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An Empirical Study of an Interactive, Session-Oriented Computerized Negotiation Support System (NSS)

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Abstract.

Negotiating is one of the four major decisional roles played by managers. In fact, resolving conflict is said to occupy 20% of a manager's working hours. This growing frequency of negotiation scenarios coupled with the increasing complexity of the issues which need to be resolved in a negotiation make the possibility of computer enhancement for negotiation very appealing. Implementations of computerized Negotiation Support Systems (NSS) in the business world, international affairs, labor law, and environmental and safety disputes have demonstrated their potential for making negotiation problems more manageable and comprehensible for negotiators. Still, pioneers in NSS research have expressed their dismay at the lack of rigorous empirical research and evaluation of NSS. In particular, research is needed which will determine how and under what circumstances negotiation processes can be enhanced by NSS support.

This article describes empirical research on the effects of a highly structured, interactive NSS on the outcome of face-to-face issues resolution and the attitudes of negotiators in both low- and high-conflict situations. In a laboratory experiment, bargaining dyads played the roles of manufacturers negotiating a four-issue, three-year purchase agreement for an engine subcomponent in conditions of high and low conflict of interest. The results of the study showed that NSS support did help bargainers achieve higher joint outcomes and more balanced contracts, but that the NSS support increased negotiation time. Satisfaction was greater for NSS dyads in both conflict levels, and perceived negative climate was reduced in low conflict.

One primary implication of the results of this study is that NSS developers should keep in mind the importance of providing users with a system with interactive qualities which not only enhance the decision-making process but also provide them with a sense of participation in reaching the solution, as was done in this study.

Key Words: empirical research, negotiation, conflict analysis and resolution, negotiation support systems, computer intervention

1. Introduction

Conflict is a phenomenon which pervades everyday life—in the realm of politics, in the business world, and in interpersonal relations. It can be argued that every group decision-making situation contains some degree of conflict. Group interaction research, however, identifies two specific types of group tasks which, by their very nature, involve conflict among the members of a group (McGrath 1984). First, the members of a decision-making

group who share common interests and goals may still find themselves in strong conflict due to differences in the set of criteria which they each use in judging the relevant information needed to make a decision. Such differences in opinion or viewpoint are called cognitive conflicts. Within organizations, members of decision-making groups often face cognitive conflict over such issues as the allocation of resources, systems acquisition, and policy formulation. Individuals involved in cognitive conflict with each other usually have no differences of interest and neither party can profit at the other's expense. Brehmer (1976) describes cognitive conflict as a benign form of conflict which can usually be resolved through a process of cooperative group decision making in which consensus is reached.

Second, conflict of interest, which is the focus of the present research, encompasses situations in which two or more parties have separate interests or goals which conflict, such that one party's goal achievement will prevent the achievement of the opposing party's goals. Because the parties are in competition with each other, but still need to cooperate to reach agreement, conflicts of interest are often called mixed-motive tasks. According to Brehmer (1976), conflicts of interest potentially yield much more disruptive disagreements than do cognitive conflicts. In the business world, conflicts of interest frequently occur in labor-management contract disputes and between organizations over mergers or purchasing contracts. Peaceful resolution of conflicts of interest is reached through negotiation or bargaining (terms which are used interchangeably in this article), a process in which opposing sides discuss the issues involved and reach an agreement which is mutually acceptable.

Negotiation is a process with which managers are familiar. It has been estimated that managers spend up to 20% of their working time in negotiation activities (Shea 1983). Success in negotiating was once considered an art, based on "interpersonal skills, the ability to convince and be convinced, the ability to employ a basketful of bargaining ploys, and the wisdom to know when and how to use them" (Raiffa 1982, p. 8). Guides to negotiators offered suggestions about specific strategies, tactics, and maneuvers which could help one win in a negotiation setting (e.g., Zartman and Berman 1982).

However, not all negotiators have the opportunity, experience, or interpersonal skills to master the art of negotiation. Even the most capable negotiators often find it difficult as well as risky to rely solely on their own subjective judgments for obtaining feasible resolutions to conflict (Antrim and Lax 1987). Conflicts can sometimes become so complex that practical resolutions are not reached because of the impossibility of identifying and understanding them (UNISYS 1987). In other cases, even if negotiating parties do reach an agreement, they may not have achieved the best possible solution.

Since the 1960s, when computer models were first employed for the support of individual negotiating sides, interest has been growing in the possibility of using computer technology and information systems to support negotiations (Nyhart and Goeltner 1987). More recently, information systems researchers have begun developing a computer tool called a Negotiation Support System (NSS), a special type of Group Support System (GSS) intended to support negotiation parties (and possibly a human mediator) in reaching an agreement (DeSanctis and Gallupe 1987; Jarke, Jelassi, and Shakun 1987; Kersten 1985). A GSS is an information system which combines electronic communications, computers, and decision technology to support group work; an NSS is a subclass of GSS where the parties being supported are attempting to negotiate or bargain to reach an agreement (Dennis et al. 1988; DeSanctis and Gallupe 1987). One useful way of operationalizing an NSS consists of an individual

Decision Support System (DSS) for each party in the negotiation plus an electronic communication channel between the parties (Lim and Benbasat 1992).

In recent years, significant work has been undertaken to build interactive, session-oriented NSS which would support the entire negotiation process (Anson and Jelassi 1990; Carmel and Herniter 1989; Carmel, Herniter, and Nunamaker 1993; Foroughi and Jelassi 1990a, 1990b; Foroughi and Perkins 1989; Delaney, Foroughi, and Perkins 1992). These NSS are session-oriented in that they are designed to be used in a single negotiating session with both parties present; further, they are designed to support the entire negotiation process from an initial statement of interests, through the generation and analysis of alternatives, to the documentation of a final agreement.

An NSS offers the potential for enhancing the problem-solving process and for helping alleviate the cognitive and socio-emotional stumbling blocks to successful negotiation (see Table 1). These stumbling blocks include (1) cognitive limitations encountered in generating and evaluating solution alternatives; (2) cognitive biases such as the consideration of issues one at a time, negative framing of the negotiation, a win-lose mentality, premature closure, and preference for salient, easily available solutions; and (3) socio-emotional aspects of negotiator behavior such as face-saving behavior, ineffective communication, negotiator overconfidence, and the tendency toward nonrational escalation of conflict.

Implementations of computer support in international affairs, labor law, and environmental and safety disputes have demonstrated the potential of such support for making negotiation problems more manageable and comprehensible for negotiators (for reviews of prior NSS, see Eden 1992; Jelassi and Foroughi 1989; Nyhart and Goeltner 1987). In many cases, the use of computerized negotiation support has "occurred almost by chance when the developer of a computer model came into contact with someone involved in a conflict to which the model applied" (UNISYS 1987, p. 2). Furthermore, none of these implementations has featured the use of a full-featured NSS, a system which provides a DSS for each party plus an electronic communication channel, computerized group process structuring techniques, and support for analytical processing. Many pioneers in NSS research continue to express the need for more rigorous empirical research in the area of NSS to determine exactly how this new technology affects negotiator behavior and negotiation processes and outcomes (Carmel and Herniter 1989; Carmel, Herniter, and Nunamaker 1993; Jelassi and Foroughi 1989; Jones 1988; Kersten et al. 1991; Lim and Benbasat 1992; Sheffield 1992).

This article describes an experimental investigation which attempted to answer the call for more rigorous empirical research in the area of NSS. The purpose of the study was to provide evidence about the capability of a computerized NSS to enhance the bargaining process and help negotiators overcome stumbling blocks to decision making in negotiation. The study featured the use of an interactive, session-oriented NSS. In a laboratory experiment, bargaining dyads played the roles of manufacturing buyers and sellers, negotiating a four-issue, three-year purchase agreement for an engine subcomponent under conditions of high and low conflict of interest. The specific variables measured included outcomes, contract balance, number of alternative contracts proposed, negotiation time, and post-bargaining attitudes.

The next section presents a survey of prior NSS empirical research, followed by a discussion of the NSS used in the present study. Then the hypotheses about the predicted effects

Table 1. Major stumbling blocks to successful negotiation and possible NSS solutions.

Major Stumbling Blocks	Possible NSS Solutions
I. Cognitive limitations The cognitive difficulty of evaluating the utility of alternative settlements and determining trade-offs (Lewicki and Litterer 1985).	Analytical processing of subjective preference and/or external objective data and identification of high joint benefit solutions or strategies (UNISYS 1987; Jelassi and Foroughi 1989).
II. Cognitive biases	
A. *Consideration of issues in isolation* The failure to integrate single issues into a single package so that potential trade-offs can be recognized (Kelley 1966; Erickson et al. 1974).	Display of entire contract for discussion to enable "log-rolling" among issues (Jelassi and Jones 1988).
B. *Negative framing of the negotiation* Evaluation of potential losses instead of potential gains, which can lead to risk-seeking behavior (Tversky and Kahnemen 1981; Bazerman and Neale 1983).	Establishment of interaction rules and use of pre-negotiation modules requiring parties to identify their interests (Anson and Jelassi 1990).
C. *Fixed-pie mentality* The assumption that their interests are in direct conflict with the other party, and that one side will win at the expense of the other (Pruitt 1983).	Public display of conflicting views, pairing of related items (Anson and Jelassi 1990), analytical methods to identify alternative solutions.
D. *Premature closure or finalizing of positions* Tendency to prematurely finalize positions before considering all possible solution alternatives (Kelley 1966).	Presentation of a negotiation text (Fisher 1978) of equivalent value to both sides as a starting point (Jelassi and Jones 1988), rules requiring consideration of all issues (Jelassi and Jones 1988).
E. *Preference for available, salent information or solutions* Tendency to recall and value most that information which is most salient or familiar (Tversky and Kahneman 1981).	Rules requiring consideration of all issues (Jelassi and Jones 1988; NSS suggestions of possible concessions, solutions, and trade-offs (Jelassi and Foroughi 1989).
III. Socio-emotional aspects of negotiator behavior	
A. *Face-saving behavior* Avoidance of agreements in which they feel they are giving in (Hiltrop and Rubin 1981).	Suggestion of possible concessions to help achieve optimal joint outcomes and permit negotiators to compromise while still saving face (Anson and Jelassi 1990).
B. *Ineffective communication* Distraction due to physical appearance of opposing parties, semantic differences, and status and power differences (Lewicki and Litterer 1985).	Participation rules, display of organized feedback (DeSanctis and Gallupe 1987), written wording to focus group attention, encourage preciseness, and document the agreement (Jarke and Jelassi 1986).
C. *Negotiator overconfidence* Overrating of their own judgments (Einhorn and Hogarth 1978), belief that neutral parties will judge in their favor (Farber 1981).	Sense of rationality brought by analytical processing of subjective preference and/or external objective data and the determination of possible solutions (DeSanctis and Gallupe 1987).
D. *Nonrational escalation of conflict* Tendency to escalate the level of conflict irrationally (Lewicki and Litterer 1985), "locking in" on hostile opening moves (Pilisuk and Skolnick 1978).	Focus of attention away from personalities and on issues resulting from use of electronic communication (DeSanctis and Gallupe 1987), participation rules (Anson and Jelassi 1990).

of the NSS support are presented, and the research methodology and experimental procedures are described. The next section describes the statistical procedures, presents the results, and includes a discussion and interpretation of the results for each dependent variable. This is followed by a discussion of the limitations of the study; the article concludes with a discussion of the implications of the results of the study and future research directions.

2. Prior NSS empirical research

The existing empirical research on the efficacy of NSS consists of several case studies of real-life implementations of NSS and a limited number of laboratory studies.

2.1. Case studies

The available NSS case studies largely consist of descriptions of computer models which have been successfully used in the support of negotiations such as legal disputes, labor/management disputes, U.S. Government agency negotiations, and national and international environmental disputes (Nyhart and Goeltner 1987). The case studies have presented generally positive results, both in negotiation outcomes and post-negotiator attitudes. Often, however, these implementations of NSS have not been critically analyzed by the writers, and have not been described in sufficient detail to allow other researchers to benefit from them. One-time-only systems have been implemented, using different tasks and group structures, so that no real comparison across implementations is possible.

Furthermore, none of the systems reported on in the above case studies were full-featured NSS, as described earlier. Despite the growing interest in these full-featured NSS, the majority of existing NSS are computer models which fall into the category of "backroom processors." According to Nunamaker, most NSS are "single workstations with limited capability to support electronic information exchange and parallel processing. Most have concentrated on providing a DSS to support the mediator or one side, rather than providing a FTF (face-to-face) GDSS" (Nunamaker 1989, p. 117).

A notable exception to the above generalization is a pair of NSS case studies conducted at the University of Arizona, in which real-life, labor-management contract negotiations were conducted in an electronic meeting room setting (Carmel, Herniter, and Nunamaker 1993). Electronic meeting tools were used to provide administrative support such as documentation and editing, as well as support for a three-step integrative bargaining approach featuring electronic brainstorming and role reversal. The participants noted that the documentation and editing software resulted in a reduction in language ambiguities, less misunderstanding and mistrust, fewer notetaking and typing chores, tracking of progress and status, increased accuracy, enforced momentum, and time savings. The EMS setting was also considered effective in providing support for integrative bargaining tasks such as exploring underlying issues, developing issues and ranking them in order of importance, developing objective criteria through electronic brainstorming, and discussing solutions.

2.2. *Laboratory studies of NSS*

Three NSS lab studies have used computer support in the form of a DSS. First, Balke, Hammond, and Meyer (1973) conducted a laboratory study in which labor and management at a chemical firm reenacted their final week of negotiation in order to determine whether cognitive feedback might have shortened the dispute. An interactive computer program was used to perform judgment analysis so as to provide pairs of negotiators with feedback data about the differential weights that participants attached to each issue and the function-forms (i.e., linear, curvilinear) that each participant used in relating his judgment to each issue. Balke, Hammond, and Meyer found that the interactive graphics displays helped the negotiators gain greater agreement on 25 alternative contracts, and improved their understanding of their own judgments as well as those of the other party.

Second, the NSS used in Jones's (1988) study provided modeling support at one step in the negotiation process (computing and presenting an optimal solution). NSS support consisted of a DSS which made contract suggestions to both parties after 12 minutes of face-to-face bargaining. Jones's study was significant in that it was the first NSS study to consider one of the most crucial variables in a negotiation—namely, the amount of conflict of interest over the issues which exists between bargainers. Her study examined NSS effectiveness in situations of both low and high conflict of interest. Her results showed that computer suggestions led to higher joint outcomes in low conflict, but required greater time. High-conflict dyads felt a more collaborative climate with computer support, but low conflict dyads did not. Low-conflict dyads were more satisfied than high-conflict dyads. Jones's multi-issue manufacturing negotiation task served as the basis for the present study.

Third, Sainfort, Gustafson, and Bosworth (1987) studied the effects of an interactive DSS which provided support at each step of a structured bargaining process, in which solutions were sought to real-life interpersonal problems rated by the negotiators as being of "high importance" or of "low importance." The performance of DSS-supported dyads was compared to that of dyads who viewed a video presentation of a multistep conflict resolution process before bargaining on their own. The DSS proved to be better for all outcome measures for high-importance dyads than for low-importance dyads. Videotape dyads produced higher quality solutions and improved problem understanding. The DSS was perceived as more useful, and it decreased frustration level and enhanced solution generation, especially in high-importance dyads. Almost all DSS dyads reached consensus, as compared to only one-half of the videotape dyads.

A study by Sheffield (1992) has been the only previous NSS lab study to examine the effects of electronic media on negotiations. Sheffield studied the impact of four different communication media—computer conferencing (text only), decision room (text + visual), telephone (audio only), and face-to-face (audio + visual) on the form, content, and outcome of bilateral monopoly negotiations. Also examined was the impact of the manipulation of bargaining orientation, by instructing subjects either to maximize their individual outcome (individualistic orientation) or maximize joint outcomes (cooperative orientation). The results showed that cooperative bargaining orientation and/or audio-mode communication increased joint outcomes. Furthermore, the visual richness of the decision room setting made it better than computer conferencing for cooperative bargainers. On the other hand, the absence of visual communication inherent in computer conferencing was better for

Table 2. Types of NSS suport provided in NSS laboratory studies.

Study	Decision Support Systems (DSS)	Electronic Communication	Structured Process	Group Dynamics Techniques	Facilitator	Documentation
Balke, Hammond, and Meyer (1973)	X					
Sainfort, Gustafson, and Bosworth (1987)	X		X		X	
Jones (1988)	X					
Sheffield (1992)		X				X
Present study	X	X	X	X	X	X

individualistic bargaining tasks, because it prevented bargainers from being distracted from the structure of the bargaining task by visual cues which may be misinterpreted as conveying competitive or hostile intent.

Recent years have witnessed more rigorous research activity in the area of NSS, which is being fostered and encouraged by journals such as *Group Decision and Negotiation*. In addition, GSS research has been investigating the role which GSS can play in conflict management during group decision making involved in the completion of cognitive-conflict tasks (Nunamaker et al. 1991b; Poole, Holmes, and DeSanctis 1991; Sambamurthy and Poole 1992).

To summarize, previous NSS lab studies have incorporated only a limited range of NSS features. A wider range of these features might include the provision of computer support at each step in the negotiation process, electronic communication between bargainers, computerized group process structuring techniques, and support for analytical processing. Table 2 summarizes the types of support provided in previous NSS lab studies as well as in the present study.

3. The present NSS

The NSS developed for use in this study represents an attempt to incorporate a wider range of NSS features. The extent of computer support in this study was expanded to provide:

Negotiation process structure: This NSS was designed to support an entire process of integrative bargaining, in which negotiators work together through a problem-solving process to find a mutually beneficial agreement (Kessler 1978). Computer support was provided at each of five stages in the integrative bargaining process: (1) statement of interests, (2) role reversal, (3) searching for common ground, (4) generation and analysis of alternative solutions, and (5) reaching agreement.

Addition of communication channels: In addition to face-to-face discussion, this NSS permitted interactive input by the negotiators, with public display of the input.

Group process stucturing techiques: The facilitator used the Problem Centered Leadership Approach suggested by Miner (1979), which emphasizes a neutral, nonjudgmental role and equal participation of all participants. A computerized form of role reversal was used in which negotiators inputted their perceptions of each other's viewpoints and interests.

Support of alternative generation and analysis: This NSS included a DSS, called the Negotiation Decision Support Tool (NDST), which was used by each party individually to generate alternatives and to evaluate them in terms of the number of points to be gained for his side as well as by the opposing side.

Documentation of agreements: The input, display, and refining of negotiating issues and solution alternatives served to document the negotiation process and the agreement. Computer records and printouts provided a permanent record of all electronic communication during the negotiation.

This research examined the effects of using an NSS in both high- and low-conflict situations, as was done in Jones's (1988) study. In the present study, the NSS incorporated all the features described above. The decision was made to use Jones's (1988) task so that a comparison could be made between the effects of the computer modeling support used in her study and the NSS used in the present study, thus contributing to the start of a cumulative tradition of research in the NSS area.

4. Research methodology

4.1. Theory and hypotheses

There is no well-developed theory relating to negotiation and negotiation support systems. As a substitute, we chose to concentrate on the major stumbling blocks to successful negotiation and possible NSS solutions to these stumbling blocks, as presented in Table 1. Many of the NSS solutions are based on ideas from Walton and McKersie's (1965) behavioral theory of bargaining. They distinguish between distributive bargaining, in which the goals of one negotiating party are in direct conflict with the goals of the other party, and integrative bargaining, in which the goals are not in direct conflict. The NSS solutions are designed to foster as much integrative bargaining as possible in a given situation.

Table 3 summarizes the predicted effects of the NSS support in this study on the problems of cognitive limitations, cognitive biases, and socioeconomic aspects of negotiator behavior. According to Walton and McKersie (1965), the most important conditions leading to the achievement of integrative bargaining agreements are: (1) simultaneous consideration of issues so that mutual trade-offs can be made; (2) a problem-solving orientation; (3) free exchange of information about preferences and needs, and trust in the accuracy of these exchanges; (4) avoidance of distributive behavior; and (5) the maintenance of high aspiration

Table 3. Predicted effects of the NSS on negotiation stumbling blocks.

Problem	Solution	Measure
Cognitive difficulty	DSS support for alternative generation and evaluation (Anson and Jelassi 1990; Jelassi and Jones 1988; Lim and Benbasat 1992).	joint outcome contract balance
Consideration of issues in isolation	DSS will encourage simultaneous issue consideration, which helps to achieve higher joint outcomes (Erickson et al. 1974).	joint outcome
Negative frame	DSS support will give bargainers more confidence of getting a fair, satisfactory outcome (Anson and Jelassi 1990; Foroughi and Jelassi 1989).	perceived collaborative and negative climate
Fixed-pie mentality	Structured integrative bargaining process will encourage bargainers to seek a mutually beneficial solution.	perceived collaborative climate
Premature closure	DSS support ensures that bargainers find a good, integrative solution before closure (Anson and Jelassi 1990).	joint outcome
Preference for salient information	DSS simplifies alternative evaluation, thus ensuring considering of multiple alternatives (Anson and Jelassi 1990).	joint outcome
Face-saving behavior	NSS support helps bargainers find an agreement which is good for both of them and will not make them lose face (Anson and Jelassi 1990; Foroughi and Jelassi 1989).	satisfaction
Ineffective communication	Electornic communication provides an extra channel of communication, encourages bargainers to clarify thoughts before inputting (Jarke and Jelassi 1986), reduces personality conflicts (DeSanctis and Gallup 1987; Lim and Benbasat 1992; Sheffield 1992).	joint outcome
Negotiator overconfidence	DSS support for alternative evaluation will bring a sense of rationality which encourages objective, realistic decision-making (DeSanctis and Gallupe 1987).	perceived collaborative and negative climate
Nonrational escalation of conflict	Electronic communication will depersonalize the atmosphere, so the bargainers can focus on issues instead of personalities (DeSanctis and Gallupe 1987; Lim and Banbasat 1992; Sheffield 1992), and will deescalate conflict by increasing confidence in achieving a good agreement (Anson and Jelassi 1990; Foroughi and Jelassi 1989).	perceived collaborative and negative climate

levels by the bargainers. Table 4 explicitly outlines the manner in which the NSS support was expected to facilitate these conditions.

A rudimentary theory of negotiation support systems was developed by Lim and Benbasat (1992) after the present study had been conducted. Their theoretical model considers the computer support to be made up of two components, electronic communication and a DSS, which is entirely consistent with the present study. They suggest that the impact of electronic communication will be that each party will perceive the commitment of the opponent to be greater, and that this greater perceived commitment will result in *greater satisfaction*

Table 4. Expected facilitation of the integrative bargaining process.

Simultaneous consideration of issues:
The DSS is designed to require simultaneous consideration of issues in the form of contract packages.
Problem-solving orientation and avoidance of distributive behavior:
NSS support will give bargainers a tool to help them solve their mutual problem of reaching a good agreement. DSS support for alternative generation and evaluation, both in terms of their own possible points and the other party's, will encourage them to view the bargaining task as a joint venture. NSS support will give bargainers confidence that they can reach an agreement which is good for both of them (Anson and Jelassi 1990; Foroughi and Jelassi 1989).
Free exchange of information:
Electronic communication will provide an extra channel of communication and will encourage bargainers to clarify their thoughts before inputting (Jarke and Jelassi 1986). Electronic communication reduces the impact of personality conflicts (DeSanctis and Gallupe 1987; Lim and Benbasat 1992; Poole, Holmes, and DeSanctis 1991; Sheffield 1992). Electronic communication encourages users to express themselves uninhibitedly (DeSanctis and Gallupe 1987; Lim and Benbasat 1992; Sheffield 1992).
Maintenance of high aspiration levels:
The presence of the NSS should give bargainers more confidence in their ability to reach an agreement with high joint outcomes, thus helping them to maintain high aspiration levels.

with the process and a *reduced time to settlement*. Further, they suggest that the DSS will provide increased information-processing capacity and capability, and that this increased capability will result in *joint solutions that are closer to the efficient frontier* (the locus of achievable joint outcomes from which no joint gains are possible), and *closer to the Nash (or fair) solution* (see Bartos 1978), as well as *solutions in which the parties are more confident*. For the present study, we adopted measures similar to the first four proposed by Lim and Benbasat (we did not measure confidence in the solution), and thus we can provide a partial test of their theory.

Joint outcomes

H1.1: In the low-conflict treatments, bargainers with NSS support will achieve a higher joint outcome than bargainers without computer support.

H1.2: In the high-conflict treatments, bargainers with NSS support will achieve a higher joint outcome than bargainers without computer support.

In both the low- and high-conflict treatments, joint outcomes are expected to increase when the NSS is used, because cognitive difficulty is reduced, all the issues are considered simultaneously, communication between the parties becomes more effective, and premature closure is avoided since alternative generation and evaluation are much easier (see Table 3 for more details and references). The comparison of joint outcomes from NSS and non-NSS conditions should accomplish essentially the same purpose as the comparison of joint outcomes relative to the efficient frontier proposed by Lim and Benbasat (1992).

Contract balance

H2.1: In the low-conflict treatments, contract balance will be lower for NSS dyads than for non-NSS dyads.
H2.2: In the high-conflict treatments, contract balance will be lower for NSS dyads than for non-NSS dyads.

In both the low- and high-conflict treatments, contract balance (the difference between the outcomes of the pair of bargainers) is expected to become smaller when the NSS is used, because each party will be aware of the approximate number of points earned by the opponent for a particular solution. This awareness will help each bargainer find a contract alternative which he feels is fair both for himself and for his partner and which he can accept without losing face. Contract balance as used in this study should serve essentially the same purpose (e.g., a measure of fairness) as closeness to the Nash solution proposed by Lim and Benbasat (1992).

Negotiation time

H3.1: In the low-conflict treatments, the time it takes bargainers with NSS support to reach an agreement will be longer than for dyads without NSS support.
H3.2: In the high-conflict treatments, the time it takes bargainers with NSS support to reach an agreement will be longer than for dyads without NSS support.

Negotiation time is expected to increase with the use of the NSS in both low- and high-conflict treatments. The NSS introduces an additional layer of complexity into the negotiation process, including another channel of communication, a DSS for each participant, and the necessity of using the computer keyboard. It is expected that the mechanics of using the technology (the NSS) will lengthen negotiation time for both treatments. This measure is the same as that proposed by Lim and Benbasat (1992), although the hypothesized direction of the NSS impact is the opposite.

Number of contracts proposed

H4.1: In the low-conflict treatments, NSS-supported dyads will propose fewer contracts than those without computer support.
H4.2: In the high-conflict treatments, NSS-supported dyads will propose fewer contracts than those without computer support.

In both the low- and high-conflict treatments, the NSS-supported bargaining pairs are expected to propose fewer contracts (before an agreement is reached) than those without the NSS. The DSS should assist the bargainers in quickly identifying ccontracts which are attractive to both parties without having to generate as many alternatives as they would without the NSS support. Lim and Benbasat (1992) did not suggest the use of this measure.

Perceived collaborative climate, perceived negative comment, and satisfaction

H5.1: In the low-conflict treatments, there will be no difference in perceived collaborative climate between NSS and non-NSS dyads.

H5.2: In the high-conflict treatments, perceived collaborative climate will be greater for NSS dyads than for non-NSS dyads.

H6.1: In the low-conflict treatments, there will be no difference in perceived negative climate between NSS and non-NSS dyads.

H6.2: In the high-conflict treatments, perceived negative climate will be less in NSS dyads than in non-NSS dyads.

H7.1: In the low-conflict treatments, NSS dyads will be more satisfied than non-NSS dyads.

H7.2: In the high-conflict treatments, NSS dyads will be more satisfied than non-NSS dyads.

Lim and Benbasat (1992) proposed measuring satisfaction with the negotiation process, and we have employed three measures which relate to this dimension. All measures were derived from a questionnaire used to measure post-bargaining negotiator attitudes (more on this later). In the low-conflict treatments, bargainers' preferences for the issues are not the same, and there is room for trade-offs. There will be a minimum of nonrational escalation of conflict and negative framing for both NSS and non-NSS dyads. Thus, the computer support is not expected to have an effect on perceived collaborative climate or perceived negative climate in the low-conflict treatments.

In the high-conflict treatments, it is anticipated that perceived collaborative climate will be greater for NSS dyads than for non-NSS dyads, and that perceived negative climate will be less for NSS dyads. The electronic communication aspect of the NSS will help focus the attention of the negotiators on the content of the negotiation instead of on any personal conflict, thus creating a more collaborative climate and minimizing nonrational escalation of the conflict. The DSS will give negotiators confidence about reaching a good outcome, thus helping them to save face and maintain a positive frame about the negotiation.

The use of the NSS is expected to increase satisfaction in both the low- and high-conflict treatments. It seems reasonable that if negotiators achieve higher joint outcomes and better contract balance, as hypothesized above, they will also be more satisfied.

4.2. Research design

The research design included two independent variables (level of conflict and type of negotiation support), each with two treatments (high or low conflict, NSS or non-NSS support), thus necessitating a 2 × 2 random factorial design (CFF-22) with fixed-effects.

4.3. Independent variables

Bargaining research has revealed the importance of the amount of conflict of interest inherent in a negotiation situation as a determinant of negotiator behavior as well as of the outcomes which negotiators achieve (Rubin and Brown 1975). Level of conflict of interest was chosen as an independent variable for this study in order to examine the effectiveness of an NSS in two different bargaining situations (low and high conflict of interest).

The bargaining task chosen for this research involved negotiation between a buyer and seller over four issues of a three-year purchase agreement for an engine subcomponent (Jones 1988). The issues were unit price, purchase quantity, time of first delivery, and warranty period. Low-conflict treatments were simulated by assigning different weights for the issues, creating a bargaining situation in which mutually beneficial trade-offs were possible. High-conflict treatments featured issues for both parties being weighted similarly, creating a zero-sum situation in which one party's gain was equal to the other one's losses. For both low and high conflict levels, point sheets were constructed for buyer and seller using these weights (see the sample case materials in Appendix). The case material included an "alternative contract," representing a contract offer by another company, which provides the subjects with a minimum point level to achieve in the negotiation.

Several criteria have been suggested for judging the appropriateness of experimental tasks for GSS research (Gallupe 1986). The negotiation task used in this study shows face validity, in that subjects are provided with background materials describing a realistic bargaining situation between two hypothetical manufacturers, and private information about their particular company. Subjects role-play the parts of representatives of these organizations. Jones (1988) found that student subjects became engrossed in their roles in the negotiation and took them seriously. The content validity of this task has been substantiated by its use in Jones's (1988) research and in the pilot testing for this present study. This experience with the task has shown that it is clearly described, logical, consistently understood by subjects, and usually performed correctly. Third, the task shows external validity, because it deals with negotiation over a multi-issue contract agreement between manufacturers, a realistic, frequent scenario in the business world. This particular task was suggested to Jones by a purchasing agent at a manufacturing company who routinely dealt with similar contracts. Appropriateness for support by GSS technology is shown by the multi-issue nature of the contract agreement in this negotiation task, in which subjects must consider possible combinations of values for the issues. Computer support is very appropriate and helpful in providing a structured negotiation process to facilitate the integrative bargaining process. The nature of the task also makes DSS support appropriate for helping negotiators overcome the cognitive difficulties involved in the task.

The experimentation took place in the Collaborative Work Support Laboratory at Indiana University. In the NSS treatments, negotiators and the facilitator each had personal computers networked together via a local area network and connected to a public display screen, printer, and file server (see Figure 1). The negotiators also had stand-alone personal computers to run the DSS software. Participants were seated across from each other and had a clear view of each other and of the public display.

Two kinds of software tools were used. First, Topic Commenter, a module of the GroupSystems software created at the University of Arizona (Nunamaker et al. 1991a), served as a means of electronic communication between the bargainers to be used for inputting their comments and proposals, displaying them on a public screen, and allowing viewing of each other's inputs on their private screens.

The second type of software was the Negotiation Decision Support Tool, the DSS developed for this study to support alternative generation and evaluation. Each negotiator had his own NDST, which consisted of a spreadsheet with two windows, running on a stand-alone microcomputer which was placed beside the networked electronic communication

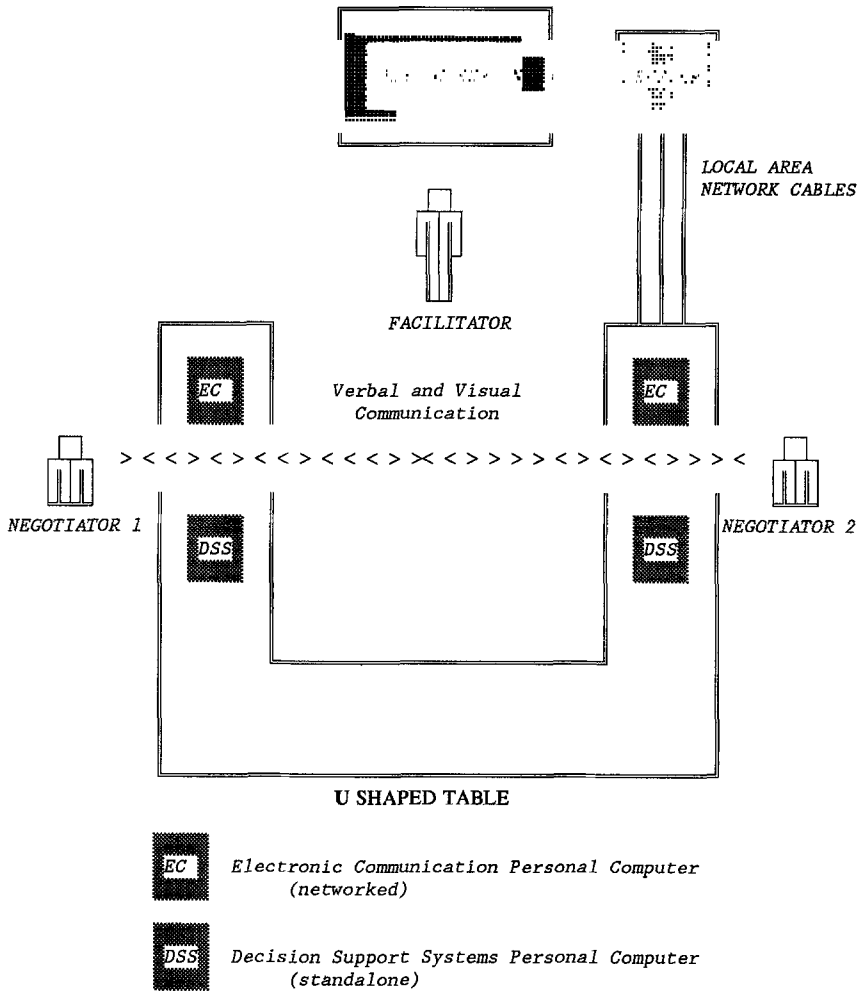

Figure 1. Negotiation room setting decision room.

device. Window #1, the Decision Tool, was used by negotiators to input their own priorities for the issues as well as their perception of the other party's priorities, based on what each participant learned about the other party during the statement of interests stage. At this stage of the negotiation process, they provided each other with strong clues about their respective rankings of the four issues, enabling each negotiator to estimate his opponent's ranking of the issues from 1 to 4. Based on the priorities input by the subjects, the Decision Tool estimated the point structure of the other party, generated all the possible contract alternatives (748 altogether), and ranked them in descending order according to the joint outcome which they would give. The Decision Tool then displayed—for the user only—the three contract alternatives which gave the highest joint outcome. The accuracy of these estimates of points depended, of course, on how carefully each bargainer had read the nego-

tiation case materials for his company, how clearly he communicated the ranking of issues to the other bargainers, and how accurately he assessed the ranking of issues by the other bargainer. The Decision Tool was designed to display only three contract alternatives, in order to avoid the possibility of information overload which might result from displaying too many contract options. Window #2 contained a Contract Point Evaluator, which was used for alternative evaluation. It incorporated the complete point structure of the negotiator. The negotiator could plug in alternative contracts, and the algorithm determined the total score (for his side only) that could be achieved with each one.

The non-NSS treatments featured the use of the same negotiation procedure as in the NSS treatments, without the computerized support. That is, the bargaining pair went through the same steps in the negotiation procedure, with the facilitator playing the same role (following a detailed script), in both NSS and non-NSS treatments. To the extent possible, the only difference was the use or nonuse of the NSS. The non-NSS dyads met in a non-computer lab, where negotiators were seated across from each other at the same distance as in the NSS treatments. The negotiators and the facilitatory communicated verbally, and the negotiators wrote their suggested contract proposals on a blackboard.

4.4. Dependent variables

Joint outcome was measured by adding buyer and seller points on the final agreement. *Contract balance* was the absolute value of the difference between the outcomes of the two bargainers in each negotiating pair. *Negotiation time* was measured as the time needed to reach an agreement or deadlock, with no time limit placed on negotiators for reaching an agreement (no deadlocks were reached). The *number of contracts proposed* was recorded on the computer for NSS treatments, and was determined from the facilitator's records for non-NSS treatments.

Post-bargaining negotiator attitudes (perceived collaborative climate, perceived negative climate, and satisfaction) were measured by a questionnaire (Jones 1988) administered at the end of the bargaining session. The subjects responded to each item in the questionnaire by circling a number from 1 to 7 on a seven-point Likert scale. Factor analysis was performed on the questionnaire data to condense the factors measured by these items into a smaller set of factors, and a Cronbach's alpha test of reliability yielded reliability coefficients of greater than 0.70 for each factor, indicating that the factors could be considered reliable.

Davis's Technology Acceptance Model questionnaire (Davis 1985) was administered to NSS groups to measure overall evaluation, perceived ease of use, and perceived usefulness of both Topic Commenter and the NDST.

4.5. Control variables

Group structure was controlled, with each negotiating side consisting of one person, and with each person in the dyad having zero history in negotiating with the other. Individual differences were also controlled, with subjects randomly assigned to the role of buyer or seller and to dyads, and with dyads randomly assigned to experimental treatments. The same task type was performed by all treatment dyads, the only difference being the assignment of weights to the issues. The physical environment was essentially the same for all treatment dyads, except for the use of computer support for NSS dyads.

4.6. Experimental procedures

128 upper-level undergraduate business student volunteers participated in this study, making 64 dyads with 16 dyads per experimental cell. To provide incentive to subjects, course credit was offered to all participants. Subjects were told that each pair of bargainers should attempt to maximize their joint score, and that a monetary reward would be given ($100) to the top pair of bargainers (in terms of joint outcome) in each experimental cell.

The experiment was conducted in three phases. During Phase 1, subjects filled out a consent form, and a ten-minute training session for Topic Commenter was provided for NSS dyads. Subjects were then given a typed outline of the procedures for the entire experiment and a listing of the rules to be observed. Next, subjects were assigned randomly to the role of buyer or seller and to experimental treatments, and were given case descriptions and a page of confidential information about their company (see Appendix). After the above materials had been read by the subjects, they were given point sheets for their respective companies. Next, subjects completed a Point Sheet Exercise, in which they were asked to add up the points for each issue of the alternative ("third party") contract and verify that the score given at the bottom of the point sheet was correct. This was done to make sure that the subjects understood how the total scores were computed. At this time, ten minutes of software training on the NDST were given to NSS dyads. Subjects then filled out a pre-negotiation questionnaire to ensure that they understood the task.

During Phase 2, subjects were given a final instructions sheet with an outline of the negotiation process. They then proceeded to negotiate, and when an agreement was reached, they signed a final agreement form.

During Phase 3, all subjects answered a post-bargaining attitude questionnaire, and NSS dyads also completed Davis's (1985) Technology Acceptance Model questionnaire. Throughout all three phases of the experiment, the facilitator directed the activities of the bargaining dyad, following a detailed script.

5. Statistical analysis and experimental results

5.1. Statistical analysis

The SPSS statistical package was used to perform statistical analysis of the experimental results, using a fixed-effects, two-way analysis of variance (2-way ANOVA) model for *joint outcome*, *contract balance*, *negotiation time*, *number of alternatives*, and *post-bargaining negotiator attitudes*. A *t*-test was used to analyze the results of Davis's Technology Acceptance Model questionnaire.

5.2. Statistical results

Table 5 summarizes the hypotheses and the results. NSS support improved joint outcome, contract balance, and satisfaction in both low- and high-conflict treatments. Negotiation time was longer for NSS dyads at both conflict levels. Subjects in the NSS treatment in low conflict perceived less negative climate than did those in the non-NSS treatment.

5.3. Results of administration of the technology acceptance model

In general, the means for both low- and high-conflict treatments were above the midpoint (4.0) on the Likert scale, indicating a favorable evaluation of both the Negotiation Decision Support Tool and Topic Commenter, with no significant differences between the technology evaluations of low- and high-conflict dyads (see Table 6).

Table 5. Hypotheses and results (sample size: 4 cells, 16 dyads per cell, total of 64 dyads, total of 128 subjects).

Hypotheses	Mean Non-NSS	Mean NSS	Level of Significance (p)	Hypotheses Supported
Joint outcome				
H1.1: low non-NSS < low NSS	118.68	131.75	$p < 0.001$	YES
H1.2: high non-NSS < high NSS	100.56	101.56	$p < 0.05$	YES
Contract balance				
H2.1: low non-NSS < low NSS	11.56	6.50	$p < 0.05$	YES
H2.2: high non-NSS < high NSS	6.44	3.30	$p < 0.05$	YES
Negotiation time				
H3.1: low non-NSS < low NSS	27.56	46.88	$p < 0.001$	YES
H3.2: high non-NSS < high NSS	32.38	52.75	$p < 0.001$	YES
Number of contracts proposed				
H4.1: low non-NSS > low NSS	5.75	5.69	N.S.	NO
H4.2: high non-NSS > high NSS	6.50	5.75	N.S.	NO
Perceived collaborative climate				
H5.1: low non-NSS = low NSS	5.67	5.98	N.S.	YES
H5.2: high non-NSS < high NSS	5.62	5.59	N.S.	NO
Perceived negative climate				
H6.1: low non-NSS = low NSS	2.71	2.17	$p < 0.05$	NO
H6.2: high non-NSS > high NSS	3.14	3.20	N.S.	NO
Satisfaction				
H7.1: low non-NSS < low NSS	5.30	5.63	$p = 0.05$	YES
H7.2: high non-NSS < high NSS	4.63	5.25	$p < 0.01$	YES

Note: low = low conflict, high = high conflict.

Table 6. Results of technology acceptance model.

Software Module	Conflict Level: Low Conflict	Conflict Level: High Conflict
Negotiation Decision Support Tool		
Overall evaluation	6.91	6.25
Ease of use	6.14	5.18
Usefulness	5.89	5.19
Topic Commenter		
Overall evaluation	4.92	5.05
Ease of use	6.97	5.87
Usefulness	4.55	4.41

6. Discussion of results

6.1. Joint outcome

There are several explanations for the higher joint outcomes achieved by NSS dyads in both low and high conflict. First, the simultaneous consideration of the issues, which was facilitated and enhanced by the Negotiation Decision Support Tool, enabled subjects to consider contract packages instead of one issue at a time. This substantiated the results found earlier by Erickson et al. (1974).

Second, bargaining research conducted by Fouraker and Siegel (1963) had shown that increased knowledge about their opponent's utility or point structure enables bargainers to improve their joint outcomes and approach or achieve Pareto-optimal solutions. In this study, the NDST assisted negotiators in estimating the number of points which their opponents would gain from different contract packages, thus increasing the amount of information which they had about the utility of contracts for their opponent and improving joint outcomes.

A third explanation for the high joint outcomes achieved by HSS dyads in this study comes from Jarke and Jelassi (1986), who predicted that NSS would alleviate problems of ineffective communication. The keying in of interests, comments, and contract alternatives would encourage participants to use more precise, unambiguous words and to consider their actions more carefully.

Fourth, Walton and McKersie's (1965) behavioral theory of bargaining stipulates that information exchange is essential for the achievement of integrative agreements. This was substantiated in integrative bargaining research conducted by Pruitt (1981) and his colleagues. In the present study, information exchange was enhanced by the addition of an extra line of communication (Topic Commenter), as well as by the enhancement of alternative evaluation provided by the NDST.

Fifth, cognitive difficulties encountered by negotiators are one of the major stumbling blocks to the achievement of integrative agreements. In this study, the NDST supported negotiators in the generation of alternatives with high utility for themselves and for their opponents, and also in the evaluation of contract packages proposed by their opponents. As predicted by NSS researchers (Anson and Jelassi 1990; Jelassi and Jones 1988), this computer support helped the subjects overcome the cognitive difficulty of these tasks, the tendency toward premature closure, and the preference for more available and more salient solutions, thus helping them achieve better joint outcomes than non-NSS dyads.

Another possible explanation for the high joint outcomes achieved by NSS dyads comes from both negotiation research and GSS research, which found that electronic communication provides a sort of "formality" which depersonalizes the negotiation and allows negotiators to concentrate on the content of the negotiation rather than on each other's personalities (Dennis et al. 1988; DeSanctis and Gallupe 1987; Lim and Benbasat 1992; Sheffield 1992).

Jones (1988) found that in high-conflict treatments, bargainers tended to ignore the computer suggestions in favor of their own solutions, even though they were often not as good as the ones suggested by the computer. Hiltrop and Rubin (1982) wrote than when negotiators are able to reach consensus, they prefer to do it on their own rather than by relying on external assistance, such as the computer suggestions presented to bargainers in Jones's research. The computer support in the present study was integrated into the negotiation

process rather than being an outside intervention. Instead of being presented with an optimal solution, as was done in Jones's study, the subjects in this study interacted with the NDST, inputting information and using the NDST to find a good solution. Their interaction with the NDST gave them a sense of "ownership" of the solution, which was absent in the computer support in Jones's study.

6.2. Contract balance

The statistical analysis confirmed that contract balance is improved for NSS dyads in both low- and high-conflict treatments. Jones (1988) had hypothesized that computer support would yield better contract balance, at least in low-conflict conditions, but this prediction was not confirmed by her results. She attributed this result to the fact that a bargainer often accepted a settlement in which the partner had many more points than he/she did, since he/she did not know what his/her bargaining partner's points were. If he/she had known how many fewer points he/she would earn than his/her opponent, he/she would have viewed this as a loss and would have continued trying to find an agreement which was closer in points for both sides.

In the present study, NSS dyads were assisted in estimating the number of points which their opponents would earn from different contract alternatives. Each negotiator entered his/her perception of his/her partner's preferences as well as his/her own preferences into the NDST, which calculated the approximate number of points both h/she and his/her partner would earn from different contract alternatives. This awareness of the approximate number of points to be earned by his/her partner helped each bargainer find a contract which he/she felt was fair for himself/hersel, which he/she could accept without losing face, and which was also fair for his/her opponent. With this kind of support, NSS dyads were able to achieve agreements with significantly better contract balance than those achieved by non-NSS dyads.

6.3. Negotiation time

As was hypothesized, negotiation time was greater for NSS dyads than for non-NSS dyads at both levels of conflict. The time involved in keying in input, waiting for the opponent's response to contract proposals, and using the NDST for alternative generation and evaluation increased negotiation time. The increased time using NSS is consistent with GSS research, which confirms that the use of the technology tends to extend decision time (Dennis et al. 1988; Gallupe 1985; George et al. 1990). Of course, the possiblity also exists that increased negotiation time with NSS was an artifact of unfamiliarity with the software used in the experiment.

6.4. Number of contracts proposed

The results of the statistical analysis did not confirm the hypotheses which predicted that NSS dyads would propose fewer contract alternatives than non-NSS dyads. The rejection of these hypotheses provides insight into the psychology of negotiator behavior, which has

important implications for NSS design. Despite the computer support provided for alternative generation and evaluation, negotiators still wanted to explore alternative contracts before deciding on one. The exchange of contract proposals between bargainers seems to be an important part of the bargaining process, which negotiators do not wish to give up, even when given computer support. In Jones's (1988) study, bargainers rejected computer suggestions even when they were better than the alternatives which they had arrived at on their own. As discussed above, this was because they felt a sense of "ownership" for their own alternatives which they did not feel for the computer suggestions.

The NSS support provided in the present study did not cause negotiators to propose fewer contracts. The implication of this result for NSS design is that computer support should be provided to enhance—but not replace—the important give and take of the bargaining process, which is so essential in giving bargainers a sense of ownership for the outcome of the negotiation.

6.5. Perceived collaborative climate

The nature of the task and the integrative bargaining process used in this study created a situation in which bargainers attempted to maximize their joint outcome rather than merely maximize their individual scores. Therefore, a generally cooperative atmosphere could be expected for all bargaining dyads. Nevertheless, measures of perceived collaborative climate and perceived negative climate shed light on how effective the NSS was in enhancing the integrative bargaining process in situations of both low and high conflict of interest.

Hypothesis H5.1, which predicted that, in low-conflict treatments, there would be no difference in the perceived collaborative climate for NSS dyads as opposed to non-NSS dyads, was confirmed by the results. In the low-conflict treatments, the bargainers' preferences for the issues were not pitted directly against each other, and they were able to find substantial room for trade-offs (Pruitt 1981; Walton and McKersie 1965). Because of this ability to make trade-offs, there appears to have been a minimum of nonrational escalation of conflict and negative framing, and computer support did not have an effect on the perceived collaborative climate. The combination of the relative ease of the low conflict task and its joint problem-solving nature worked together to provide a high level of collaborative climate for all dyads.

In the high-conflict treatments, however, the hypothesis that perceived collaborative climate would be greater for NSS dyads than for non-NSS dyads was rejected. As was the case for Hypothesis H5.1, these results may be explained by the nature of the task and the integrative bargaining process used in this study. Because subjects had been instructed to maximize their joint outcome and were guided by the facilitator through a joint problem-solving process, a generally positive climate existed at the outset. The NSS support did not significantly alter this favorable climate.

6.6. Perceived negative climate

In a manner similar to that discussed above for perceived collaborative climate, the joint problem-solving process involved in this negotiation task should have resulted in a low

level of negative climate. It was hypothesized that in the low-conflict treatments, there would be no difference in negative climate between NSS and non-NSS dyads, because there was ample room for trade-offs among the issues. However, this hypothesis was rejected. The presence of the computer support helped bargainers to realize the relative ease of their task and alleviated the tendency toward negative climate. Therefore, inflexibility and suspiciousness were at a minimum, and negotiators did not encounter a great deal of difficulty in reaching agreement.

The hypothesis that perceived negative climate would be significantly less in NSS dyads than in non-NSS dyads in high-conflict treatments was not confirmed. The high-conflict level presented a bargaining situation which was more difficult to handle and which created more potential for hostile feelings between the bargainers, despite the collaborative effort which was encouraged by the integrative process. The results indicate that perceived negative climate was higher for high-conflict bargainers than for low-conflict bargainers, for both NSS and non-NSS dyads. At the higher level of perceived negative climate, the NSS was not effective in reducing the perceived task difficulty or in reducing the perceived inflexibility and suspiciousness experienced by the bargainers.

6.7. Satisfaction

The results confirmed the hypotheses that satisfaction would be greater in NSS dyads in both low- and high-conflict treatments. The presence of computer support to help solve their negotiation task increased the satisfaction of NSS dyads with their outcomes, in addition to improving their performance. Increased satisfaction with the NSS may have resulted from the assistance given to the negotiators in finding an acceptable solution which would not make them lose face (Anson and Jelassi 1990; Foroughi and Jelassi 1989).

7. Limitations of this research

Laboratory experimentation was chosen as the research method for this study, because this was the first known implementation of an interactive, session-oriented NSS of this type, and the controlled, rigorous nature of laboratory experimentation was thought to be appropriate.

This research study made several assumptions, however, that may limit the generalizability of the results. First, student subjects were used in a laboratory setting, under the assumption that their bargaining behavior with and without computer support would provide insights into the usefulness of NSS in actual organizational settings. Although threats to the external validity of laboratory experimentation conducted with student subjects are obvious, such experimental settings have been used in the majority of studies in the area of GSS (Dennis et al. 1988), and student subjects have been found to be acceptable surrogates for organizational decision makers (Gallupe 1985). Further justification for the use of student subjects in negotiation research comes from a study conducted by Siegel and Harnett (1964), which found strong similarities between the bargaining behavior and outcomes of industrial sales personnel and college students. The potential for experimeter bias (Campbell and Stanley 1969), which can occur in laboratory experimentation, was reduced by the facili-

tator's use during all bargaining sessions of scripts which were identical for non-NSS and NSS dyads, except for the extra instructions given to NSS dyads concerning the use of the technology.

A second limitation of this study was the fact that only bargaining dyads were used. This was perhaps appropriate for a buyer-seller task setting, but it failed to incorporate dimensions, such as coalition formation, audience effects, and responsibility to constituents, which exist in negotiating between teams of bargainers. Third, level of conflict was simulated by setting up a zero-sum game, which was assumed to produce a high level of conflict, and a non-zero-sum game, which was assumed to involve a low level of conflict. It is questionable whether actual hostile conflict such as that in a labor-management or international-negotiation setting can be simulated in a laboratory setting with student subjects (Morley and Stephenson 1977). Furthermore, the joint problem-solving nature of the task used in this study makes the results of this study applicable only to situations where hostility is minimal and joint gains are sought.

A fourth limitation is the fact that only one type of negotiation task, a four-issue contract agreement for an engine subcomponent, was used in this study. The negotiation case used in this study assumed the willingness of the negotiators to share information with each other about their preferences for the issues, a situation which does not always occur in real-life negotiations. This limited the generalizability of the results. Fifth, this study only examined the effectiveness of a single type of NSS, and the results are not generalizable to other settings in which different software and negotiation processes are used.

Sixth, the use of both DSS and communication support in this study may have confounded the results, making it difficult to determine if the results obtained were due to the DSS support or the communication support alone, to both, or to the interaction of the two technologies. Finally, the simulated nature of this experimentation made it necessary for many important aspects of the task to be specified to the negotiators, thus increasing the controlled nature of the task setting, but also decreasing the realism achieved in this task. Two of the predetermined items built into the task materials in this study were the point structures (representing utilities) for each bargainer and the assumption of the existence of a "zone of agreement" (Raiffa 1982) consisting of contracts whose utilities are greater than the alternative agreement.

8. Implications and future research directions

The interactive nature of the system used in this study not only enabled negotiators to reach high joint outcomes and good contract balance, but also provided them with a sense of ownership of the solution, because they had arrived at it themselves. This interactive support, which enhanced rather than replaced the human interaction and give-and-take which are the essence of bargaining, proved to be more beneficial than mere computer presentation of solutions, as provided in Jones's (1988) study. NSS developers should keep in mind the importance of providing users with a system which not only enhances the decision-making process but also provides a sense of participation in reaching the solution.

The results of the study also tended to substantiate some key hypotheses posited in Lim and Benbasat's (1992) article: Satisfaction was greater with NSS, joint outcomes were

increased, and "fairer" solutions were achieved. Negotiation time, on the other hand, was shorter with NSS as Lim and Benbasat had predicted. Because the present study did not evaluate the effects of the DSS and the electronic communication separately, it is impossible to sort out the individual effects of the two technologies. Future studies comparing the separate effects of DSS support and electronic communication support are needed to provide a more accurate test of Lim and Benbasat's theory.

As discussed above, the generalizability of the results of this study is limited. This research project represents only a beginning in the vast amount of research which needs to be conducted before we have definite answers about the effectiveness of NSS in different negotiation situations. For instance, studies need to be conducted on the effects of NSS (1) on bargaining between negotiating teams, (2) in different mixed-motive task environments, and (3) in remote settings. Also interesting would be studies which compare and contrast various NSS features (e.g., communications software versus DSS).

Also needed are experiments using different NSS to solve the same problem with similar types of users, so that comparisons can be made between systems. The user interface for an NSS also needs to be studied, as well as the role that an NSS can play in the negotiation process. More complete knowledge of the role which different systems can play in negotiation settings, as well as an awareness of any assumptions built into various systems which might restrict their behavior, will enable decision makers to make more rational choices of negotiation support tools (Kersten 1987). An article by Herniter, Carmel, and Vogel (1990) sets a good precedent for research in another very important area, namely, NSS user-interface issues.

Most important, researchers need to study the use of NSS in actual negotiation situations. This will entail intensive analysis of the actual process of negotiation, using interaction coding systems such as those described by Poole, Holmes, and DeSanctis (1991). The use of such communication analysis mechanisms would greatly enhance the evaluation of the effects of NSS on the negotiation process and help determine the benefits of NSS.

Appendix

Note: The following materials were provided to the Roberts negotiator (the buyer) in the low-conflict treatments. Variations of these materials were provided to the Simo negotiator (the seller) in the low-conflict treatments, and to both parties in the high-conflict treatments.

GENERAL NEGOTIATION CASE INFORMATION

Tuborcharger Negotiation

Assumption: Date is now December 1989

Background information on buyer

Roberts Enterprise, Inc. is a major U.S. engine manufacturer. During the first two quarters of 1989, total sales (adjusted for seasonal fluctuations) increased slightly; however, as a

percent of market share, sales do not look good. Roberts's market share remained constant during the first quarter and has dropped slightly during the second, despite vigorous sales efforts.

In an effort to reverse this trend, the marketing research department has proposed introducing a lower priced engine which would sell for approximately $3,000. An important subcomponent for this engine is the turbocharger, which Roberts can purchase for *substantially* less than they can manufacture themselves. The negotiation in which you are about to participate concerns the specific terms of a *three-year* contract to purchase this subcomponent.

Roberts's marketing department is flowing with enthusiasm, sure that the market will respond to this new product. They are hopeful that turbocharger delivery can begin within five months in order to penetrate the spring 1990 boating market. This will be possible only if the parts begin arriving by the first of the year.

The engineering department estimates that $200.00/unit is a reasonable price to pay for the turbocharger. Marketing has advised the purchasing department that a contract which guarantees purchase of more than 5,000 units per year would be risky. In addition, it is very desirable to Roberts to obtain a full four-year warranty (parts and labor) on turbochargers, as they have just lengthened their engine warranty to four years. Although in previous contracts with suppliers, Roberts has often accepted shorter warranties, their new sales policy requires a four-year warranty agreement from suppliers.

Roberts deals regularly with three major suppliers. All offer quality parts and good service, and all have made good on all aspects of previous purchase agreements. Roberts is confident that it can expect the same good performance in the future from these companies.

Background information on supplier

Simo Parts Distributor has enjoyed a good working relationship with Roberts Enterprise for several years. The company began as a small engine parts supplier, with pistons and connecting rods accounting for the majority of their sales. Over the past several years, the small engine parts market has become extremely competitive due to the increase in foreign imports. Simo has responded by expanding its product line to include more expensive engine subcomponents such as crankshafts and turbochargers. They have found that they can be very competitive in this area, because they have the technical skill to build components to buyers' specifications and can use existing distribution channels.

Both marketing and production are in agreement that several less profitable small parts should be dropped from their production line in order to place more emphasis on the speciality subcomponent market. Simo is building a good reputation in this area and the company's future looks bright.

When a Roberts purchasing agent first mentioned the special turbocharger to Simo's sales representatives, the representatives called a meeting with major department heads to discuss what would be—in Simo's terms—a "fair agreement." During the meeting the vice-president of production explained that a significant investment in research and development would be required to finalize the deisgn of the turbocharger. Additionally, the company would incur setup costs and lost production costs on the small parts lines which would have to be converted for turbocharger processing. The production VP is confident, however, that the first shipment could be ready within eight months. The company is also very willing to offer a full one-year warranty on parts and labor.

In order to recoup costs, the production, marketing, and finance departments agree that the absolute minimum price which they would be willing to commit to over the next three years is $224.00/unit. Further, they could only agree to this low price if Roberts agreed to purchase a minimum of 8,000 units per year. Considering the quality of the product which they will be delivering and the development and production costs which they will incur, Simo considers this to be a very reasonable offer.

In summary, the companies have a good working relationship with each other, and both would like to come to agreement on the terms of the purchase/sales contract. At the present time, however, their stands on the four issues of *minimum purchase quantity*, *warranty period*, *price*, and *first shipment delivery* are not compatible. It may be difficult to negotiate a compromise. Neither side should enter into an agreement where they feel they are "being taken"; conversely, neither side should be so inflexible that compromise is impossible.

CONFIDENTIAL INFORMATION FOR ROBERTS'S PURCHASING AGENTS

The marketing department projects the following sales for the new engine:

1st year	8,000 units
2nd year	10,000 units
3rd year	12,000 units

As a general rule, in this industry, manufacturers try not to sign agreements to buy more than half of the parts which they project they will need, especially when a new product is involved. (1/2 of 8,000 + 10,000 + 12,000 = 15,000 or 5,000 per year.)

The problem with these projections is that the time estimates may be optimistic. It could take as long as two years for the new engine to catch on, and Roberts cannot afford to buy parts it does not currently need. It does not have the money or the inventory space. Although inventory purchases of 5,000 units per year could be managed, it is of CRITICAL IMPORTANCE that the quantity agreed upon not exceed this figure significantly.

Roberts is also concerned about the delivery time of the first shipment. In order to capitalize on spring boat sales, Roberts desires an early shipment date, the earlier the better. This is VERY IMPORTANT.

Of course, warranty time period and the price are IMPORTANT to Roberts. The less paid and the longer the warranty, the better. These issues, however, are not as critical as quantity and delivery time. Thus, if the minimum quantity can be kept low and the product delivered quickly, Roberts would be willing to pay a higher price and sign a contract with a shorter warranty period.

As shrewd purchasing agents, you have explored possible agreements with your two other major suppliers. One could not make delivery before next May, so you ruled that company out. The other has made the following final bid (and this is what you will take if you do not reach agreement with Simo):

Quantity	7,000 units per year
Warranty	3 years
Price	$208/unit
Delivery	7 months

Roberts's point sheets (buyer/LC): possible terms for the contract

Possible terms for the three-year contract:

Quantity Units = Points		Warranty Period Years = Points	$Price $ = Points		Delivery Time Months = Points
5000 = 39	7000 = 13	4 years = 16	$200 = 16	$216 = 5	5 months = 29
5500 = 33	7500 = 7	3 years = 10	$204 = 13	$220 = 3	6 months = 16
6000 = 27	8000 = 0	2 years = 5	$208 = 11	$224 = 0	7 months = 10
6500 = 20		1 year = 0	$212 = 8		8 months = 0

The total points on your alternative contract is 44.

References

Anson, R., and M.T. Jelassi. (1990). "A Developmental Framework for Computer-Supported Conflict Resolution." *European Journal of Operational Research* 46(2), 181–199.

Antrim, L.N., and D.A. Lax. (1987). "Support and Analysis for International Commercial Debt Negotiations." Working Paper Series, WP-10, Program on the Processes of International Negotiation, American Academy of Arts and Sciences, Cambridge, MA.

Balke, W., K. Hammond, and G. Meyer. (1973). "An Alternative Approach to Labor-Management Relations." *Administrative Science Quarterly* 18, 311–327.

Bartos, O.J. (1978). "A Simple Model of Negotiation: A Sociological Point of View." In I.W. Zartman (ed.), *The Negotiation Process: Theories and Applications*. Beverly Hills, CA: Sage Publications.

Bazerman, M.H., and M.A. Neale. (1983). "Heuristics in Negotiation: Limitations to Dispute Resolution Effectiveness." In M.H. Bazerman and R.J. Lewicki (eds.), *Negotiation in Organizations*. Beverly Hills, CA: Sage Publications.

Brehmer, B. (1976). "Social Judgment Theory and the Analysis of Interpersonal Conflict." *Psychological Bulletin* 83, 985–1003.

Campbell, D.T., and J.C. Stanley. (1969). *Experimental and Quasi-Experimental Designs for Research*. Chicago, IL: Rand-McNally.

Carmel, E., and B.C. Herniter. (1989). "MEDIANSS: Conceptual Design of a System for Negotiation Sessions." *DSS-89 Transactions*, 239–256.

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

Davis, F.D. (1985). "A Technology Assessment Model for Empirically Testing New End-User Information Systems: Theory and Results." Unpublished doctoral dissertation, Massachusetts Institute of Technology.

Delaney, M., A. Foroughi, and W. Perkins. (1992). "An Empirical Study of the Efficacy of a Computerized Negotiation Support System (NSS)." *Proceedings of the 1992 Annual Meeting of the Midwest Decision Sciences Institute*, 79–81.

Dennis, A.R., J.F. George, L.M. Jessup, J.F. Nunamaker, Jr., and D.R. Vogel. (1988). "Information Technology to Support Electronic Meetings." *MIS Quarterly* 12(4), 591–624.

DeSanctis, G., and R.B. Gallupe. (1987). "A Foundation for the Study of Group Decision Support Systems." *Management Science* 33(2), 589–609.

Eden, C. (1992). "A Framework for Thinking About Group Decision Support Systems (GDSS)." *Group Decision and Negotiation* 1(3), 199–218.

Einhorn, H., and R. Hogarth. (1978). "Confidence in Judgment: Persistence of the Illusion of Validity." *Psychology Review* 85, 395–416.

Erickson, B., J. Holmes, R. Frey, L. Walker, and J. Thibaut. (1974). "Functions of a Third Party in the Resolution of Conflict: The Role of a Judge in Pretrial Conferences." *Journal of Personality and Social Psychology* 30, 293–306.

Farber, H.S. (1981). "Divergent Expectations, Threat Strategies, and Bargaining under Arbitration." Presented to the Econometric Society, San Diego, CA.

Fisher, R. (1978). *International Mediation: A Working Guide*. New York: International Peace Academy.

Foroughi, A., and M.T. Jelassi. (1990a). "NSS Solutions to Major Negotiation Stumbling Blocks." *Proceedings of the 23rd Annual Hawaii International Conference on System Sciences*, Vol. 4: *Emerging Technologies and Applications Track*. Kailua-Kona, Hawaii, pp. 2–11.

Foroughi, A., and M.T. Jelassi. (1990b). "Interactive Negotiation Support Systems: Results of an Experimental Study." *Bulletin of the TIMS/ORSA Joint National Meeting* (29). Las Vegas, Nevada, p. 116.

Foroughi, A., and W.C. Perkins. (1989). "An Empirical Study of the Effects of Computer Negotiation Support Systems (NSS) on Negotiation Outcomes and Negotiator Attitudes." *Proceedings of the Decision Sciences Institute 20th Annual Meeting*, Vol. 1, pp. 648–650.

Fouraker, L.E., and Siegel, S. (1963). *Bargaining Behavior*. New York: McGraw-Hill.

Gallupe, R.B. (1986). "Experimental Research into Group Decision Support Systems: Practical Issues and Problems." *Proceedings of the 19th Annual HICSS*, pp. 515–524.

Gallupe, R.B. (1985). "The Impact of Task Difficulty on the Use of a Group Decision Support System." Unpublished doctoral dissertation, University of Minnesota.

George, J., G. Easton, J.F. Nunamaker, Jr., and G. Northcraft. (1990). "A Study of Collaborative Group Work With and Without Computer-Based Support." *Information Systems Research* 4, 394–415.

Herniter, B.C., E. Carmel, and D.R. Vogel. (1990). "A Comparison of Visual Displays of Negotiation Support Systems." *Proceedings of the 23rd Annual Hawaii International Conference on Systems Sciences*, Vol. 4: *Emerging Technologies and Applications Track*. Kailua-Kona, Hawaii, pp. 12–21.

Hiltrop, J.M., and J.Z. Rubin. (1981). "Position Loss and Image Loss in Bargaining." *Journal of Conflict Resolution* 25, 521–534.

Jarke, M., M.R. Jelassi, and M.F. Shakun. (1987). "Mediator: Towards a Negotiation Support System." *European Journal of Operational Research* 31(3), 314–334.

Jarke, M., and M.T. Jelassi. (1986). "View Integration in Negotiation Support Systems." *Transactions of the Sixth International Conference on Decision Support Systems*, Washington, DC, pp. 180–188.

Jelassi, M.T., and A. Foroughi. (1989). "Negotiation Support Systems: An Overview of Design Issues and Existing Software." *Decision Support Systems: The International Journal* (Special Issue on Group Decisioin Support Systems) 5(2), 167–181.

Jelassi, M.T., and B.H. Jones. (1988). "Getting to Yes with NSS: How Computers Can Support Negotiations." In R.M. Lee, A.M. McCosh, and P. Migliarese (eds.), *Organizational Decision Support Systems*. Amsterdam: North-Holland.

Jones, B.H. (1988). "Analytical Negotiation: An Empirical Examination of the Effects of Computer Support for Different Levels of Conflict in Two-Party Bargaining." Doctoral dissertation, School of Business, Indiana University, Bloomington, IN.

Kelley, H.H. (1966). "A Classroom Study of the Dilemmas in Interpersonal Negotiations." In K. Archibald (ed.), *Strategic Interaction and Conflict: Original Papers and Discussion*. Berkeley, CA: Institute of International Studies.

Kersten, G.E., W. Michalowski, S. Szpakowicz, and Z. Koperczak. (1991). "Restructurable Representations of Negotiation." *Management Science* 37(10), 1269–1290.

Kersten, G.E. (1987). "Two Roles Decision Support Systems can Play in Negotiations." *Information Processing and Management* 23(6), 605–614.

Kersten, G. (1985). "NEGO—Group Decision Support System." *Information and Management* 8, 237–246.

Kessler, S. (1978). *Creative Conflict Resolution: Mediation Leader's Guide*. Washington, DC: National Institute for Professional Training.

Lewicki, R., and J. Litterer. (1985). *Negotiation*. Homewood IL: Richard D. Irwin, Inc.

Lim, L.H., and I. Benbasat. (1992). "From Negotiation to Negotiation Support Systems: A Theoretical Perspective." *Proceedings of the 25th Annual HICSS*, 153–163.

McGrath, J. (1984). *Groups, Interaction and Performance*. Englewood Cliffs, NJ: Prentice-Hall.

Miner, F. (1979). "A Comparative Analysis of Three Diverse Group Decision Making Approaches." *Academy of Management Journal* 22(1), 81–93.

Morley, I., and G. Stephenson. (1977). *The Social Psychology of Bargaining*. London: Allen and Unwin.

Nunamaker, J.F., Jr. (1989). "Experience with and Future Challenges in GDSS (Group Decision Support Systems): Preface." *Decision Support Systems* 5, 115–118.

Nunamaker, J.F., Jr., A. Dennis, J. Valacich, D. Vogel, and G. George. (1991a). "Electronic Meeting Systems to Support Group Work." *Communication of the ACM* 43(7), 40–61.

Nunamaker, J.F., Jr., A.R. Dennis, J.S. Valacich, and D.R. Vogel. (1991b). "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 Processes of International Negotiation, American Academy of Arts and Sciences, Cambridge, MA.

Pilisuk, N., and P. Skolnick. (1978). "Inducing Trust: A Test of the Osgood Proposal." *Journal of Personality and Social Psychology*, 8, 121–133.

Poole, M.S., M. Holmes, and G. DeSanctis. (1991). "Conflict Management in a Computer-Supported Meeting Environment." *Management Science* 37(8), 926–953.

Pruitt, D.G. (1981). *Negotiation Behavior.* New York: Academic Press.

Pruitt, D.G. (1983). "Achieving Integrative Agreements." In M.H. Bazerman and R.J. Lewicki (eds.), *Negotiating in Organizations*. Beverly Hills, CA: Sage Publications.

Raiffa, H. (1982). *The Art and Science of Negotiations*. Cambridge, MA: Belknap/Harvard University Press.

Rubin, J.Z., and B. Brown. (1975). *The Social Psychology of Bargaining and Negotiation*. New York: Academic Press.

Sainfort, F., D.J. Gustafson, and L.K. Bosworth. (1987). "Experimental Evaluation of a Computer-Based Conflict Resolution Program." Paper presented at TIMS/ORSA Joint Meeting, New Orleans, LA.

Sambamurthy, V., and M.S. Poole. (1992). "The Effects of Variations in Capabilities of GDSS Designs on Management of Cognitive Conflict in Groups." *Information Systems Research* 3(3), 224–251.

Shea, G.F. (1983). *Creative Negotiating*. Boston: CNI Publishing.

Sheffield, J. (1992). "The Effects of Bargaining Orientation and Communication Medium on Negotiation." *Proceedings of the 25th Annual HICSS*, pp. 174–184.

Siegel, S., and D.L. Harnett. (1964). "Bargaining Behavior: A Comparison Between Mature Industrial Personnel and College Students." *Operations Research* 12, 334–343.

Tversky, A. and D. Kahnemen. (1981). "The Framing of Decisions and the Psychology of Choice." *Science* 211, 453–458.

UNISYS Corporation. (1987). "Computer Assisted Negotiation at the American Academy of Arts and Sciences." Cambridge, MA.

Walton, R.E., and R.B. McKersie. (1965). *A Behavioral Theory of Labor Negotiations*. New York: McGraw-Hill Book Company.

Zartman, I.W., and M.R. Berman. (1982). *The Practical Negotiator.* New Haven, CT: Yale University Press.