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In Search of Value-for-Money in Collective Bargaining: An Analytic-Interactive Mediation Process

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Summary

In this paper we introduce an analytic-interactive mediation approach to facilitate conflict resolution in collective bargaining. Based on field observations of labor-management negotiations in the German railway industry, we develop an approach which combines human mediation with IT-based contract modeling. The system addresses two shortcomings of existing negotiation support systems (NSS) for collective bargaining: first, limited information exchanges to computer-based channels and, second, a lack of frameworks, which reflect existing cognitive schemes of labor-management negotiators beyond standard utility vs. utility approaches. The negotiation modeling approach of the system introduced in this paper rests on the value-for-money principle, analyzing contract options based on costs for the management and benefit to the unions. We use this principle in order to design a comprehensible, and thereby applicable negotiation support system. The approach helps to identify concession exchanges across contract options that result either in small cost increases for management and large benefit gains to the union, or large cost savings and few benefit losses. We apply the system to a case study to show that pareto-improvements can serve to increase the settlement probability and the quality of the final contract. The system is designed for negotiations nearing deadlock.

Keywords: *collective bargaining, integrative negotiation, resource allocation, decision conference, multi-criteria decision analysis*

Introduction

Stories of mediated conflict resolution date back almost to the start of human history. King Solomon's arbitration over the maternity of a child is an example from the Judeo-Christian tradition. Ancient cultures, such as the Vikings and the Chinese, used conflict resolution via third parties to settle property conflicts and domestic relations (Wall, Stark et al., 2001). Through time, the modeling and understanding of these types of interventions have become more sophisticated and formalized. Over the last 50 years, attempts have been made to apply game theoretic applications to real-world negotiations (see for example, Nash, 1950; Nash, 1951; Luce and Raiffa, 1957; Schelling, 1960; Myerson, 1991; Brams, 2003). These approaches have been supplemented through the creative and intensive use of information technology to create a number of negotiation support systems (NSS) approaches which aim to enhance the effectiveness of third party interventions in negotiations (Foroughi, Perkins et al., 1995).

Despite the ongoing NSS development for more than 30 years, a dominant approach has yet to emerge. Currently, a variety of different systems and conceptual developments co-exist. Methods range from simple spreadsheet approaches to advanced systems based on artificial intelligence and sophisticated operations research modeling. To model negotiation situations, researchers have, for example, used expert systems (Kersten, 1990, Kersten, 1993; Kersten and Meister, 1996), conflict analysis (Fraser and Hipel, 1981), evolutionary system design (Shakun, 1987; Shakun, 1995) or graph models for conflict resolution (Fang, Hipel et al., 1993; Kilgour, Hipel et al., 1994; Kilgour, Fang et al., 1995). For reviews of these and more recent web-based approaches, see Anson and Jelassi (1990), Foroughi (1995), Wilkenfeld, Kraus et al.(1995) and Kim and Segev (2005).

In contrast to the numerous conceptual developments in NSS, real-world applications remain scarce. Some of the few applications that have been documented in the last 30 years include the negotiation modeling of international oil tanker standards, the Panama Canal negotiations, US military base negotiations in the Philippines and energy taxation levels (Barclay and Peterson, 1976; Ulvila and Snider, 1980; Ulvila, 1990; Bragge, 2001). In the area of collective bargaining, applications are limited as well.

Researchers have used a decision-tree approach to enhance the communication processes within negotiations teams (Winter, 1985), designed an Electronic Meeting Room to aid labor and management negotiators to find efficient settlements (Carmel, Herniter et al., 1993) and applied an analytical mediation approach based on resource allocation processes (Mumpower and Rohrbaugh, 1996). Apart from these important contributions, this relatively short list clearly represents a tiny minority of all possible areas of application. In view of the scarce documentation of successful and repeated applications of NSS, the widespread applicability of NSS in collective bargaining has yet to occur.

This paper aims to contribute to enhancing the real-world applicability of negotiation support systems in collective bargaining. The system we propose in this paper is based on a joint project with the collective bargaining parties for the former monopolist in the German railway industry. The leading negotiators have not changed in recent years, so trust and co-operative behavior - similar to an iterative negotiator's dilemma – has been established between the parties. This climate of openness and methodological curiosity provided us with a unique research opportunity. For several weeks, the management and union teams allowed us to observe their confidential preparation and subsequent joint negotiation sessions in the 2004 collective bargaining round. Based on these observations and a subsequent sequence of evaluation interviews with both collective bargaining parties, we designed a negotiation simulation (Schilling, Mulford et al., 2006) and the NSS for collective bargaining, as presented in this paper. After a discussion of existing NSS for collective bargaining, both parties referred to two core weaknesses of existing approaches: the restriction of communication through electronic channels and the use of 'inapplicable and detached' economic concepts to which bargaining parties can not relate to.

First, when designing NSS for collective bargaining, the complex organizational and political environment has to be recognized. A real-world applicable system therefore needs to be compatible with pre-existing organizational and political constraints – which generally includes the need for face-to-face interactions. Understanding these interaction processes during conflict resolution can significantly enhance the applicability of NSS (Raith, 2007). Although systems which channel communication through computers (see, for example,Rangaswamy and Shell, 1997; Kersten and Noronha, 1999) might be highly

relevant for certain contexts, such as international negotiations, at least some collective bargaining situations seem to require face-to-face interaction. We therefore advocate an NSS which builds on simple and transparent models from the area of decision analysis. These models, importantly, leave the negotiating parties in control of the negotiation process and do not restrict communication to computers.

Second, the system we present in this paper recognizes the educational background of collective bargaining negotiators. As labor-management negotiations end in the signing of contracts, a substantial number of lawyers usually have to be involved in collective bargaining. In the course of developing a simulation in this area, we found that economic concepts are not or not yet very prevalent both for management and union representative. In particular the system we present below accommodates feedback from practitioners to alter the standard utility vs. utility negotiation concepts (Raiffa, 1982; Mumpower and Rohrbaugh, 1996; Raiffa, Richardson et al., 2002). In our experience, very few actual negotiators think of contracts in terms of utility maximization. Rather, management usually approaches the negotiation as an exercise in minimizing costs. Unions focus on protecting the labor force and, if possible, expanding benefits. We recognize that these concepts can be converted into utilities, but much of NSS applicability is lost in this type of translation. Using the language and concepts in the existing cognitive scheme of the participants thus enhances the applicability of the system.

Based on this background, we advocate a principle which is relatively easily recognizable and understood by the negotiators – the value-for-money principle. Transferring this principle from operations research literature (Bana e Costa, 2001; Bana e Costa and Beinat, 2005; Phillips, 2007), we suggest value-for-money, not the notion of utility, as one possible measurement to assess and improve performance of both parties in collective bargaining. We thereby use recent advances in modeling techniques in the area of decision analysis (Phillips and Bana e Costa, 2007) to extend earlier work at the interface between negotiation and resource allocation analysis (see for example, Teich, Wallenius et al., 1996; Mumpower and Rohrbaugh, 1996) and negotiation support for collective bargaining (see for example, Carmel, Herniter et al., 1993). Specifically, we introduce an analytic-interactive process which can be used by a mediator to aid parties in

labor disputes in settling for more efficient agreements and thereby reducing the likelihood of an impasse. Improvement suggestions, based on the two final offers before the impasse, can be seen as a modification of the post-settlement settlements (Raiffa, 1985). The objective of the approach is to facilitate the process of reaching mutually acceptable and more efficient settlements. Our system enables mediators to define several possible solutions at or close to the efficiency frontier. Note that we are claiming applicability in a relatively narrow, but important subset of collective bargaining situations, namely those where negotiations have proven difficult, last offers have been made, and a breakdown of negotiations seems likely.

In the next section of this paper, we review currently available negotiation support systems which simultaneously aid several parties to reach efficient agreements. Subsequently, we introduce our analytic-interactive mediation support system. The technical basis of the system is a portfolio-focused, multiple-criteria decision analysis. The social side consists of human mediation done in the framework of decision conferencing. We apply the approach to a hypothetical case study which we developed together with German union and management parties. Finally, we highlight potentially fruitful research paths and further possible areas of applications.

Negotiation Support Systems – Review

Since the 1960s, researchers have been developing computer models to support individual negotiation parties (Nyhart and Goeltner, 1987). These conceptual developments in negotiation support systems can be roughly divided into two categories: ‘asymmetric-prescriptive’ systems – those which aim to give advice to only one of the negotiation parties – and ‘symmetric-prescriptive’ systems – those which aim to provide help to several parties simultaneously (Raiffa, 1982; Raiffa, Richardson et al., 2002).

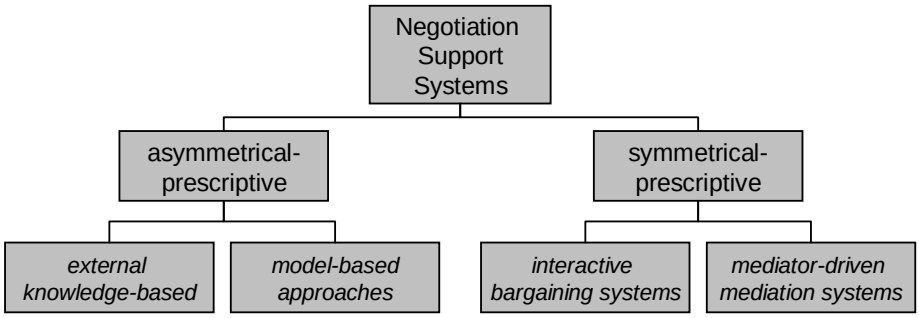


Figure 1 – A possible classification of Negotiation Support System

Asymmetrical-prescriptive NSS

As displayed in Figure 1, asymmetrical-prescriptive NSS can itself be further sub-divided into external knowledge-based and model-based systems. Negotex (Eliasberg, Gauvin et al., 1992), Nego (Kersten, 1985), Genie (Wilkenfeld, Kraus et al., 1995) and Match (Samarasan, 1993) are examples of external knowledge-based systems. These systems are applicable to specific negotiation situations only and rely on artificial intelligence to provide condensed expert knowledge (Kilgour, Fang et al., 1995). As these approaches build on existing external knowledge, they are usually less adoptable in novel negotiation contexts.

In contrast to these domain-specific systems, model-based approaches usually incorporate negotiators' subjective preferences, tactical choices and predictions of other parties' actions and/or preferences. Model-based systems use, for example, graph models to find a mutually beneficial and stable equilibrium (Fang, Hipel et al., 1993; Kilgour, Hipel et al., 1994), decision trees to evaluate the risk of different negotiation tactics (for example, Winter, 1985; Aaron, 1995) or multiple-criteria negotiation models to enable negotiators to assess the value of different contracts and to estimate the contract valuations of the other party (Barclay and Peterson, 1976; Keeney and Raiffa, 1991; Raiffa, Richardson et al., 2002; Ulvila, 1990; Ulvila and Snider, 1980).

Symmetrical-prescriptive NSS

In contrast to asymmetrical-prescriptive NSS, symmetrical-prescriptive systems can be used simultaneously by several parties to reach mutually beneficial agreements. A

variety of procedures to aid several parties in conflict resolution exist. In political contexts, mediators successfully developed Single Negotiation Texts (Fisher and Ury, 1981; Raiffa, 1982). More recent examples include fair division approaches, such as the 'Adjusted Winner' procedure developed by Brams and Taylor (1996) and Brams and Taylor (1999). This approach enables parties to find efficient, envy-free and equitable solutions to disputes, possibly without computer support. To focus the following review of symmetric-prescriptive NSS, we limit our review primarily computer-based approaches. These systems can be classified into interactive bargaining systems and mediator-driven mediation systems.

Interactive bargaining systems usually limit the face-to-face contact of the negotiators and channel the communication processes through computer-based networks (Rangaswamy and Shell, 1997). These systems usually consist of private Decision Support Systems (DSS) for each of the parties, which are interconnected with an electronic communication channel (Foroughi, Perkins et al., 1995; Lim and Benbasat, 1992). In the last few decades, researchers have developed a variety of these interactive bargaining systems to improve negotiation processes for several parties simultaneously. PERSUADER, for example, integrates case-based reasoning with multi-attribute utility approaches in order to suggest efficient final settlements (Sycara, 1991). The MCBARG system uses an interactive mediation procedure based on a multiple-objective optimization approach to provide compromise solutions, which the parties can improve iteratively (Wierzbicki, Krus et al., 1993). NEGOTIATION ASSISTANT also consists of a computer network to facilitate a structured negotiation process (Rangaswamy and Shell, 1997). In order to help parties move toward optimal contracts, preference assessment in these cases is based on simple additive utility functions (Keeney and Raiffa, 1991) and/or on conjoint analysis techniques (Green and Srinivasan, 1978). With the recent advances in web programming possibilities, researchers have started to develop web-based interactive bargaining systems. INSPIRE, for example, uses a 'hybrid conjoint analysis' somewhat similar to the approach used by Rangaswamy and Shell (1997), in order to help parties reach pareto-efficient contracts (Kersten and Noronha, 1999). Focusing on negotiators' flexibility, *Negotiator Assistant*, recently developed Druckman, Ramberg et

al., 2002) as a question-based system for international negotiations, has been applied to e-mediation (Druckman, Druckman et al., 2004).

The effects of channeling communication in negotiations through computer systems with interactive bargaining systems have been mixed. On the one hand, the systems have enhanced task-oriented communication (Lim and Benbasat, 1992; Siegel, Dubrovsky et al., 1986). In some contexts, the anonymity has also been shown to facilitate the creation of options for mutual gain (Nunamaker, Dennis et al., 1991). However, the evidence as to whether information technology actually leads to more efficient contract generation is inconsistent. While Croson (1999), for example, reports computer-mediated outcomes to be more integrative than face-to-face interactions, Arunachalam and Dilla (1995) find evidence of electronic communication leading to lower group and individual profits. E-negotiation has also been shown to result in less trust through fewer clarifying questions and etiquette rituals (Morrison, Nadler et al., 2002). In addition, Dubrovsky, Keisler et al. (1991) found that computer-based systems significantly increase the probability and severity of conflict escalation (Dubrovsky, Keisler et al., 1991).

While channeling communication through computers may have some advantageous effects in some specific laboratory contexts, it can restrict real-world applicability, especially in collective bargaining contexts. Mediator-based systems avoid this problem by replacing the computer with a person who aims to support both parties in finding acceptable and efficient agreements. These systems include *Mediator* (Jarke, Jelassi et al., 1987), which uses Evolutionary Systems Design to aid human mediators in assisting parties reach mutually beneficial solutions (Shakun, 1987). The system is able to analyze qualitative and quantitative data about possible settlements, particularly in the pre-negotiation phase (Jelassi and Foroughi, 1989). Also designed for the pre-negotiation stage, the *Conflict Analysis Program - CAP* (Fraser and Hipel, 1981) is able to assist a third party in analyzing initial strategy formulation stages. CAP uses metagame analysis, aiding the mediator in identifying and discarding unfeasible agreements, prioritizing possible settlements and determining equilibria which result in stable outcomes (Jelassi and Foroughi, 1989). NEGO (Kersten, 1985), on the other hand, is based on multi-

objective linear programming models. It facilitates a two-stage interactive process of proposal formulation and negotiation based on a generalized theory of negotiations (Kersten and Szapiro, 1985).

Whereas these symmetrical systems avoid the problems associated with the computer-driven communication systems, at least two significant shortcomings inhibit their real-world applicability. First, some artificial intelligence or linear programming approaches compute final contracts in an opaque, 'black-box' way. 'Black-boxed' or complicated algorithms can generate solutions, which are difficult to understand readily by most real-world negotiators. Second, related to this complexity, there is a reduced perception of control by the parties over the process which results from the use of existing NSS. The lack of detailed knowledge of the process, coupled with a reduced feeling of control, can lead to feeling of mistrust and a lack of ownership in the proposed settlements. Like Mumpower and Rohrbaugh (1996), we view this 'sense of ownership' as a key factor for the successful application of the NSS in real-world contexts.

Our analytic-interactive mediation system – outlined in the following sections – avoids these shortcomings. It is designed as a mediator's aid especially in collective bargaining contexts. It does not restrict communication between the negotiation parties and therefore conflicts with fewer organizational and political constraints. Based on a transparent 'value-for-money' approach, it aims to enable parties to understand the process with which settlement proposals are generated. Finally, the system aims to create a 'sense of ownership' by the parties in the proposed settlement and hence enhances the real-world applicability of NSS in collective bargaining contexts.

An analytic-interactive mediation system for collective bargaining

Our analytic-interactive system extends the *analytical mediation* approach at the interface of negotiation and resource allocation (Mumpower and Rohrbaugh, 1996). The technical side of the system builds on transparent multiple-criteria decision modeling, whilst the human mediation processes is based on the decision conferencing approach (Phillips, 1989; Phillips, 2007). Similar methodological approaches have been used, for example, to allocate R&D resources (Phillips and Bana e Costa, 2007), prioritize options in public infrastructure development (Bana e Costa, Costa-Lobo et al., 2002), evaluate public tenders (Bana e Costa, Correia et al., 2002) as well as develop marketing strategies (Schilling and Schulze-Cleven, 2007). We transfer this methodology to collective bargaining negotiations.

More specifically, our analytic-interactive mediation system is designed to aid negotiation parties resolving deadlocks in collective bargaining. When initial labor-management negotiations have failed and conflict is escalating, e.g. a major strike is foreseeable, mediators or arbitrators are often invited to bridge the difference between parties. Our system is designed to help these third parties analyze the negotiation situation, generate value-for-money alternatives and use this value to suggest more efficient and acceptable settlements to both parties.

The technical side: The value-for-money principle

Collective bargaining can be analyzed as a resource allocation decision. Based on this view, the negotiation process represents a sequence of investment decisions by both parties about how to spend a certain amount of resources. The initial demand of the union and the initial offer of the management thereby serve as starting point for the distribution of resources, i.e. for making concessions. Both parties can make concessions in a variety of investment areas, such as salary, working time or job security. Each of the areas represents one issue to be negotiated, with a variety of discrete ‘investment’ options, such as 40 hours/week, 39.5 hours/week, 39 hours/week, etc. Realizing these options result in certain costs and benefits to the negotiation parties. An additive scoring system - based on multi-attribute utility theory (Keeney and Raiffa, 1976) – serves to assess the value of

each of these options. The final negotiation model subsequently allows the bargaining teams to evaluate the overall costs and benefits of different settlements.

To illustrate this approach, assume that three issues being negotiated in a management-union dispute are the number of days of vacation per year, percentage increase in salary and number of working hours per week. A variety of possible concessions, such as one or two additional vacation days, a 1%, 1.5% or 2% increase in salary or a decrease of one, two or three working hours a week, can be analyzed in terms of incremental costs to the management and incremental benefits to the union. Costs (or savings) and benefits (or 'pains') in this context do not necessarily refer to monetary values only. Political and/or emotional considerations have to be taken into account. For example, a company which concedes on visible contract issues might set a precedent which results in similar demands by unions of other subsidiaries or divisions. An increase in benefit for the union by $x might, in this case, generate costs to the management side of several times $x. On the other hand, changes on politically sensitive issues for unions, such as holidays, can result in small savings for management, but in extraordinary 'pain' (very low benefits) for employees.

Usually, researchers in these situations use negotiation modeling approaches which plot the negotiation parties' utilities of different contracts against each other (Mumpower and Rohrbaugh, 1996; Raiffa, Richardson et al., 2002). However, our observations of real-world collective bargaining in the German railway industry, as well as a sequence of expert interviews with negotiators on both side in order to develop a collective bargaining simulation (Schilling, Mulford et al., 2006), showed a clear preference for the management party to think in costs and the union to think in negative benefits ('pains'). In order to increase the real-world relevance of NSS, we therefore model collective bargaining in a cost-benefit framework, which has also been used for resource allocation decisions, such as for R&D, marketing or corporate strategy decisions (Burnett, Monetta et al., 1993; Schilling and Schulze-Cleven, 2007; Phillips, 2007)[1]. Cost for the management and benefit to the union of contract options can be captured with different sized value-for-money triangles, as displayed in Figure 2. The incremental costs for management for each contract option are thereby plotted on the horizontal axis, the incremental benefits to the union on the vertical access. The slope of the triangle reflects

the benefit-to-cost ratio for each contract option – the steeper the slope, the higher the benefit-to-cost ratio. Obviously, costs for management and benefits for the unions could be converted into standard utility calculations. Although theoretically appealing, this would, however, reduce the comprehensibility and applicability of the system in most collective bargaining situations significantly.

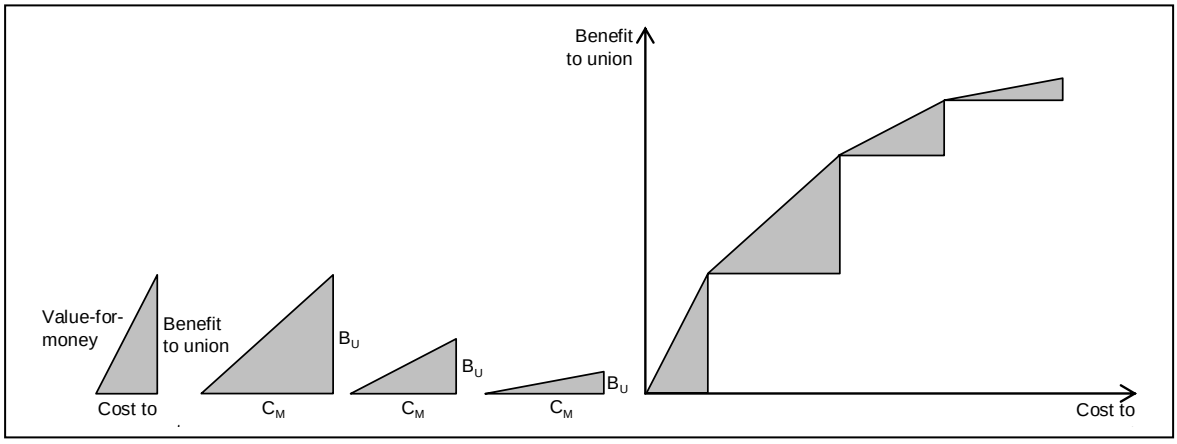


Figure 2 - Value-for-money triangle for three contract options

According to the value-for-money principle, management and union should prioritize their sequence of concessions according to the decreasing priority index $PI = \frac{B_U}{C_M}$. Contract options that are highly beneficial for the union and result in few costs compared to the other options have a high priority index and should be included in the contract first. On the union side, demands for concessions which are highly costly to the management side and result (relative to the other options) in few benefits, should be dropped first in order to create efficient contracts. Negotiating according to this approach is a modified version of 'cutting the other parties' costs' – a central recommendation common in the negotiation literature. More generally, we know that integrative approaches generally create both higher joint and individual gains. These gains are generally created by reciprocal trade-offs across issues with high priority index scores. Identifying and successfully converting these opportunities into real gains is difficult, in particular, in complex labor-management negotiations with thousands of contract

possibilities. A structured analysis of efficient concession priorities using an analytical-interactive mediation system can reveal significant joint gains which a mediator can use to help the parties reach more efficient final settlements. The actions of a mediator in this structure plays a crucial role in the process.

The human mediation side: Decision Conferences

An impartial mediator – a person of trust to both parties – is responsible for effectively structuring the analysis process. Similar to the decision conferencing approach, analysts are responsible for the IT-based modeling, while the mediator guides the negotiation parties to effectively build the decision model (Phillips, 2007). The mediator thereby acts as a process consultant, not contributing to content, but aiding the parties with constructive feedback (Schein, 1999). The objectives of the process are to generate insights into efficient contracts, create within-team alignment on the negotiation strategies and a commitment to resolve the deadlock (Quaddus, Atkinson et al., 1992; Phillips, 1989).

After parties reach a deadlock situation and have called for third party help, the mediator initiates the process in a joint session. In this meeting, the parties construct a negotiation model with the to-be-negotiated issues and a range of possible contract options. Both parties then break away in confidential scoring sessions. The mediator aids both parties separately to identify the costs to the management and benefit to the union for each contract option. Usually, the management side is able to calculate the different costs relatively well – standard accounting techniques and past experiences with the cost of collective bargaining aid with this task. On the union side, however, the scoring task is often more difficult. The union representatives have to incorporate a wide variety of perspectives about the evaluation of contract options, such as the value of higher payment vs. the reduction of vacation time. In addition, the union negotiation team sometimes has to negotiate in a two-level game context – both with the employers and with a large committee which represents the rank and file (Schilling, Mulford et al., 2006). In this complex situation – similar to a decision conference – a structured approach has the potential to resolve intra-team disputes and to create a shared understanding of the negotiation situation (Phillips, 2007). The mediator thereby uses a visually displayed

model to facilitate team discussions regarding the costs (on the management side) and the benefits (on the union side) of the different contract options. We outline more details on the contract assessment procedure for the management and the union side in the hypothetical case study below.

The mediator is responsible for keeping the evaluations strictly confidential and merging them at the end of the process. Based on the value-for-money principle as outlined above, the final model – which contains both the costs to the management and the benefit to the unions of each contract option – serves to identify potential efficiency improvements to reduce the settlement distance between the two negotiating parties. Ideally, the result of the process is a contract which reduces both costs to the employer and increases benefits to the union relative to the positions before the deadlock. To provide clarity, we now turn to an extended hypothetical case study, based on a collective bargaining simulation, which we developed together with negotiation parties from the German railway industry.

The analytic-interactive mediation processes – A hypothetical case study

Based on the observations of collective bargaining in the German railway industry, mentioned above, we developed, together with a variety of negotiation experts – both from the employer and from the union side – the simulation 'Zug um Zug 2015'. The setting represents a plausible negotiation scenario in the German railway industry in the future, which serves in the following as the basis to apply the analytic-interactive mediation process (for details regarding the development and the content of the case study see Schilling, Mulford et al., 2006).

In this particular case, imagine that after the initial positioning of both parties with high demands from the union and less generous offers from the management, tensions between the parties have risen. After some small, short strikes, both parties have agreed to call in a mediator to help them reach a mutually acceptable settlement. The mediator's task is to first create a negotiation model with both parties which includes contract options on a variety of to-be-negotiated issues. Second, the mediator assists both parties in assessing the value of these contract options confidentially. The result of the process is

suggestions for efficient contracts which aim to reduce the settlement distance between the two parties, facilitating effective conflict resolution.

The negotiation model

So far, both parties have been negotiating mainly on the issues of salary, working time and vacation days. In order to increase the integrative potential of the negotiation situation, i.e. the possibility to create value to both parties (Raiffa, Richardson et al., 2002), the mediator and the parties decided to include the issues of job security, working break acknowledgement and ticket discount for employees in the negotiations. Working break acknowledgement captures the amount of break time counted as working time – an important issue in the railway industry where employees have frequent and long breaks during their working day. The current demand of the union and the current offer of the management on these six issues determine the top and the bottom option in each area. A specific contract is then defined by the parties' joint choice of one option in each issue. A possible contract would be an 3.2% increase in wages, a decrease of one working hour per week, three year job guarantee, a full acknowledgment of the working break, two additional vacation days and no ticket discount. A hypothetical negotiation model with issues to be negotiated and a limited number of discrete options for each issue is displayed in Figure 3. Of course, most issues are continuous and making them discrete is a simplification of the negotiation situation. Nonetheless, it is often not necessary to model all possible contract options. The model can be extended at any time in the mediation process if either party considers it necessary.

+6%					
+5.6%					
+5.2%					
+4.8%					
+4.4%	37 h/week		full acknowledgement	29	
+4%	37.5 h/week		1 h/80% ackn.	28	
+3.6%	38 h/week	guarantee 4.5 years	30 min/80% ackn.	27	full support
+3.2%	38.5 h/week	guarantee 3 years	80% ackn.	26	120 € support
+2.8%	39 h/week	guarantee 1.5 years	60% ackn.	25	80 € support
+2.4%	39.5 h/week	political commitment	30% ackn.	24	40 € support
+2%	40 h/week	no guarantee	no acknowledgement	23	none
Salary	**Working time**	**Job security**	**Working break acknowledgement**	**Vacation in days**	**Ticket discount**

Figure 3 - Contract space with six to-be-negotiated issues

The model should be designed requisitely (Phillips, 1984), i.e. kept as simple as possible, but include all relevant aspects of the negotiation situation. The contract options are thereby constructed as mutually exclusive and preferences as independent, i.e. each option on each issue can be scored independently of the chosen options on other issues (Keeney and Raiffa, 1991). To make potentially dependent issue preferences independent, the mediator may suggest unbundling or redefining issues (Keeney and Raiffa, 1991; Thompson, 2005). Preference independence (Keeney and Raiffa, 1976) is the prerequisite for the confidential scoring of contract options by both parties, as described below.

Scoring and weighting of contract options

After the construction of the negotiation model, each team confidentially appraises each contract option ‘i’ against a cost criterion (for management) or a benefit criterion (for union). Let us consider, for example, the issue of working time. The management side calculates for each option a monetary value, adjusted by non-financial concerns, such as negative precedents and/or reputation concerns. The option 37 hours/week, for example, could be in particular expensive, as the management recently committed itself to its shareholders to increase the working time in order to enhance competitiveness. On the union side, the benefit criterion reflects the degree of economic and emotional welfare of a certain option to the rank and file. It can be assessed using

relative 0 to 100 scales, assigning a score v_{ik} to each option *i* in area *k*. To illustrate, let us assume that $v_{ik} = 0$ refers to the lowest value (not to "no value") of one activity in one area, and $v_{ik} = 100$ refers to the highest value in one area. Values for the in-between options are scored on an interval scale. The union's valuation of the options on the issue of job security can, for example, be captured with $v_{noguarantee} = 0$ and $v_{4.5\ years} = 100$. However, differences between these anchor points can be non-linear. Due to an early promise of the union leaders to reach at least three years of job guarantee for the rank and file, the improvement of this option might be of much greater value than the incremental benefit gain when moving from 3 year job guarantee to 4.5 year. The task of the mediator is to capture these differences in valuation quantitatively.

After the scoring process, each negotiation team has to assess a weight w_k for each of the k issues to adjust the lengths of the 0-100 scales. To illustrate, assume the union team values the difference on the issue 'job security' from 'no guarantee' and '4.5 years of guarantee' as twice as important as the difference between the decrease from 40 to 37 hours on the issue working time (the difference between the highest and lowest reference points in both issues). To reflects this difference in preference, the issue 'salary' would be assigned a weight of $w_S = 1.0$ and the issue 'holiday' a weight of $w_V = 0.5$. The overall value of each contract option v_i is then derived by multiplying the value of an option on an issue k (v_{ik}), with the normalized weights of each issue (w_k):

(1) $v_i = v_{ik} * w_k$

Taking a portfolio perspective, the overall value v_c of a contract can be determined by simply summing the weighted values of the selected options for each issue:

(2) $v_c = \sum_k w_k v_{ik}$

The scoring and weighting approach builds theoretically on multi-attribute value analysis (see for example, Keeney, Raiffa et al., 1976; von Winterfeldt and Edwards, 1986; Keeney and Raiffa, 1991). Figure 4 shows the result of the process. In each area, the weighted scores for the union and the management side constitute the individual value-for-money triangles.

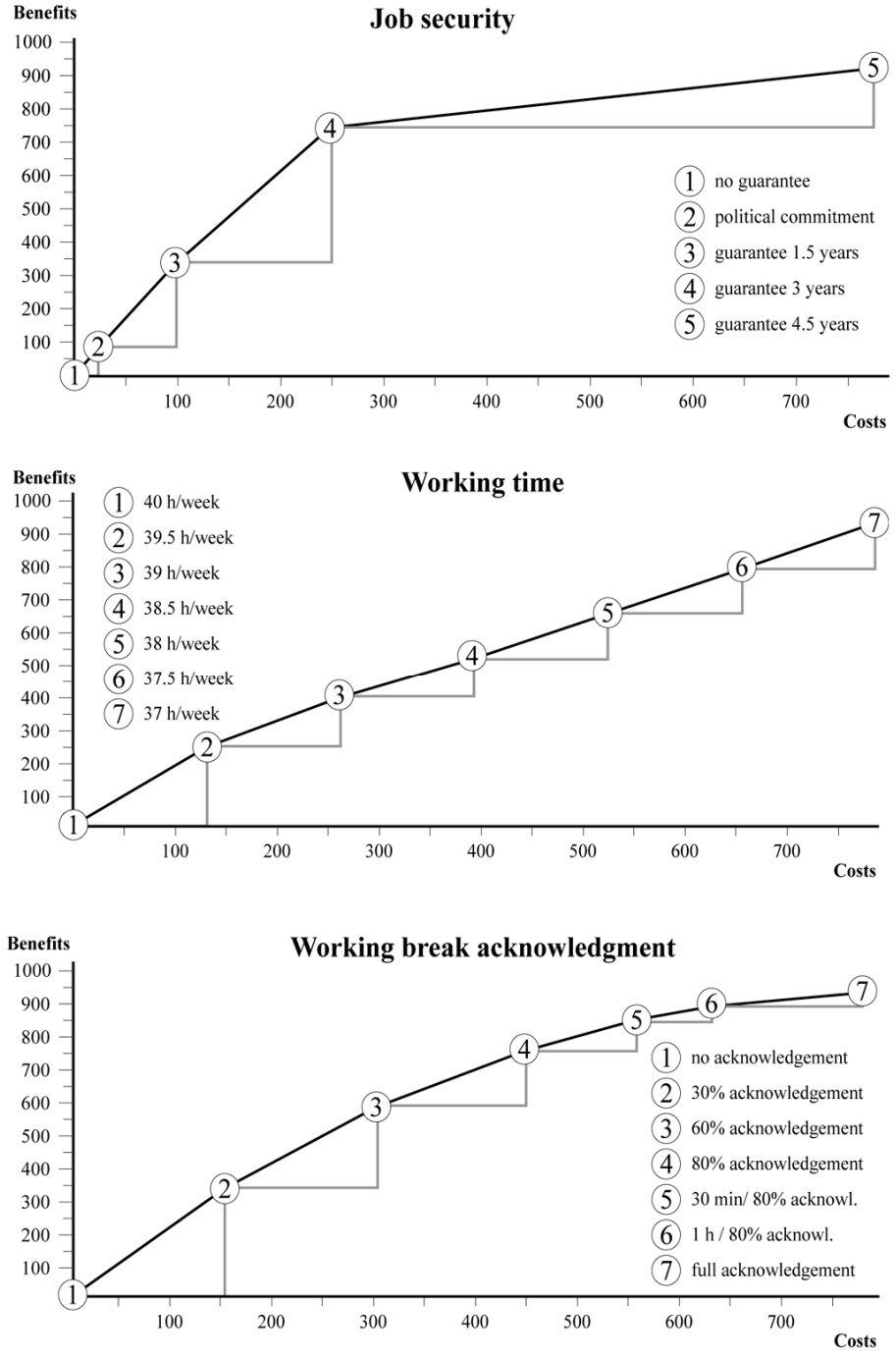


Figure 4 – Value-for-money triangles on the issues job guarantee, working time and working time acknowledgement

In this example, the parties can use the joint value-for-money principle to guide concession making effectively. If we assume that both parties are interested in cutting the

other party's costs in exchange for concessions, contract options with flat value-for-money triangles are the concession targets of the management – these options result in large cost savings and small benefit losses to the unions. Steep value-for-money triangles – options which result in a high incremental benefit for the union and relatively low cost for the management – are the union's concession targets. An initial concession from the union to the management on job security, such as moving from 4,5 year to 3 year of guarantee, and a reciprocal concession from the management to move from 37 to 37.5 hours working time, are examples of an effective exchange of concessions, guided by the value-for-money principle.

Pareto-improvements to reduce settlement distance

Based on this confidentially scored and weighted negotiation model, the mediator is now able to determine the value in benefit and money of each party's last offer – the offers made before the process was considered to be in deadlock. These offers can be positioned within a 'contract envelope', an area which represents the cost and benefit values of all possible settlements within the negotiation model (see grey area in Figures 5 and 6). The single overall value for each settlement allows for comparisons of different contracts. By using this system, a proposal, for example, with a 3.0% increase in salary, 39 working hours per week, a job guarantee of 2 years, etc., can be compared to a contract with a 3.5% increase in salary, 38 working hours per week, no job guarantee, etc. In our illustrative example, displayed in Figure 3 – which is based on the collective bargaining simulation – approximately 94,000 different contracts can be chosen. To build the efficiency frontier, the value-for-money triangles are stacked in declining order of slope (Phillips and Bana e Costa, 2006). Due to the differences in preferences of parties across and within issues, the area is lens-shaped. A negotiation about one issue only would turn the contract space into a line, representing a zero-sum game. Although being a standard analysis of an integrative negotiation, the software supported graphical display is part of the information which the mediator presents to the parties, therefore facilitating their understanding and ownership of the process.

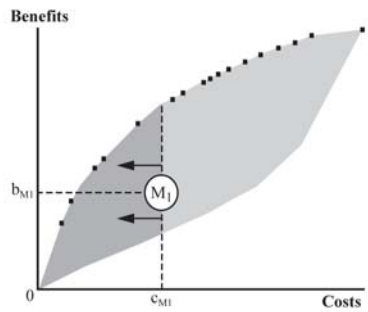
Figure 5a displays an illustrative last offer of the management side M_1 with costs $c(M_1)$ and benefits $b(M_1)$ before the analytic-interactive mediation process was started.

Assuming appropriate scores and weights for all contract options, the management side should, as indicated by the black arrows, accept any settlement proposal P_i by the mediator if, and only if:

$$c(P_i) \leq c(M_1)$$

Figure 5b shows the last offer of the union U_1 with associated costs $c(U_1)$ and benefits $b(U_1)$. If the union scored and weighted their preferences correctly, they should accept, as indicated by the black arrows, any settlement proposal P_i by the mediator if, and only if:

$$b(P_i) \geq b(U_1)$$



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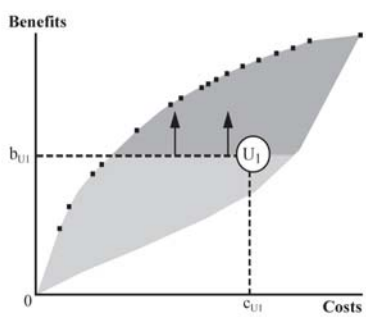
+4.4%	37 h/w.		full ackn.	29	
+4%	37.5 h/w.		1 h/80% ackn.	28	
+3.6%	38 h/w.	guar. 4.5 y.	30 min/80% ackn.	27	full supp.
+3.2%	38.5 h/w.	guar. 3 y.	80% ackn.	26	120 € sup.
+2.8%	39 h/w.	guar. 1.5 y.	60% ackn.	25	80 € sup.
+2.4%	39.5 h/w.	pol. comm.	30% ackn.	24	40 € sup.
+2%	40 h/w.	no guarantee	no ackn.	23	none
Salary	**Working time**	**Job security**	**Working break acknowledgement**	**Vacation in days**	**Ticket discount**

Figure 5a – Value and contract characteristic of the management's last offer (grey area represents all cost and benefit values of potential contracts)



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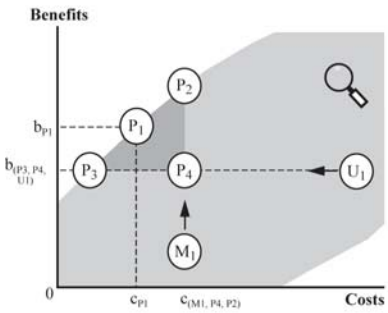
+2.8%	39 h/w.	guar. 1.5 y.	60% ackn.	25	80 € sup.
+2.4%	39.5 h/w.	pol. comm.	30% ackn.	24	40 € sup.
+2%	40 h/w.	no guarantee	no ackn.	23	none
Salary	**Working time**	**Job security**	**Working break acknowledgement**	**Vacation in days**	**Ticket discount**

Figure 5b – Value and contract characteristic of the union's last offer

Based on the model and the last offers of the parties before the third-party was called, the mediator can use pareto improvements, as displayed in Figure 5c, to suggest final contracts, which are more efficient and more acceptable to both parties. If the grey-shaded zone with the cost and benefit values of all contracts is denoted with Ω, the mediator should choose final settlements P_i in the area:

$$P_i = \{(c,b) \varepsilon \Omega: c(P_i) \leq c(M_1),\ b(P_i) \geq b(U_1)\}$$

For illustrative purposes, four of these possible settlements solutions are displayed in Figure 5c as P_i with i=1,2,3,4. We suggest that the mediator *simultaneously* proposes several settlements at or close to the efficiency frontier and allows parties to settle the final contract themselves. According to our observations, collective bargaining parties usually do not want to settle as quickly as possible for the best possible solution. Signaling procedures toward constituencies such as walk-outs or cost cutting demands are important negotiation tactics not only for producing results, but for placating external observers. Any system which inhibits this kind of behavior greatly reduces the applicability in collective bargaining settings. Defining simultaneous suggestions of several offers at or close to the efficiency aids parties in their search for feasible agreements without taking away control of the negotiation *process*. It is obvious that under this system, parties would have the ability to give the mediator false information with the hope of gaining a strategic advantage by manipulating the shape of the efficiency frontier. While successful manipulations of this type are theoretically possible, they seems highly unlikely, primarily because it would require a high degree of information asymmetry. Specifically, for one party to manipulate the shape of the efficiency frontier to their advantage, they would need to have nearly complete information as to the intensity of preferences across issues of the other party. If they did not, they would run a significant risk of damaging their own prospects. Further, the system is meant to be applied as a negotiation approaches deadlock. Presumably, to make the preferences reported to the mediator plausible, the manipulating party would have had to either anticipate the application of the method and/or acted in a way consistent with the false preference structure during the initial negotiation.



Salary	Working time	Job security	Working break acknowledgement	Vacation in days	Ticket discount
+6%					
+5.6%					
+5.2%					
+4.8%					
+4.4%	37 h/w.		full ackn.	29	
+4%	37.5 h/w.		1 h/80% ackn.	28	
+3.6%	38 h/w.	guar. 4.5 y.	30 min/80% ackn.	27	full supp.
+3.2%	38.5 h/w.	guar. 3 y.	80% ackn.	26	120 € sup.
+2.8%	39 h/w.	guar. 1.5 y.	60% ackn.	25	80 € sup.
+2.4%	39.5 h/w.	pol. comm.	30% ackn.	24	40 € sup.
+2%	40 h/w.	no guarantee	no ackn.	23	none

Figure 5c – The mediator's possible settlement suggestions based on pareto improvements (grey shaded contract characteristic refer to P1)

Of course, the situation displayed in Figure 5a - 5c is an optimistic one. If the parties' last offers are well inside the envelope, the potential value-for-money is sufficiently large to bridge the remaining differences of the parties. However, if the initial positions are far away or relatively efficient, a different picture, as shown in Figure 6, emerges.

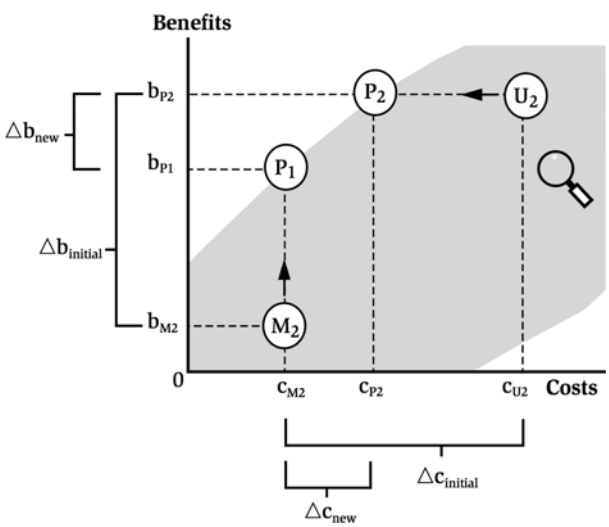


Figure 6 – Reduced settlement difference using pareto improvements

In this case, pareto improvements can only reduce the settlement difference between the parties. A compromise solution, as displayed in Figure 5c (where the union does not have to accept a decrease in benefit or the management an increase in costs with the mediator's proposals) is not possible in this case. The initial differences in costs and benefits between the last offer of the union (U_2), and the last offer of the management (M_2), is displayed in Figure 6 with $\Delta c_{initial}$ and $\Delta b_{initial}$. Here, the mediator is able to identify proposals at, or close to, the efficiency frontier, displayed as P_1 and P_2, which result in smaller distances in cost and benefit values (Δc_{new} and Δb_{new}). As a final settlement, the mediator can propose several settlements at, or close to, the efficiency frontier between P_1 and P_2. If the mediator is able to get the parties to move a little bit further from their initial positions – which he/she would have to do without use of the system as well - a settlement still may be reached.

Conclusion

Observations in an ongoing, real-world industrial dispute in the area of collective bargaining in the German railway industry revealed some weaknesses in existing NSS. First, according to our experience, channeling information through computers tends to limit the applicability of NSS in some collective bargaining contexts. Inhibiting face-to-face interaction would be incompatible with some political constraints of collective bargaining. In addition, many labor-management negotiators are not, according to our observations, particularly interested in systems which facilitate quick and efficient settlements. Common signaling procedures – threats, such as as strikes, walk-outs, cost cutting demands, etc. – toward respective constituencies such as the rank and file of the union or shareholders are essential parts of the negotiation process. The system, presented in this paper, therefore, does not 'invade' existing organizational communication structures nor limit communication to electronic systems.

Second, due to the lack of expertise in economic concepts, negotiators have difficulties to understand complex utility concepts, used in some existing NSS. The system, introduced in this paper, therefore analyzes collective bargaining in the language and concepts in the existing cognitive schema of the negotiators - benefit to the unions and costs to the management. Although the notion value-for-money can be converted in utility maximization, NSS applicability would be lost in this type of translation. Based on the value-for-money principle, the system aids parties' abilities to cut the other party's cost in order to induce reciprocal concession behavior. The system helps a mediator to simultaneously issue several efficient contract proposals, using pareto-improvements, to enhance settlement probability in the negotiation. It is in particular applicable when negotiation failure looms.

The pressures on parties to settle can be a fertile ground for the application of a mediation support system - particularly in the case of labor-management negotiations close to an impasse with a significant escalation possibility. Further development of NSS in collective bargaining could include analytic-interactive NSS – systems which combine human mediation and IT-based contract modeling – as discussed in this paper. In our opinion, NSS in collective bargaining should be designed with a clear understanding of

the constraints in negotiation settings. These systems can aid in reaching more viable and efficient solutions and are more likely to be adopted and to succeed in practice.

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Notes

[1] Systems for portfolio-based multiple-criteria analysis include: Equity, www.catalyze.co.uk; High Priority www.krysalis.co.uk and Logical Decisions www.logicaldecisions.com.

References

Aaron, M. C. (1995). The Value of Decision Analysis in Mediation Practice. *Negotiation Journal,* 123-133.

Anson, R. G. and M. T. Jelassi (1990). A development framework for computer-supported conflict resolution. *European Journal of Operational Research* 46(2), 181-199.

Arunachalam, Y. and W. N. Dilla (1995). Judgment Accuracy and Outcomes in Negotiation: A Causal Modeling Analysis of Decision-Aiding Effects. *Organizational Behaviour and Human Decision Processes* 61(3), 289-304.

Bana e Costa, C. (2001). The use of multi-criteria decision analysis to support the search for less conflicting policy options in a multi-actor context: Case study. *Journal of Multi-Criteria Decision Analysis* 10, 111-125.

Bana e Costa, C. A. and E. Beinat (2005). Model-structuring in Public Decision-Making. LSE Working Paper OR 05-79, London School of Economics, London.

Bana e Costa, C. A., E. C. Correia, et al. (2002). Facilitating bid evaluation in public call for tenders: a socio-technical approach. *Omega* 30, 227-242.

Bana e Costa, C. A., M. L. Costa-Lobo, et al. (2002). *Multicriteria Approach for Strategic Town Planning: The Case of Barcelos*. In D. Bouyssou (eds.), Aiding Decisions with Multiple Criteria: Essays in Honour of Bernard Roy. Dordrecht, NL: Kluwer Academic Publishers.

Barclay, S. and C. R. Peterson (1976). Multi-criteria utility models for negotiations. Technical Report 76-1. Arlington, Decision and Designs Inc.

Bragge, J. (2001). Premediation Analysis of the energy taxation dispute in Finland. *European Journal of Operational Research* 132, 1-16.

Brams, S. J. (2003). *Negotiation Games - Applying Game Theory to Bargaining and Arbitration (revised Edition)*. New York: Routledge.

Brams, S. J. and A. D. Taylor. (1996). *Fair Division - From cake-cutting to dispute resolution*. Cambridge: Cambridge University Press.

Brams, S. J. and A. D. Taylor. (1999). *The Win/Win Solution: Equalizing Fair Shares to Everybody*. New York: W.W. Norton.

Burnett, W. M., D. J. Monetta, et al. (1993). How the Gas Research Institute (GRI) helped transform the US natural gas industry. *Interfaces* 23(1), 44-58.

Carmel, E., B. C. Herniter, et al. (1993). Labor-Management Contract Negotiations in an Electronic Meeting Room: A Case Study. *Group Decision and Negotiation* 2(1), 27-60.

Croson, R. (1999). Look at me when you say that: An electronic negotiation simulation. *Simulation and Gaming* 30(1), 23-47.

Druckman, D., J. N. Druckman, et al. (2004). e-Mediation: Evaluating the Impacts of an Electronic Mediator on Negotiating Behavior. *Group Decision and Negotiation* 13(6), 481-511.

Druckman, D., B. Ramberg, et al. (2002). Computer-Assisted International Negotiation: A Tool for Research and Practice. *Group Decision and Negotiation* 11, 231-256.

Dubrovsky, V. J., S. Keisler, et al. (1991). The equalization phenomenon: Status effects in computer-mediated and face-to-face decision-making groups. *Human-Computer Interaction* 6(2), 119-146.

Eliasberg, J., S. Gauvin, et al. (1992). An Experimental Study of Alternative Preparation Aids for International Negotiations. *Group Decision and Negotiations* 1, 243-267.

Fang, L., K. W. Hipel, et al. (1993). *Interactive decision making: The graph model for conflict resolution*. New York: Wiley.

Fisher, R. and W. Ury. (1981). *Getting to Yes: Negotiating Agreement Without Giving in*. Boston: Houghton Mifflin.

Foroughi, A. (1995). A survey of the user of computer support for negotiation. *Journal of Applied Business Research* 11(2), 121-134.

Foroughi, A., W. C. Perkins, et al. (1995). An Empirical Study of an Interactive, Session-Oriented Computerized Negotiation Support System (NSS). *Group Decision and Negotiation* 4, 485-512.

Fraser, N. M. and K. W. Hipel (1981). Computer Assistance in Labor-Management Negotiations. *Interfaces* 11(2), 22-29.

Green, P. E. and V. Srinivasan (1978). Conjoint Analysis in Consumer Research: Issues and Outlook. *Journal of Consumer Research* 5, 103-123.

Jarke, M., M. T. Jelassi, et al. (1987). MEDIATOR - Towards a negotiation support system. *European Journal of Operational Research* 31(3), 314-334.

Jelassi, M. T. and A. Foroughi (1989). Negotiation Support Systems: An Overview of Design Issues and Existing Software. *Decision Support Systems* 5(2), 167-181.

Keeney, R. L. and H. Raiffa. (1976). *Decisions With Multiple Objectives: Preferences and Value Trade-offs*. New York: John Wiley.

Keeney, R. L. and H. Raiffa (1991). *Structuring and Analyzing Values for Multiple-Issues Negotiations*. In H. P. Young (eds.), Negotiation Analysis. Ann Arbor: University of Michigan Press.

Kersten, G. E. (1985). NEGO - Group Decision Support System. *Information & Management* 8, 237-246.

Kersten, G. E. (1990). Structuring and Simulation Negotiation: An Approach and an Example. *Theory and Decision* 28(3), 243-273.

Kersten, G. E. (1993). Negotiation Support: Development of Representations and Reasoning. *Theory and Decision* 34(3), 293-311.

Kersten, G. E. and D. B. Meister (1996). Qualitative Representations of Negotiations: Tutorial on a Rule-based Approach. *Group Decision and Negotiation* 5(2), 177-202.

Kersten, G. E. and S. J. Noronha (1999). WWW-based negotiation support: design, implementation, and use. *Decision Support Systems* 25(2), 135-154.

Kersten, G. E. and T. Szapiro (1985). Generalized approach to modeling negotiations. *European Journal of Operational Research* 26(1), 142-149.

Kilgour, D. M., L. Fang, et al. (1995). GMCR in Negotiations. *Negotiation Journal* 11, 151-156.

Kilgour, M. D., K. W. Hipel, et al. (1994). Negotiation Support Using the Graph Model for Conflict Resolution. *Group Decision and Negotiation* 3(1), 29-46.

Kim, J. B. and A. Segev (2005). A Web Services-enabled marketplace architecture for negotiation process management. *Decision Support Systems* 40, 71-87.

Lim, L. H. and H. Benbasat (1992). A Theoretical Perspective of Negotiation Support Systems. *Journal of Management Information Systems* 9(3), 27-44.

Luce, R. D. and H. Raiffa. (1957). *Games and decisions: Introduction and critical survey*. New York: John Wiley.

Morrison, M. W., J. Nadler, et al. (2002). Schmooze or lose: Social friction and lubrication in e-mail negotiations. *Group Dynamics: Group Dynamics: Theory, Research, and Practice* 6(1), 89-100.

Mumpower, J. L. and J. Rohrbaugh (1996). Negotiation and Design: Supporting Resource Allocation Decisions through Analytical Mediation. *Group Decision and Negotiation* 5, 385-409.

Myerson, R. B. (1991). *Game Theory: Analysis of Conflict*. Cambridge, MA: Harvard University Press.

Nash, J. F. (1950). The Bargaining Problem. *Econometrica* 18, 155-162.

Nash, J. F. (1951). Non-cooperative games. *Annals of Mathematics* 54, 286-295.

Nunamaker, J. F., A. R. Dennis, et al. (1991). Information Technology for Negotiating Groups: Generating Options for Mutual Gain. *Management Science* 37(10), 1325-1346.

Nyhart, J. D. and C. Goeltner (1987). Computer Models as Support for Complex Negotiations, Working Paper Series WP-10, The Program on the Process of International Negotiation, American Academy of Arts and Sciences, Cambridge, MA.

Phillips, L. D. (1984). A Theory of Requisite Decision Models. *Acta Psychologica* 56, 29-48.

Phillips, L. D. (1989). *People-centred Group Decision Support.* . Knowledge-based Management Support Systems. In G. Doukidis, F. Land and G. Miller (eds.). Chichester: Ellis Horwood.

Phillips, L. D. (2007). *Decision Conferencing*. In W. Edwards, J. Ralph F. Miles and D. v. Winterfeldt (eds.), Advances in Decision Analysis. Cambridge, MA: Cambridge University Press.

Phillips, L. D. and C. Bana e Costa (2007). Transparent prioritisation, budgeting and resource allocation with multi-criteria decision analysis and decision conferencing. *Annals of Operations Research* 154, 51-68.

Quaddus, M. A., D. J. Atkinson, et al. (1992). An application of decision conferencing to strategic planning for a voluntary organization. *Interfaces* 22(6), 61-71.

Raiffa, H. (1982). *The Art and Science of Negotiation*. Cambridge/London: Harvard University Press.

Raiffa, H. (1985). Post-settlements Settlements. *Negotiation Journal* 1(1), 9-12.

Raiffa, H., J. Richardson, et al. (2002). *Negotiation Analysis - The Science and Art of Collaborative Decision Making*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press.

Raith, M. G. (2007). *Procedural Design for Conflict Resolution*. In R. Avenhaus and I. Zartman (eds.) Diplomacy Games - Formal Models and International Negotiation. Berlin: Springer.

Rangaswamy, A. and R. Shell (1997). Using Computers to Realize Joint Gains in Negotiations: Toward an "Electronic Bargaining Table". *Management Science* 43(8), 1147-1163.

Samarasan, D. K. (1993). Analysis, Modeling, and the Management of International Negotiations. *Theory and Decision* 34(3), 275-292.

Schein, E. H. (1999). *Process Consultation Revisited: Building the Helping Relationship*. Reading, MA: Addison-Wesley.

Schelling, T. C. (1960). *The Strategy Of Conflict*. Cambridge, MA: Harvard University Press.

Schilling, M. and P. Schulze-Cleven (2007). Beyond Matrices and Black-box Algorithms: Strategic Marketing Budgeting for Marketing Managers. *Journal of Marketing Management.* In review.

Schilling, M. S., M. A. Mulford, et al. (2006). Collective Bargaining as a Two-level Game: Direct Learner-Expert Interactions. *Simulation and Gaming* 37(3), 326-338.

Shakun, M. F. (1987). *Evolutionary Systems Design: Policy Making Under Complexity and Group Decision Support Systems*. San Francisco, CA: Holden Day.

Shakun, M. F. (1995). Restructuring a Negotiation with Evolutionary Systems Design. *Negotiation Journal,* 145-150.

Siegel, J., S. Dubrovsky, et al. (1986). Group Processess in Computer-Mediated Communication. *Organizational Behavior and Human Decision Processes* 37, 157-187.

Sycara, K. (1991). Problem restructuring in negotiation. *Management Science* 37, 1243-1268.

Teich, J. E., H. Wallenius, et al. (1996). Identifying Pareto-optimal settlements for two-party resource allocation negotiations. *European Journal of Operational Research* 93(3), 536-549.

Thompson, L. (2005). *The Mind and Heart of the Negotiator*. Upper Saddle River, New Jersey: Pearson Prentice Hall.

Ulvila, J. W. (1990). *Turning Points: An Analysis*. In J. M. Jr. and D. Bendahmane (eds.), U.S. Bases Overseas. Boulder, CO: Westview Press.

Ulvila, J. W. and W. D. Snider (1980). Negotiation of International Oil Tanker Standards: An Application of Multi-criteria Value Theory. *Operations Research* 28(1), 81-96.

von Winterfeldt, D. and W. Edwards. (1986). *Decision Analysis and Behavioral Research*. Cambridge: Cambridge University Press.

Wall, J. A., J. B. Stark, et al. (2001). Mediation - A Current Review and Theory Development. *Journal of Conflict Resolution* 45(3), 370-391.

Wierzbicki, A. P., L. Krus, et al. (1993). The Role of Multi-Objective Optimization in Negotiation and Mediation Support. *Theory and Decision* 34, 201-214.

Wilkenfeld, J., S. H. Kraus, et al. (1995). GENIE: A decision support system for crisis negotiations. *Decision Support Systems* 14(4), 369-391.

Winter, F. (1985). An Application of Computerized Decision Tree Models in Management-Union Bargaining. *Interfaces* 15(2), 74-80.

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