cycle, not when a dispute arises. In this way, his main concern is more with making progress towards a solution by consensus and less on the resolution of disputes.

Within IIASA there are already considerable skills that could be directed towards performing facilitation tasks. The challenge of matching these skills to the needs of computer assisted negotiations is an opportunity for good scientific work. A few examples will suggest the direction such research

* See Appendix B for a more complete list of questions.

could take:

- Very often analysts and negotiators hold very different views of the problems they are addressing. There is a need to synthesize these views so that the scientists and practitioners can work together as a team.
- Negotiators both within the same party and in different parties also may have conflicting views of the problem. In fact, for most cases involving complex problems, absence of a common understanding or shared interpretation of the problem by the parties in conflict may be the central obstacle to resolution. How, with the aid of a computer or other technical assistance, to reach common definitions at the outset of a decision process, is a rich field for investigation and live experimentation.
- Getting negotiators to use models or other technical assistance requires that they develop an "ownership" in the process and learn how to use it with confidence and understanding. Issues raised by trying to make them "user friendly" must be addressed in greater depth.
- More theoretical areas of systems analysis such as optimization, gaming, dual control, etc. must be brought progressively into the process of negotiation.

A possible way to proceed, taking advantage of capabilities already existing within IIASA, would be as follows:

1. Establish a core facilitation group within the International Negotiations Project. Membership in the group would draw upon individuals in Adaptive Resource Policies (ARP), or other interested and qualified persons.
2. This core facilitation group would work under the supervision of the Negotiations Project director to perform live experiments in computer assisted negotiations.
3. The facilitation group would also help in internal communication within IIASA as the design of models for a particular negotiation develops. They would also be concerned with encouraging and taking part in the sort of research opportunities suggested above.

APPENDIX A:

THE DECISION CYCLE

This version of the decision cycle is in the form of five concentric rings. In concept, the outer ring is stationary and represents the stages through which a decision can, but does not necessarily, go (see Figure A1).

The second ring represents the procedures that can be invoked by persons in seeking solutions to a problem. Almost any one of these procedures can be used during any stage of the cycle.

The third ring represents the tools which may be employed in connection with different procedures and at different stages during the cycle.

The fourth ring represents disputes or other interruptions in the smooth operation of the cycle as it turns towards a decision.

The inner ring represents third party assistance that can be extended to the parties for the resolution of disputes or, in the case of facilitation, for help in the management of the decision making process at any stage in the cycle and for the selection and use of procedures and tools.

Thus, in concept, the outer ring remains fixed and the inner rings can rotate to associate procedures, tools, disputes, and third party assistance with each other and with different stages of the cycle.

STAGES - THE OUTER RING

Awareness of problem: There comes a time when someone, or perhaps a small group, becomes aware that a problem may exist. It could be evidence of water pollution, such as dead fish or discoloration of the water; a sudden blight affecting a forest, race riots breaking out in an inner-city, or a change in birth-rates as revealed by the latest census.

Definition of problem: A failure to define the problem and the goals that a decision is designed to achieve at an early stage can cause trouble at later stages. If more than one party or one set of interests are involved, then definitions of the problem and goals should be developed jointly, if at all possible. Even if full consensus cannot be achieved on the definition of the problem and the goals desired, then at least the fullest possible understanding of what are the differences is desirable. In cases where no such collabo-

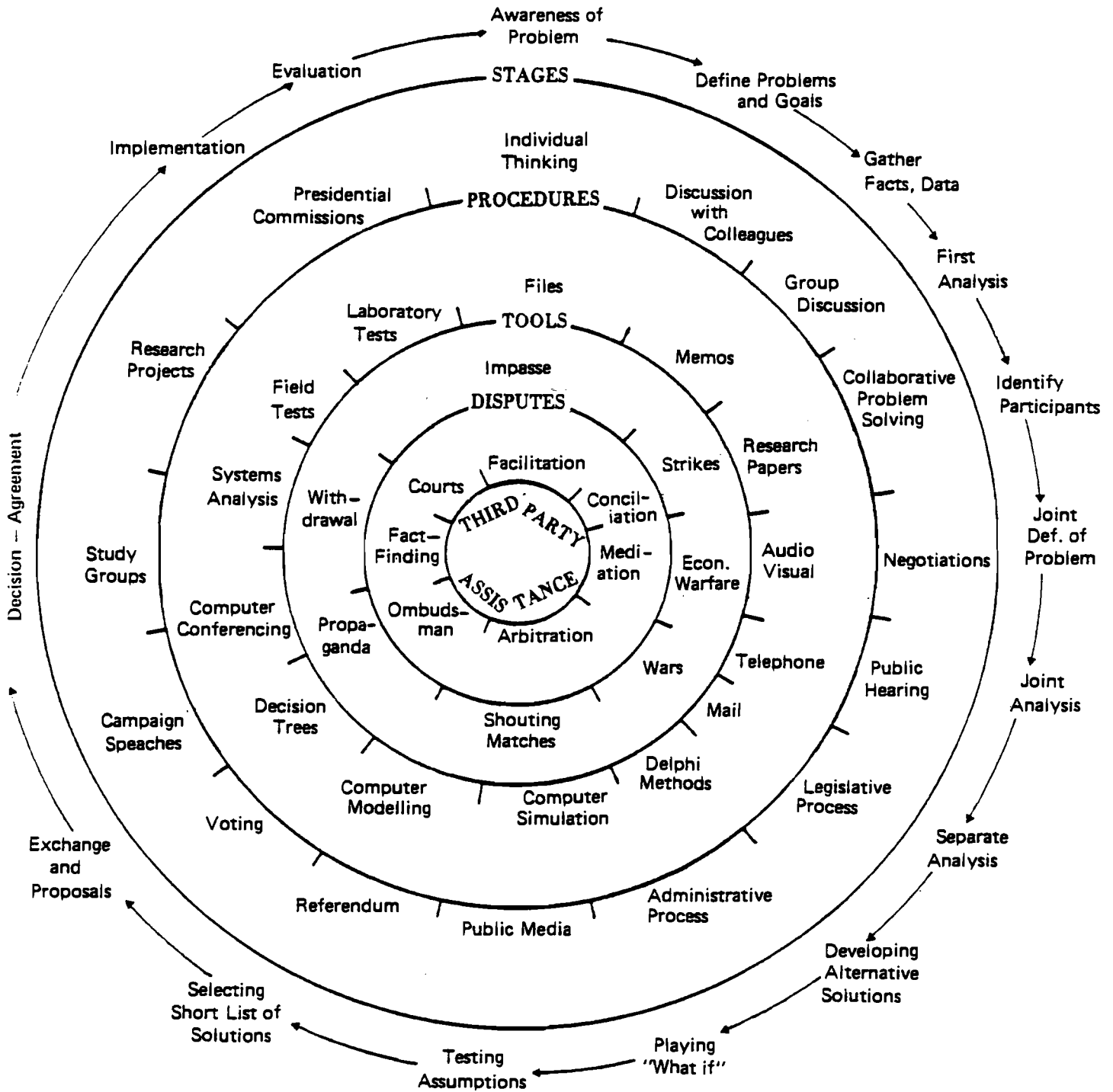


Figure A1. The decision cycle.

rative attempts are possible to reach common definitions, the decision cycle is likely to become adversarial or even combative. This is another reason why the attempt at definition should be made at an early stage. Even if the situation is such that adversarial attitudes and behavior seem inevitable, the attempt should be made because, in many instances, an early attempt could surprisingly transform what at first appears to be an inevitable conflict into an at least partially collaborative effort.

Gathering facts: A normal reaction to the awareness of a problem could be the gathering of available facts to obtain a better comprehension of the problem, or perhaps the initiation of research to learn more about it than is presently available.

First analysis: As soon as a problem is identified and some facts are in hand, there is a tendency to make a first analysis and a danger to "jump to conclusions" before going much further. Decision cycles are often short-circuited at this point, with people leaping to an immediate decision before further analysis or identification of who else might be concerned and therefore involved.

Identifying participants: Most large-scale and complex issues involve many persons and groups, and even nations, with a stake in the outcomes -- whether they be the result of conscious action and intervention or of letting "nature take its course". The identification of concerned individuals and groups is more difficult than it first sounds. The closing of a beach for health or ecological reasons may affect not only those in adjacent neighborhoods but others miles away who wish to use the beach for occasional vacations. Any intervention into the quality of the ambient air will have wide consequences of concern to many. And, difficult as these questions of identification may be, the next question of who, and what groups, should be included in the decision-making process is even more difficult. Some of the factors that must be considered and resolved are: how many persons can be involved without making it unwieldy; how many must be involved in order to get consensus in or acquiescence to the ultimate decision; what level of technical expertise is necessary for participation in various stages of the cycle; what are the cultural requirements for wide, democratic decision-making at one extreme or authoritarian decisions by a few at the other extreme. Errors in judgement at this stage can cause mounting and incremental troubles in later stages.

Joint analysis: If a joint definition of the problem and the goals can be achieved, then a logical next step is joint analysis.

Separate analysis: If joint definition cannot be achieved, or if there were no attempt to achieve it, separate analysis is a next likely stage, to be followed by various later stages of adversarial activity. Of course, this is not a matter of all one or the other. No matter how collaborative the process, there will be separate analyses done by all groups at virtually every stage of the cycle.

Developing alternative solutions: Ideally, alternative solutions will emerge after careful fact-gathering, analysis, problem definition and goal setting, preferably under collaborative processes. More often, they will be developed unilaterally and phrased for use in adversarial debate. All too often, they will be reached with inadequate definition or analysis of any kind.

Playing "what-if": Once alternative solutions are conceived, different ones are tested by speculating on the impacts and consequences that would occur. Again this can be done unilaterally or collaboratively.

Selecting a short list of solutions: This stage is a natural consequence of playing "what-if", and out of this list will emerge the eventual decision, possibly after another round of "what-if".

Decision: A decision is the end-product of the decision cycle.

Implementation: No decision is worth very much if it cannot be implemented. The ease of its implementation, or in fact whether it can be implemented at all, will depend in large part upon the incremental successes in former stages of the cycle.

The cycle begins again: Very few problems are solved permanently. More often a decision and subsequent implementation soon reveals new problems and the cycle begins once again.

Comment: No decision cycle passes through each of the above stages, nor is the sequence likely to be identical to the one depicted. Many of the stages will be omitted or short-circuited, either by design or unconsciously. It is also possible, when large scale or complex issues are involved, that there

will be reiterations of the stages. Review of definitions or goals may be necessary or desirable after analysis or after playing "what if"; re-identifying participants may be necessary at later stages, etc.

PROCEDURES - THE SECOND RING

On the second ring there are listed various procedures which are used by people and institutions as they move through the stages of the decision cycle. This list is not exhaustive, and the descriptions set forth below can be expanded and greatly improved. If one can imagine that this ring can rotate so that each procedure can be turned to coincide with a stage of the cycle on the outer ring, it will be found that most of the procedures can be employed at several stages. But it is important to observe that human behavior, attitudes, and interactions will differ with each procedure. For those concerned with making the decision cycle proceed as smoothly and efficiently as possible, this observation is important because it also follows that the aids employed to help the cycle along must fit the needs of the procedure being employed. For example, it is obvious that a computer model need be far more interactive if used in connection with negotiations or collaborative problem solving than if it is used by an individual or a unilateral decision group to pick a solution.

Individual thinking: Most problems are solved, and most inventive or innovative solutions are developed, by individuals thinking alone. But as problems become more complex, and as more people or groups are involved in the consequences, then procedures are required for managing the resulting dialogue and for keeping it from becoming a chaotic "Tower of Babel".

Discussion with colleagues: Discussion among colleagues, particularly up to but not exceeding four or five, can be casual and in need of little structure or advanced planning.

Group discussion: When more than four or five are involved, and particularly if they may have different interests and goals, then the preparation and process becomes more critical. There is a whole literature on the running of meetings and group discussions, and there is room in such procedures for many new and often technical aids, including access to computer models and information. How these aids can best be used for groups up to around 15 in number has been the subject of a great deal of recent research and innovation.

Collaborative problem solving: Where groups with different interests agree to collaborate, the needed procedures and aids become more sophisticated. Collaborative problem solving can be accomplished in small groups up to around 15. But if more must be involved, then different arrangements are possible, including a series of different small groups that reach into different levels of the same party, or involve different levels of authority or technical expertise. If even wider participation is required, then various forms of computer conferencing or even the use of mass media on an interactive basis have been used.

Negotiations: Very often parties with different interests will not agree to collaborate but will agree that any eventual decision must achieve some accommodation or consensus. Under these circumstances, the adversarial yet joint procedure of negotiations is often chosen. Once again it should be noted that the technical aids that can help negotiations will differ in critical details from those that will be found useful in collaborative processes. For example, if computer models are to be used, the way in which they can be built will differ, and the rules for access must also be adopted to meet the particular circumstances and desires of the parties.

ANOTHER IMPORTANT OBSERVATION: THE DISTINCTION BETWEEN ADVERSARIAL AND COLLABORATIVE PROCEDURES MAY NOT ALWAYS BE OBVIOUS OR SHARP. MANY NEGOTIATIONS GO THROUGH STAGES OF COLLABORATIVE EFFORTS, AND NOT ALL COLLABORATIVE PROCEDURES AVOID MOMENTS OF ADVERSARIAL ATTITUDES AND BEHAVIOR. AN INTERESTING RESEARCH QUESTION IS HOW TO IDENTIFY SHIFTS FROM ADVERSARIAL TO COLLABORATIVE BEHAVIOR AND HOW TO SHAPE THE TECHNICAL AND ENVIRONMENTAL AIDS TO ACCOMMODATE THE SHIFTS. AS A TENTATIVE HYPOTHESIS, THE AIDS SHOULD SEEK TO MOVE ADVERSARIAL BEHAVIOR TOWARD COLLABORATIVE BEHAVIOR, OR TO KEEP COLLABORATIVE BEHAVIOR FROM SHIFTING TOWARD THE ADVERSARIAL. BUT AT THE SAME TIME, IT IS PROBABLY NOT A GOOD IDEA TO KEEP EMPLOYING AIDS DESIGNED FOR ONE TYPE OF BEHAVIOR WHEN THE SHIFT HAS OCCURRED, BUT RATHER TO SHIFT THE AIDS WITH THE BEHAVIOR OF THE PARTIES. THIS MAY INCLUDE SUCH SIMPLE-SEEMING DETAILS AS THE SHAPE OF THE TABLE OR THE CONFIGURATION IN WHICH PEOPLE SIT; TO MORE SOPHISTICATED CONCERNS AS WHERE COMPUTER TERMINALS SHOULD BE PLACED OR THE DEGREE TO WHICH THE MODELS SHOULD BE INTERACTIVE.

Public hearings, legislative and administrative processes: There are, in Western democracies, many forms of governmental decision making bodies with a wide variety of procedures and varying degrees of public participation. Almost all are patterned to conform with a largely adversarial culture. With the possible exception of hearings connected with environmental impact statements (especially in the U.S.) there have been few changes or innovations. Because they are so deeply imbedded in history and tradition, they are particularly resistant to innovative change. Nevertheless, in recent years, computer terminals are appearing in the offices of some legislators in the U.S. Congress (and probably elsewhere), and the new Office of Technical Assistance attached to the U.S. Congress is charged with the development of the newest decision aids for this legislative body.

Public media: Newspapers and the electronic media have always been used by proponents of different interests and positions to influence the public. In recent years, there have been experiments with interactive devices in connection with the radio and television; for example, telephone call-backs from listeners. One innovative experiment even called upon all those in favor of a particular suggestion to flush their toilets. The theory was that the surge in the use of water could be measured at the central water pumping station. In the foreseeable future, television sets in the home will be equipped with interactive devices so that instantaneous votes, with gradations between the simple "yes" and "no", can be measured. The hard technology is far ahead of the soft-ware and know-how for its use.

Voting and referenda: Many questions in Western democracies that were once left entirely to the elected representatives or appointed technocrats to decide are now submitted to the public for their decision by vote, or for their approval by referendum. While the complexity of the issues submitted to the voter are growing more complex and more technical, the means of communicating with and educating the public about these issues has changed very little. In some cases, efforts have been made to display information from computer runs to general audiences; but without some interactive opportunities it has been recognized that these programs do as much to reinforce previously held prejudices as to increase understanding. This presents an opportunity for research on the public dissemination of the potential power of interactive computer models for educational purposes in all societies, not just in Western democracies.

TOOLS - THE THIRD RING

On this ring there are listed tools that can be used with different procedures and at different stages in the cycle. Among these tools, of course, are those developed at IIASA, but of course the IIASA products are not the only tools that will be used and attention must be paid to how these, new and more technical aids can be used to supplement the value of the more traditional methods.

Files, memos, telephone, mail, etc: Little need be said about these familiar aids to decision making other than to recognize that they exist and remain fundamental to the decision making process.

Delphi methods, decision trees, role playing: Less technical but nevertheless sophisticated aids to decision making are the products of many other research centers throughout the world and many of them are in general use in many decision-making situations. An important challenge to those involved in IIASA research is to learn how to incorporate what they have to offer with computer-assisted procedures.

DISPUTES - THE FOURTH RING

Disputes can occur at every stage in the cycle, not just near the end, as is the more traditional view. When the decision cycle is long and involves many parties and complex issues, early recognition and resolution of disputes is desirable. Examples of early disputes might be differences over the definition of the issues, disagreement over what data to select or the validity of the data, who should participate in the decision making activities and when, etc.

THIRD PARTY ASSISTANCE - THE INNER RING

Third party, or impartial assistance, is typically used for the resolution of disputes, and, as previously stated, usually near the end of the decision cycle when positions have become hardened and emotions run high. But most of the informal procedures such as mediation, conciliation, arbitration, or fact-finding, can be used at any stage of the cycle once a dispute has been identified. The newest of these procedures is facilitation, a form of process consultant with skills in the management of the cycle's movement from one stage to another, in the selection and use of appropriate tools, and in an understanding of available dispute resolution strategies.

APPENDIX B: RESEARCHABLE QUESTIONS

What characteristics of a model relate to use in decision-making? interactive capacity?

Transparency

Flexibility - capacity of being modified as cycle turns
as attitudes and perceptions change
as new data introduced

as new priorities, weightings, algorithms are developed

Details sufficient to understand workings of real world

Aggregation sufficient to permit human discussion

Ability to zoom from macro to micro scales

geographic

subject matter etc.

How to match the characteristics of model to stage of negotiation for which it is intended:

How to match the characteristics of model for use in different kinds of decision-making?

Individual decision maker

Small groups

Negotiations - adversarial

Collaborative problem solving

Disputes

Interaction with larger groups, ratification,
implementation

Who beside technical model builders should participate in building it?

Top decision makers

Technical staff of decision maker

Subordinates of decision maker

Concerned (perhaps opposing) citizen groups

When should participants be involved?

Determining use of model

Deciding on data and other inputs

Deciding on goals, assumptions

Fine tuning, sensitivity runs

How can models be used to achieve implementation, ratification?

Repeater terminals

TV and closed circuit

Getting feed-back during development

What is best way to move from discussions and bargaining table to use of models and V.V.?

How can you program a global model to provide "Gestalt" imagery to help select key issues for interactive negotiation?

How to program model to achieve

Transparency

Retrieval of "human-sized chunks" of outputs

How to design for "chunks" that match the way people

negotiate and reach decisions
Allow for interim changes, and to absorb new inputs
and reflect their impact on the rest of the model.

What is effect of model on adversarial attitudes?

How can they be used to move participants from adversarial to collaborative attitudes and behavior?

Need for and role of facilitator in

Communicating between scientists working on different models

Communicating between scientists and decision-makers

Managing the decision-making cycle and procedures

Resolving disputes

What should be participant access to terminals

What should be the ground rules

Who should make them

How enforced

Where should terminals be placed

Should the access be direct

through neutral programmers

through a party's own programmers

What are the uses of a model by a mediator

Confidentiality

Data mediation

Developing new solutions