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AN ARCHITECTURE FOR A PRESCRIPTIVE NEGOTIATION SUPPORT SYSTEM

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Abstract: A Negotiation Support System (NSS) architecture is presented that provides a negotiator with prescriptive support in a complex negotiation environment. Both strategic and tactical support are considered and form the basis for the NSS architecture. The decision making philosophy of the strategic support is based on conflict analysis. Tactical support is provided by a rule-based system. The specific goals and characteristics of the negotiator are reconciled with the possible plans of action generated by the tactical and strategic support systems through the use of a multicriteria decision making technique. The research required for the practical implementation of this system is currently being completed.

Keywords: *Negotiation Support Systems, Strategic Support, Tactical Support, Conflict Analysis, Rule-Based Systems*

1 Introduction

Negotiations arise in personal, business and political settings. The number of parties can vary from two, for example in a parent-child setting, to the many countries that negotiate at the General Agreement on Trade and Tariffs (GATT). Similarly, the issues to be resolved during the negotiation can also vary from two to many. As the number of issues and/or parties increases, the complexity of the negotiations becomes greater. As tasks become more complex, error usually becomes more likely. Because the results of complex negotiations often significantly affect the future of the parties, mistakes must be avoided.

One tool that may improve the preparation of negotiators is a Negotiation Support System (NSS). A NSS is an interactive system that integrates data structures and analytical techniques to help decision makers scrutinize ill-structured problems. Negotiations are ill-structured problems from an analytic perspective (Sycara, 1990). While the use of NSS is not widespread, Nyhart and Goelmer (1987) found seventeen instances of practical use. Since that time, interest has increased on both academic and industry levels (Jones and Sanford, 1990) with many proprietary systems having been implemented.

Perhaps the most elegant justification for NSS has been given by Anson and Jelassi (1990). They state that the three primary impediments to good negotiation results are (i) the cognitive biases of the negotiator,

(ii) socio-emotional factors and (iii) analytical processing difficulties. They conclude that a NSS helps to free the negotiator of cognitive biases that hinder the development of relevant strategy by allowing a negotiator to experiment with novel scenarios. Socio-emotional factors can be positively influenced by a NSS that guides its user to collaborative actions that build trust with the negotiation counterparts. Finally, as negotiations become highly complex, the capability to manage the different parties, options, preferences, time factors and external events become overwhelming for humans and a NSS can be used to manage the information.

Bell *et al* (1989) discuss three orientations to negotiation analysis: descriptive, normative and prescriptive. Prescriptive analysis develops advice for an individual that allows the individual to make better choices. A prescriptive orientation is of most interest to practitioners. The combination of a prescriptive negotiation analysis approach with the generic benefits of a NSS leads to the following conclusions:

- the negotiator is able to investigate the ramifications of actions that may be taken, enabling the NSS to assist in unlocking cognitive biases. Actions may be either strategic or tactical.
- a NSS with tactical and strategic components guides the negotiator towards principled (Fisher and Ury, 1981) and Win-Win negotiations (Jandt, 1985) overcoming socio-emotional factors to win at all costs.
- a NSS manages the data complexity of the negotiations allowing the negotiator to focus on important matters such as the selection of strategy rather than the management of data.

Existing NSS do not provide the type of support outlined. Either tactical or strategic support is missing and often the system is a planning system rather than a prescriptive tool. A prescriptive approach defines the system to be an active decision aid rather than an electronic notebook. In the remaining sections, a description of a system that accomplishes these tasks is presented. The system described by the architecture is currently under development.

2 General System Architecture

Figure 1 illustrates the NSS architecture (gray ovals depict the system components). Development of strategy is accomplished within the strategic and tactical components and the interface is used to reconcile the user's goals with these strategies. The information provided to the user allows for more thorough planning and understanding of the problem, which should improve the quality of the decision making process.

The interface guides the user through the negotiation environment definition, helps the user specify long- and short-term goals and integrates the strategies developed with the defined goals. The strategic support system

primarily be used to unlock the cognitive biases of the negotiator by allowing the user to discover what the outcomes of certain actions are likely to be. The tactical support system gives advice about what bargaining tactics to apply given the parameters of the situation and the personality traits and goals of the user.

3 Strategic Support System

The purpose of the Strategic Support System (SSS) is to assist the user in realizing the effects, both positive and negative, of certain courses of action during negotiation. The SSS is an interactive system that allows the user to study possible changes in strategy and to revise the model to reflect new information. As shown in Figure 2, coalition analysis, hypergames and dynamic analysis are featured. The underlying decision making technique for the SSS is based upon conflict analysis. Conflict analysis is a technique developed by Fraser and Hipel (1984) that can be used to gain insights into the structure and likely resolution of conflicts. It has been applied, with success, to trade, environmental, political and economic disputes. However, algorithmic tools have not previously been developed that permit accurate modelling and analysis of dynamic negotiations.

The SSS permits the user to perform coalition analysis and/or hypergame analysis. Coalition formation metrics are used to evaluate the goal similarity of the negotiating parties. A coalition metric developed by Meister *et al* (1991) can be used to measure goal compatibility and to suggest beneficial concessions. Hypergames

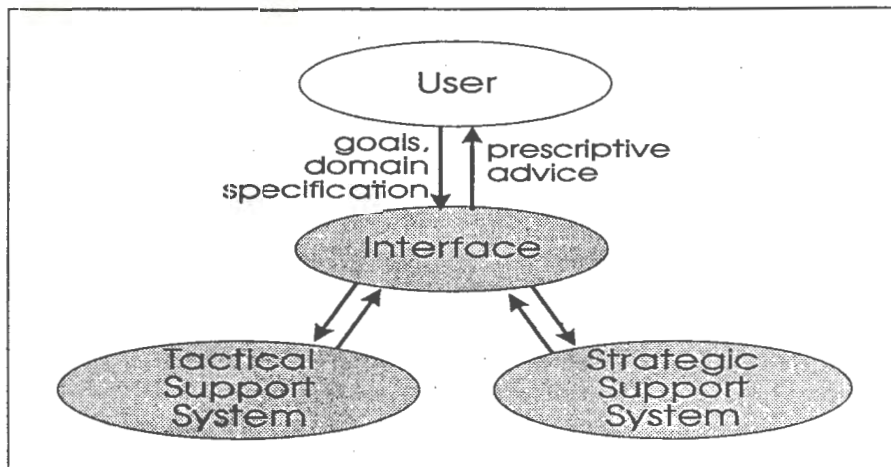


Figure 1: NSS Architecture

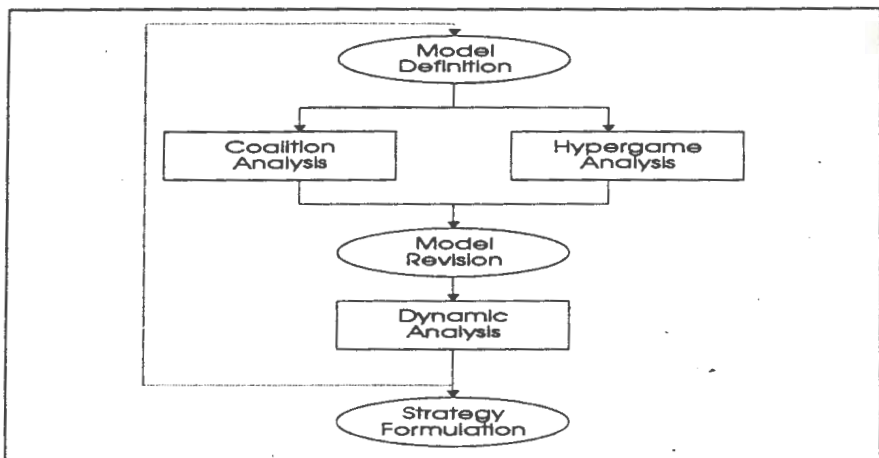


Figure 2: Strategic Support System Flow Chart

are a method of modelling games in which at least one of the decision makers has a misperception about some part of the model (Fraser and Hipel, 1984). The use of hypergames falls into two categories. First, hypergames can be used to model bluffing that the user may want to try out and see the results. Second, hypergames allow the user to ask "what-if" questions to perform a sensitivity analysis of the other parties' preferences. These two analytic techniques are considered independently.

As a negotiation progresses, the negotiation environment may change. For example, during a labour strike, a company may be more willing to compromise as its stock-in-hand is reduced. Alternatively, options available to a party may exist only for certain specific time periods. Dynamic analysis can be used to evaluate the effect that time specific events have on the resolution of the negotiation. Dynamic models for conflict analysis do not currently exist and a current topic of research.

The user may then decide to interpret the information so that the model should be modified. An example would be where a highly possible coalition exists between two counterparts and the user wishes to merge these two participants to study the effects. After the model has been specified to the satisfaction of the user, dynamic analysis is performed on the model. The user can modify the model when new information is received or it is desired that another strategy be analyzed. If no modifications are necessary, the results of the SSS are returned to the interface component.

The approach presented permits the user to revise the model based on the information generated, to reflect upon the results, to make further modifications and to save the various strategies for evaluation using the integrative interface. The interactive nature of this subsystem assists the user by unfreezing an ingrained way of thinking about the problem and by helping the user identify good strategies (Anson and Jelassi, 1990).

4 Tactical Support System

The general design of the Tactical Support System is a rule-based system. Pedersen (1989) poses a series of questions that can be used to determine the suitability of a system to a certain domain. Upon evaluation the selection of bargaining tactics seems to be a reasonable rule-based system application. The rule base will be drawn from practical bargaining literature such as Fisher and Ury (1981) and Jandt (1985). The system can be used to guide the negotiator towards good negotiation practices by incorporating rules about Win-Win and principled negotiations and discouraging other zero-sum type actions. The prototype for this system has been developed and is currently undergoing testing.

5 Integrative Interface

The purpose of the Integrative Interface is to facilitate definition of the goals, the parameters and the proper strategies for the negotiation. The user will structure the negotiations and then be required to identify the relevant parties to the negotiations. The goals of the user are then identified as well as the actions that are available to further those goals. The feasible actions of the other parties involved are specified at the next stage in the model development. The information gathered at this stage is then used by the two subsystems when generating prescriptive advice. Various methodologies such as the Analytic Hierarchy Process (Saaty, 1980) and ÉLECTRE (Roy, 1985) have been developed to select between alternatives on the basis of a set of criteria or issues. These methods use cardinal values, assigned by the user, to select the best alternative. However, it is not always possible for a user to assign a cardinal value with a satisfactory degree of confidence. On the other hand, it is usually feasible to rank the capacity of the each alternative to satisfy each issue. A methodology, the Ordinal Hierarchy Method (OHM), that uses ordinal relationships to evaluate the alternatives has been developed by Meister and Fraser (1991).

6 Conclusions

The NSS architecture presented is prescriptive as the user is guided towards beneficial types of behaviour through the tactical support system and effectual strategy is developed using the strategic support system. Substantial development has occurred towards the completion of the interface and tactical support components. The generic benefits of Negotiation Support Systems (Anson and Jelassi, 1990) are realized by this NSS as explained in the main text. Therefore, the NSS outlined provides a powerful and useful tool for negotiators in practical, complex situations.

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