

Working Paper

Summary of the Workshop on Systems Analysis Techniques for International Negotiation

Project Leader: Bert Spector

Rapporteur: Anna Korula

WP-91-55

December 1991



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SUMMARY OF THE WORKSHOP ON SYSTEMS ANALYSIS TECHNIQUES FOR INTERNATIONAL NEGOTIATION

Organized by the Processes of International Negotiation Project

October 9 - 10, 1991
Laxenburg, Austria

Workshop Objectives – Bert Spector

The purpose of the workshop was to answer some very critical questions about the utility of systems analysis techniques in support of international negotiation, namely:

Why are these techniques not used very much during negotiations?

Is there really a role for them?

How can the situation be turned around so that these tools can be truly supportive to practitioners?

What are the contents, plan, and architecture for a meaningful set of techniques?

The issues that were to be addressed are given below:

1. Descriptive/Explanatory vs. Normative Objectives

Analytical tools to describe and explain negotiation process in historical negotiations, *versus* use of analytical tools to assist negotiators in a practical way during the process. The former are rather successful, but can be regarded as overly academic and impractical in the actual negotiation setting. How best can the analytical techniques presented at this conference be transformed into practical/normative tools to support negotiators?

2. Process- versus Substance-focused Tools

Negotiation and decisionmaking research have resulted in many techniques that can help explain and move the process forward, make it more effective, responsive and timely. They help actors analyze proposals, construct and test strategies, evaluate strategies of other actors and assess possible outcomes. The process tools can evaluate the proposals and formulas of the substance models in the light of what is politically possible, given the realities of the negotiators' interest, values and goals.

Issue-specific research has resulted in techniques that can help analyze the substance of the negotiation. These contribute to an in-depth understanding of the issue, enabling it to be examined from all sides, and to test various assumptions. In short, they help to frame and define a problem, test what-if scenarios, and generate alternate proposals and formulas for agreement. How can substance and process be integrated in a meaningful way?

3. Technique- versus End-user Focus

As a result of a focus on techniques, practitioners and negotiators generally resist the use of these tools. An end-user focus would incorporate the negotiator's requirements for information and analysis during the course of the negotiation. It would target efforts on those analytical techniques most appropriate to negotiator needs.

4. What is the best way of presenting the tools and their results for negotiators?
5. Of the methods and approaches presented it would be useful to understand where each technique can help and under what circumstances. Examples of actual use should also be discussed.
6. In addition, a primary purpose in bringing this multidisciplinary group together was to design a research agenda for the PIN Project, dealing with the practical use of analytical techniques by international negotiators.

SUBSTANTIVE MODELS

Two substantive models were demonstrated on-line and discussed in brief.

Interactive RIver System Simulation (IRIS) – Andrzej Salewicz

IRIS is a PC-based DSS for water resources management of large international rivers. It deals with structural and operational problems of water resources management. The simulation is based on mass conservation; the program calculates physical factors, flows, energy generated, etc., but not economic indicators, and results are displayed as a time series. IRIS offers post-processing, i.e. results of the simulation can be used as input data for other models.

While IRIS has not been used specifically in any negotiation contexts, it has the potential for assisting policy makers and negotiators in identifying the implementation of alternative negotiated outcomes.

Regional Acidification INformation and Simulation (RAINS) Model – Markus Amann

The RAINS model was presented: It models the complete cycle of acidic air pollution in Europe, from generation through atmospheric transport to deposition. This tool has been selected by the UN Economic Commission for Europe to support renegotiation of the Convention on Long-Range Transboundary Air Pollution.

PROCESS MODELS

The following papers were presented and discussed.

Decision Analysis for Practical Negotiation Application – Bert Spector

The paper examines how a family of decision analysis techniques can be applied effectively to support international negotiations in a practical fashion. These techniques are viewed as being most appropriate in support of the pre-negotiation phase, when parties are diagnosing the situation, assessing their own plans and strategies, and evaluating likely reactions and outcomes. How these approaches have been used to assist negotiation practitioners, the application of decision analytic approaches in terms of particular analytical requirements in the pre-negotiation period, and how these process-oriented tools can be integrated with substantive tools are discussed, in addition to suitable ways in which these tools can be presented to practitioners.

Conflict Analysis Support for International Negotiations – Niall Fraser

Conflict analysis involves the application of negotiation models that consist of decision makers, options and preferences. It is based on ordinal non-cooperative game theory, and provides information about the expected courses of action of the decision makers. It is best used at the planning stage of a negotiation. Benefits of the approach include the provision of a formal structure for assessing a complex multilateral negotiation, the ability to focus on others' interests, and the use of a flexible communications medium. Its foundation in ordinal game theory means that the results are clearly valid and useful to the negotiator.

Research on the Use of Analysis and Modeling in Negotiation: An Illustration – Dhanesh K. Samarasan

A paper on Analysis, Modeling and the Management of International Negotiations was submitted and complemented by a presentation on the above. The topics noted below are discussed briefly, with emphasis placed on the third: The experimental use of a range of computer-based tools in the mediation of international conflicts by professionals whose mediation credentials are not in question; the experimental adoption by negotiators in a prolonged, multilateral, international negotiation of a range of computer-based tools; and the analysis of modeling of substantive issues in negotiations pervading the management of an East-West joint venture and the use of the resulting dynamic simulation models directly by the negotiators in the management of their daily negotiations. Using the example of a real-world client, an attempt is made to observe client negotiations before and after the introduction of the tools and conclusions are drawn regarding the costs and benefits of the experimental approach, as well as its effectiveness.

The Role of Multi-Objective Optimization in Negotiation and Mediation Support – Andrzej P. Wierzbicki and Marek Makowski

The methodology of multi-objective modeling and optimization used in decision support is reviewed. These models represent expert knowledge in a given field. Modeling and optimization methods are treated not as goals in themselves, but as tools that help an analyst or decision maker to interact with the model, generate and analyze various decision options and learn about the possible outcomes of these decisions. Although applications of such methods in the negotiation field are scarce, their flexibility increases the possibility of their use. Various aspects of negotiation and mediation methods related to multi-objective optimization and game theory are also reviewed.

Multi-Criteria Mediation Support – Lech Krus and Piotr Bronisz

Techniques of mediation support in the form of computer-based decision support systems are presented. A class of bargaining situations with multiple players and multiple conflicting objectives and interests is considered. The support can be provided by learning about the possible decision options and outcomes of particular players and by helping parties reach consensus or an outcome acceptable to all players. Both of these features are incorporated in MCBARG, a computer-based decision support system. MCBARG enables interactive, multiobjective analysis of the bargaining problem with emphasis on learning and supports the mediator in calculating a multilateral, cooperative solution based on the players' preferences or proposals. A single negotiation text can be analyzed and criticized by players as it is modified and remodified in subsequent iterations.

A Model of the Negotiation Process – Setsuo Onari

A mathematical model that examines all possible cases that can occur in a simple distributive negotiation context was presented.

Rule-based Modeling of Negotiation Processes – Grzegorz E. Kersten

Logic-based approaches, such as rule-based formalisms, make it possible to blend unique and specific aspects of a problem, with general reasoning mechanisms and rationality postulates. A rule-based approach to represent complex and difficult problems and to reason through the use of formal structures was presented. The rule-based modeling of the negotiation process includes predicate calculus which provides the basis for the rule-based representation of knowledge, for structuring decision problems with production rules, and exercising reasoning on the structures developed. The expert systems thus designed with the inclusion of a knowledge base can enhance and expand human capabilities, not replace human knowledge and reasoning. Many problems, despite their complexity and depth, can be explained in terms of a closed world. These can be represented in a computer system so as to provide recommendations to negotiators.

Cognitive Mapping: A Tool for Supporting International Negotiators – Matthew Bonham

This is a specialized approach to the representation of causal and quasi-causal reasoning with respect to general situations or specific issues that are treated in a text. Although the technique is able to capture only a small part of textual context, the presupposition behind the approach is that a structure of quasi-causal reasoning is an important source that can shed light on the political thinking of a text's author. The flexibility of this approach across different levels of abstraction makes it applicable to a wide variety of policy situations. Cognitive mapping is a useful tool throughout the negotiation process. During the talks negotiators can engage in policy enrichment, a technique for enriching the structure of their thinking, or policy experimentation, a technique for modifying the content of their views. Cognitive mapping has been used in business group decision making with success.

Statistical Analysis for Decision Support – Dan Druckman

Statistical analysis can play an important role in the application of knowledge about negotiating behavior and can contribute to an understanding of a negotiation as it unfolds through time. One approach to bridging the gap between the general, theory-based knowledge accumulated through statistical analysis of data and the specific information about cases by practitioners and policy makers is to place the case in a dimensionalized space based on a wide sampling of situations. Such a situational diagnosis is an assessment of the negotiating situation in terms of the presence (or absence) of those elements hypothesized to influence outcomes. Such an assessment is based on knowledge of relationships among situational, and process and outcome variables, using a knowledge base for inferring relationships among the variables of interest. The variations among cases are reduced to a smaller set of types of cases grouped according to dimensions of similarity and dissimilarity; this provides an empirical basis for a taxonomy of negotiating situations. Additional cases are considered to take into account dimensions that were not in the original data base and a matching exercise is carried out. These steps in the diagnosis provide the information required for diagnosing the likelihood that particular negotiations would result in agreement. By assessing a negotiation situation

in terms of whether the key elements relating to negotiation are present, it is possible to estimate the extent to which parties are willing to move from their initial positions to get an agreement or to produce a stalemate. Using the experimentation procedure, reactions of negotiators or role-players can be used to establish weights for the variables. The weighted variables provide opportunities to influence the negotiation process. This information would help a negotiator to gauge the flexibility of the opponent, it would aid a mediator who tries to determine how much flexibility exists in a particular situation, and how it would contribute to an analysts' understanding of the negotiation process.

Another approach is to perform time-series analyses of the specific case. If done correctly, a statistical time-series of a single case can uncover patterns that project reliably into the future. One such pattern is the way negotiators respond to their opposite numbers through the course of the talks. Content analysis coding of moves made in earlier rounds can be used to project trends of moves to be made in later rounds. As longitudinal analysis is not suited for hypothesis testing, this requires that the case, rather than the time period, serve as the unit of analysis. By gathering a data base of cases, it would be possible to test hypotheses about relationships among variables as they operate across a spectrum of cases, facilitating the comparative analysis of cases.

I Cut You Choose: A Model for Negotiating Tradeoffs in Complex, Multi-Issue Negotiations – P. Terrence Hopmann

The “I cut, you choose” metaphor provides a mechanism to assure equal division of uniformly valued goods, whereas the tradeoff procedure suggests ways in which goods may not only be divided equally, but also in such a way that parties with divergent preferences may actually get more than 50 per cent of the original value of the disputed item. The first procedure is a possible solution to the problem of distributive bargaining, whereas the second procedure makes it possible to turn this into an integrative solution, where both parties benefit. The paper suggests the basic principles behind such a simple model and demonstrates how it has been applied as an analytical tool to facilitate negotiations on conventional disarmament in Europe. In any situation, as in trade or environmental negotiations, where the complexity of multiple interlocking issues makes it difficult to find mutually beneficial tradeoffs, this procedure may help to produce mutually beneficial agreement.

Cognitive Approach to Consensus Attainment Under Conditions of Unstructured Information - Victor Akimov

A cognitive approach to consensual decisionmaking is described. Three computer-based tools that apply such cognitive approaches include: automatic construction of cognitive maps using verbal data; distributed systems of message analysis; and neural networks as models of the collective decisionmaking process.

Interactive Systems Support for International Negotiation: The State of the Art and the State of the Feasible – Stephen J. Andriole

With dramatic changes in the design, development and use of decision support systems (DSS), expectations are rising correspondingly. The paper addresses questions such as the methods, tools and techniques that are available to support international negotiations, what forms these can and should take and who should implement and manage negotiation-oriented DSSs. Hybrid models and methods are likely to be preferable to single model-based solutions. Multi-media technology, or the ability to store, display, manipulate and integrate sound, graphics, video and alphanumeric data as well as voice input, are all becoming plausible features; DSSs will exploit these possibilities. Next generation

systems will be capable of addressing operational, tactical and strategic structured and unstructured problems via the application of data, knowledge, and models that exploit their integration. International negotiators will not need extensive training to use next generation systems; the emphasis will be on functionality and the timely application of validated analytical processes. DSSs will become problem-solving partners, providing analytical support of all kinds. At present, decision support is targeted at mid-level management; tomorrow, all levels will be supported by powerful, interactive, adaptive systems augmented through networking and advanced communications technology connected to extensive data and knowledge bases.

Are Available Game-theoretic Concepts Suitable Negotiation-Aid Tools? – Bertrand R. Munier and Jean-Louis Rulliere

Different types of refined Nash-equilibria, which are based on the principle of backward induction, have led to fundamental contradictions with respect to the modeling of rationality, therefore making them unsatisfactory. The degree of confidence in the principle of backward induction necessarily depends upon the evaluation of the likelihood of potential deviations with respect to the extended Nash-equilibrium and upon the interpretations of such deviations by the different players. The nature of the latter interpretations may call for a serious conceptual reappraisal and a revision of the principle of backward induction and therefore of currently available concepts of refined Nash-equilibria. Only under these conditions would the inclusion of game-theoretic concepts in interactive negotiation support systems appear possible. Some form of forward induction would then become the real yardstick of rationality, giving to Simonian procedural rationality the extended form of “cognitive rationality”. This would open the way for a renewed game-theoretic approach to negotiation-support systems.

Game Theory – Wulf Albers

A revealed demand negotiation game model was presented, based on the results of some 3000 experimental games.

Discussion

The Use of Analytical Methods and Tools for the Practice of International Negotiations – Gerhard Hafner

Any attempt to evaluate the possible use of systems analysis techniques requires a thorough examination of the negotiation process itself, subdivided into its pre-negotiation, negotiation and post-negotiation phases. There are many actors involved, namely states, IGOs and NGOs. There are also different categories of negotiation decisions, i.e., independent and dependent, where the former is generally in the pre-negotiation phase and are based on factors that lie entirely within the influence of the decision maker and the latter where the decisions are influenced by external factors and decisions, these being typically taken during the negotiations. States' interests and distinctions between decisions of procedure and substance are other factors that structure the negotiation process. Characteristics of negotiations which should be taken into account when constructing DSSs are listed. The limitations of such systems are also highlighted. For example, only some states can afford DSSs, increasing inequalities among states. Time constraints would also restrict the use of analytical tools during negotiations; however, they could be particularly useful in the pre-negotiation phase. In

concluding, if these tools can help identify a state's interests and preferable solutions in the preliminary round of decision making, as well as facilitate coalition building, and be simple and inexpensive to access and use, they would be used, especially in the pre-negotiation phase. Bringing practitioners and designers together is a logical way to advance the techniques.

Jacobus Wessels (Discussant):

An important issue to be borne in mind when conducting research is the circumstances under which tools are used and are useful. It is important to have a conceptual description of negotiating situations and processes and to identify what types of support are required. Tools that assume rational behavior based on preferences are somewhat dangerous; caution has to be exercised regarding data collection of preferences that might be biased. It should be possible to devise a taxonomy that would determine what type of systematic analytical support can be useful. There is a tendency to come up with the most complicated cases which are most in need of help; developers should be content with implementing simple tools that are useful now and introduce the possibilities of more advanced technologies.

Future Research Directions

Families of analytical methods such as decision analysis, multi-objective optimization, statistical analysis, cognitive theory, game theory, information management and expert systems, have a solid foundation of results that can be used to push forward an integrated plan of research which incorporates the best aspects of each in designing a toolkit for international negotiators. However, there needs to be a clear agenda as to how these research tracks can be merged with the objective of developing a practical set of tools. Four research activities must be accomplished to achieve this goal:

1. *Information Requirements Analysis.* Information engineering and logic suggest that any attempt to apply analytical methodologies to support international negotiators should commence with a needs assessment. Ideally, this evaluation would seek to identify both the information and analytical requirements of negotiation actors at all levels, at all stages of the process, and within all types of negotiations. This is a large, if not impossible, task, if a comprehensive analysis is desired. However, it would be useful to conduct such a requirements analysis in more manageable pieces incrementally, to understand the needs of negotiators at different actor levels, stages, and types in this structure. Researchers would have to collect data through direct interviewing, observation, analysis of case studies and memoirs of negotiators, and evaluation of the negotiation literature.

2. *Inventory and Experimental Assessment of Techniques.* A detailed inventory of existing methodologies, describing their capabilities and limits, would be very useful in assessing the opportunities to support international negotiators. Again, to make this activity manageable, only analytical techniques that have been applied to negotiation settings should be included in the inventory. The families of techniques mentioned above can serve as the basic categories for this review. In addition, it would be interesting to conduct an experimental assessment of a few of the prominent methodologies from each of the families. Such an experiment would challenge each

of the selected techniques to analyze and provide recommendations, as best it can, against a common set of historical negotiation cases. The experiment would help researchers assess the benefits and limitations of each technique while holding the application constant; it would uncover the ways in which each technique can support negotiators, as well as the extent and level of detail of such support. The results of these activities would yield an understanding of the relative strengths and weaknesses of the available methods, and begin to provide a roadmap of how the techniques might be integrated into a negotiator's toolkit.

3. *Needs-Capabilities Matching*. This activity matches the requirements analysis with the assessment of technique capability. The resulting matrix would provide researchers with an understanding of how techniques can be applied to satisfy negotiator needs.

4. *Capacity Building and Dialogues with Practitioners*. The recognition and acceptance of analytical methodologies by negotiation practitioners is not a foregone conclusion, despite an end-user orientation and requirements analyses that may be performed. There needs to be a general building of capacity in understanding and applying analytical tools among negotiators and their staff. This can only be accomplished in a spirit of dialogue between researchers and practitioners. Training in the form of policy exercises and games that introduce such techniques as supportive tools within the process of negotiation would provide opportunities for applied learning. Small working groups comprised of both researchers and negotiators that focus on real negotiation problems framed by the practitioner offer another forum for negotiators to try out alternative methodologies in search of bargaining outcomes.

International negotiators and their staff are sorely in need of information and analytical support that the research community can provide. An orderly and integrated approach to designing useful tools for practitioners is likely to offer the most advantageous results. While it may appear to be a long-term goal, the design of a practical toolkit for practitioners can be a reality in the short term if a focused and incremental approach is implemented.

The list of participants and agenda of the workshop are given in Appendix I and II.

Appendix I

Systems Analysis Techniques for International Negotiation Scoping Conference

October 9 - 10, 1991
Laxenburg, Austria

AGENDA (Revised)
Meeting Room: Seminar Room

Wednesday, October 9, 1991

- 8:00 Pickup from Hotel by Bus
- 8:45 Registration and Coffee
- 9:00 Conference Objectives B. Spector
- Demonstration of Substantive Decision Support Tools for Environmental Negotiation
- 9:30 Interactive River System Simulation (IRIS) Program K. Salewicz
- 10:15 Regional Acidification INformation and Simulation (RAINS) Model M. Amann
- 11:00 Coffee Break
- Process Techniques
- 11:15 Decision Analysis B. Spector
- 11:45 Conflict Analysis N. Fraser
- 12:15 Lunch
- Process Techniques (continued)
- 13:45 Process Simulation D. Samarasan
- 14:15 Multi-Criteria Optimization A. Wierzbicki and M. Makowski
- 14:45 Multi-Criteria Mediation L. Krus
- 15:15 Coffee Break
- Process Techniques (continued)
- 15:30 Game Theoretic Approaches B. Munier
- 16:00 Mathematical Models S. Ohnari
- 16:30 Discussant and General Discussion J. Wessels
- 17:30 Directly to Heurigen (Dinner) from Schloss by Bus

Thursday, October 10, 1991

8:00 Bus Pickup from Hotel

Process Techniques (continued)

9:00	Cognitive Mapping	M. Bonham
9:30	Decision Support Systems	V. Akimov
10:00	Interactive Systems	S. Andriole

10:30 Coffee Break

Process Techniques (continued)

10:45	Game Theory	W. Albers
11:15	Rule-Based Systems	G. Kersten
11:45	Statistical Analysis	D. Druckman
12:15	I Cut, You Choose	T. Hopmann

12:45 Lunch

14:15 Practitioner's Perspective G. Hafner

14:45 Technique Practicality and Process-Substance Synthesis General Discussion

15:45 Design of a Systems Analysis Research Agenda
and Action Plan for PIN General Discussion

17:30 Return to Vienna by Bus

Appendix II

Systems Analysis Techniques for International Negotiation

Scoping Conference

October 9-10, 1991

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