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ABSTRACT

In this paper, a Web-based Collective Bargaining Support System (CBSS) is introduced. CBSS is designed to support the negotiation process for the parties from remote sites. It provides at least three features different from a traditional (face-to-face) bargaining process: 1) parallel telecommunication, 2) structured bargaining process, and 3) automatic documentation. The system is written in the Java language, and can be accessed easily through the World Wide Web without the need for a special installation at the user's site.

The validity of CBSS as a negotiation tool was tested through a simulated union-management contract negotiation experiment. The statistical analysis of the results reveals that CBSS is considered a valid alternative negotiation tool by users. It is also concluded that, although CBSS is perceived to be slower than face-to-face negotiation, it does have some advantages. It makes the negotiation process easy to organize, and facilitates the preparation of a final contract. CBSS is viewed to make a valuable contribution to the negotiation process and does not have a negative impact on the final bargaining outcome. CBSS has demonstrated a great potential to facilitate remote negotiation through the fast growing and widely available World Wide Web.

Keywords: Collective Bargaining, Negotiation Support System, World Wide Web, Java Applications.

1. Introduction

Negotiation is an important way to solve conflicts in human society. In labour-management relations, a conflict between management and a union is often resolved through negotiation between their representatives in a process known as collective bargaining. Due to the nature of conflicting interests, negotiation is often a complex, time-consuming, and frustrating process. In order to understand and improve the negotiation process, a variety of negotiation theories have been studied and, based on these theories, different types of computer-based negotiation support systems have been developed.

A Negotiation Support System (NSS) is a system designed to assist negotiators and/or their mediators. The NSS provides solutions, advises, or facilitates the process of negotiation. In general, NSS can be differentiated into two types: solution-driven NSS and process support NSS. Most existing NSS are solution-driven ([Carmel et.al, 1993]). They suggest solutions but support only a certain stage in the negotiation process ([Foroughi et.al 1995]). Rather few process support NSS have been developed. They usually require specific "decision room" or "electronic meeting room" settings ([Carmel and Herniter 1989, Foroughi et.al 1995]). The complexity, limitation, and inconvenience of setting up and using NSS are probably the main reasons why these systems are not widely used, especially for organizations that do not need frequent use of such systems.

However, remote process support NSS has now become more appealing. In recent years, Internet use has been growing very rapidly, particularly because of the popularity of the World Wide Web (Lee et al [1994]). Many companies, large and small, have started doing business on the Web, and have created Intranets and Extranets for business operations. The rapid growth of electronic commerce, globalization, and new concepts of virtual companies, have stimulated demand for

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remote negotiation. Technically, the availability and popularity of multimedia personal computers, the widespread availability of Internet connections, advances in Web technology, and the advent of the Java language, have made possible the development of Web-based negotiation support systems. A Web-based negotiation support system can be accessed anywhere around the world through the Internet without the need for sophisticated system settings and software installation.

The objective of our research was to develop a Web-based negotiation support system to support remote negotiation process, and to evaluate the validity and the effectiveness of the system in comparison with face-to-face negotiations.

The rest of the paper is organized as follows. Section 2 reviews existing NSS. Section 3 describes the design and implementation of CBSS. Section 4 presents the experimental design, the hypotheses, data analysis, and user comments. Section 5 presents the conclusions and considers future research directions.

2. Review of Existing Negotiation Support Systems

A dynamic group decision making process almost always involves some levels of conflict. A special Group Decision Support System (GDSS) for managing these conflicts is called a Negotiation Support System (NSS). Carmel et.al [1993] proposed a comprehensive definition of NSS: "a Negotiation Support System is a system consisting of hardware, software, people, procedures, and data that assist the individual negotiator, negotiation team, and third party. The NSS advises, provides a solution, or facilitates the process of negotiation".

Carmel et.al [1993] differentiated NSS into two types, solution-driven NSS and process

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support NSS. The solution-driven NSS provides solution alternatives or suggests possible agreements to the negotiating parties. These suggestions are derived from a number of different models such as: Social Judgment Theory Models, Hypergame Decision Models, Bargaining Models, Multiobjective Linear Programming, and Expert Systems.

A process support NSS does not provide any suggested solutions. It is designed to support the process of negotiation, from the preparation stage to the contract signing stage. A process support NSS addresses two dimensions that a solution-driven NSS does not: enriched communication channels and cooperative work [Carmel et.al 1993]. The process support type NSS may be used either in face-to-face negotiation (decision room setting) or in a "distributed-synchronous" (teleconferencing setting) negotiation. According to Burke et.al [1995], a distributed-synchronous meeting (different places at the same time) is somewhat less interactive and permits fewer types of message transmission. However a distributed-synchronous meeting exhibits less social presence, is less expressive, less emotional, and is more de-personalized and businesslike (Short et.al [1976]).

Lim and Benbasat [1993] argued that it is important to distinguish between the effects of the decision support component of a NSS and its support for communication among participants. The decision support component, which provides alternative solutions, affects negotiation outcomes such as the distance from the efficient frontier and the distance from the Nash solution (see Bartos [1978]). A communication support component should decrease the time to achieve a settlement and increase satisfaction with the results by increasing the commitment of the participants to a mutually satisfactory outcome.

Various kinds of NSS have been developed for over a decade. However, according to Carmel

et.al [1993], most NSS systems are solution-driven. They do not support interactive negotiation and are used to support only a certain stage in the negotiation process. For example, among the eight NSS reviewed by Anson and Jelassi [1990], only two support some form of multiple participant system input interaction (the remaining systems are operated by a single negotiator). These systems support the process in a certain stage only, such as: pre-negotiation strategy formulation (Computer Decision Tree [Winter, 1985], Decision Maker [Fraser and Hipel, 1981], Rune [Kersten et.al, 1986]), and evaluation of alternatives (Decision Analysis [Executive Software Inc., 1983], DTG-Analytical Mediation [Mumpower et.al, 1986], Mediator [Jarke et.al, 1987], Nego [Kersten, 1985], Policy PC [Executive Decision Services, 1983]).

According to Anson and Jelassi [1990], the primary shortcomings of existing NSS are their lack of support for: 1) handling cognitive bias and socio-emotional aspect of conflict situations, 2) structuring the negotiation process, and 3) facilitating direct interaction between the negotiation parties.

Recently, a special type of GDSS, the Electronic Meeting System (EMS) has been used as a NSS (at least in a case study). However, as pointed by Carmel et.al [1993], an EMS does not address an implication of the negotiation task, which is the idea of a "dyad" (two adversarial groups meeting together). This is because an EMS is designed for a group meeting (group members share common interests and goals) and not for negotiation parties (parties have different interests and goals). The EMS can be adapted to the NSS form by adding software tools to support the dyadic approach and to facilitate process structuring.

Anson and Jelassi [1990] developed a framework for designing a type of process support

NSS. They believe that an NSS should address analytical processing, socio-emotional and cognitive obstacles, and it should assist the negotiators' interactions or communications during all stages of the negotiation process. Several general characteristics of NSS have been advocated by many researchers (Anson and Jelassi [1990], Carmel and Herniter [1989], Fisher and Ury [1981], Jelassi and Foroughi [1989]), including: 1) separate personalities from problems, 2) improve communications among the participants, 3) generate alternatives before judging, and 4) use objective data and criteria.

Foroughi, Perkins, and Jelassi [1995] designed an experimental NSS in order to investigate the effects of a process support type NSS on negotiation time, negotiator satisfaction, and joint outcomes of certain conflict situations. This NSS was designed to support an integrative bargaining process in five stages: 1) statement of interests, 2) role reversal, 3) searching for common ground, 4) generation and analysis of alternative solutions, and 5) reaching agreement. The experimentation took place in the Collaborative Work Support Laboratory at Indiana University. Two software tools were used: the Topic Commenter of the University of Arizona GDSS system, and the Negotiation Decision Support Tool (NDST). This system was implemented in a "decision room" setting in which NSS was used in conjunction with face-to-face meetings. The system was tested through a laboratory study. The results of the study showed that joint outcome and contract balance were improved and satisfaction was greater with the use of NSS. However, negotiation time was longer for NSS dyads than for non-NSS dyads.

A Web-based negotiation support system named INSS (Internet Negotiation Support System) [http://www.business.carleton.ca/interneg] was developed recently at the School of Business, Carleton University, Canada. The system was implemented by using the Java Script language. This

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system can be categorized as a solution-driven NSS which provides a method to construct the negotiators' utility functions (based on their issue ratings and option ratings) to evaluate the proposals of the other side. INSS also provides suggestions or solution alternatives to both sides by comparing both negotiator's utility functions. INSS is a good system for negotiating a single contract with multiple variables, such as car buyer-seller negotiation, where price, warranty, and model can be included in a single deal. However, since it uses a rather simple communication channel, INSS. does not provide full process support for negotiators to organize and negotiate a complex set of separate issues.

Our objective was to build a Web-based Collective Bargaining Support System (CBSS) that supports remote negotiation by providing electronic communications, online documentation, and process structuring. Since it is based on Web technology, it should be widely accessible and easy to use. CBSS can be further extended by adding modules such as: audio and video conferencing, multimedia document sharing, and specific decision support system modules such as fuzzy negotiation models based on fuzzy set theory (Zadeh [1977]).

3. The Design of CBSS

3.1 The main features of CBSS

The design of CBSS was inspired by Anson and Jelasi's [1990] negotiation process stages and by Gulliver's [1979] eight-step negotiation process model. The philosophy behind the CBSS design is to develop computer software to support the collective bargaining process in distributed-synchronous meetings. CBSS is designed to provide process support, especially through remote communication, documentation handling, and process structuring, but it does not provide

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suggestions or solutions to the users at the current stage.

As a computer-based negotiation system, CBSS provides at least three advantages over a traditional bargaining process (face-to-face negotiation): 1) parallel communication, 2) structured pattern of bargaining process, and 3) automatic documentation. Parallel communication allows two or more participants to send and receive messages at the same time. It also promotes idea generation by allowing participants to contribute their ideas freely and anonymously. With CBSS, a team may conduct a caucus meeting privately during the negotiation process. Team members can exchange ideas and prepare messages privately without being observed by the opposite party. This overcomes problems common to face-to-face meetings, namely that team members cannot freely exchange their ideas in front of the opposite party and they cannot be protected from the adverse effects of contributing ideas during negotiations (i.e. being put in a difficult position in the future). Since the negotiation parties may not see each other or use other communication media such as a regular telephone for coordination, CBSS provides a hot line for communication and coordination between two parties.

CBSS provides a structured pattern for bargaining by organizing the entire bargaining process into well organized stages. It displays each bargaining issue in separate windows so that the negotiation parties can move from one issue to another without losing track of the current status of each issue. CBSS records all discussions and comments, so that the participants can decouple themselves from a discussion to pause, think, type comments and then rejoin the discussion. CBSS will deliver all the messages to the place they belong without mixing them. In this way, CBSS makes the negotiation well organized but still provides a great degree of flexibility.

Documentation support may also reduce communication problems that occur when participants miss the other party's points or they forget what has been discussed previously. With CBSS, all messages are automatically recorded in different files in an organized way. Participants can review all the statements that have made by each party on each issue and at each particular time in separate windows, without losing any information. Automatic documentation also makes the final contract agreement much easier to prepare at the end of the negotiation process.

The traditional bargaining process requires participants to be present in the same place at the same time for face-to-face negotiations. CBSS provides the possibility of conducting distributed-synchronous bargaining. The negotiating parties may conduct bargaining from a remote site, thus reducing the cost of hotel rooms, conference rooms, and travel. Since communication is conducted through the Internet, the communication cost can be significantly reduced, compared to the traditional private teleconferencing arrangement.

3.2 The implementation of CBSS

CBSS is based on a cooperative processing client/server architecture, where the processes are divided between the client program and the server program. The CBSS server program is installed on a Web server site, and the client program, which is executable under a Web browser, is delivered to the user's machine whenever the user accesses the CBSS web site. Server and Client programs were written in the Java language (Flanagan [1996]) to ensure platform-free properties. The "Abstract Window Toolkit" (AWT) package of Java provides the Graphical User Interface (GUI) and the "What I See Is What You See" (WISIWYS) property of the system's windows.

The client program consists of three main components: **Dialogue Management, Data**

Management, and **Communication Management**, and supports two main modules: **the Pre-Session** module and the **Session module.** The server program consists of three main components: **Client Management, File Management**, and **Communication Management.** The overall architecture is shown in Figure 1. The CBSS home page is shown in Figure 2, and some of the user interfaces are shown in Figure 3 to 5.

<Figure 1 to 5 are about here>

Two modules providing direct interaction between the users and the system are **Pre-Session** and **Session modules.** These modules are presented to users as pull-down menus which are easy to use. The **Pre-Session** module is provided to support the preparation stage. It is used for recording the bargaining items, setting initial goals, and preparing discussion notes (see Figure 3). Related data are sent to the server to be saved as data files. These data files are used later during bargaining session stages. Structuring of the negotiation process is implemented in the **Session** module where the process is divided into three phases: General Discussion, Issue Discussion, and Completing the Agreement. In each phase, a new window is created, which is divided into three sub-windows: **Our Window, Their Window**, and **Common Window** (see Figure 4 and 5). **Our Window** displays messages which have been sent by the user to the other side. **Their Window** displays messages which have received from the other side. The **Common Window** is a window for displaying the agreement between the negotiating parties. A small dialogue window called the **Comment Editor** can be activated by a **Compose a Message** button (see Figure 4). It is used for preparing messages privately before sending them out to the public (the message can also be saved as a note for private use). During negotiation, messages (such as proposals and count-proposals, arguments, explanations, etc.) are sent and displayed publicly (Shown in the other side's **Their Window** and

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the user's **Our Window**) and at the same time recorded in the text files at the server site. These text files are the discussion log-books, and can be retrieved at any time or used to re-start negotiations in the case of scheduled breaks or system outages.

The structure of the negotiation process is in parallel with Gulliver's [1979] negotiation process stages. **General Discussion** supports step 2 (Agenda Setting) and step 3 (Explore the Field) where parties discuss the collective bargaining agenda until they agree on the issues to be negotiated, the time allocated to each issue, and the trade-offs and the limits of the issues in dispute. **Issue Discussion** supports step 4 (Narrowing the Difference), step 5 (Preliminaries to Final Bargaining), and partially step 6 (Final Bargaining), where parties negotiate and search for solutions to a particular issue. **Completing the Agreement** supports step 6 (Final Bargaining) and step 7 (Ritual Affirmation), by providing a communication channel for proposal exchange and documentation of the final agreement.

Although CBSS's process structuring does not precisely follow Anson and Jelassi [1990], the pre-session module is inspired by their work. In addition, there are function similarities between CBSS's session module and Anson & Jelassi's session stage. For example, CBSS's General Discussion module is similar to Setting the Stage and Formulating the Problem, Issue Discussion is similar to Processing the Issue stage, and Completing the Agreement is similar to Resolving the Issue stage.

In addition to the sessions, the Hot Line (see Figure 3) is an important dialogue tool for two parties to coordinate with each other, such as to start negotiation or change issues for discussion. It is also a simple monitoring window to automatically notify the other side activities of such as

opening an issue window, preparing a message, etc. so actions of the two parties can be synchronized during the session.

Three system components are designed to support user activities during the Pre-Session and the Session: Dialogue Management, Data Management, and Communication Management. The **Dialogue Manager** manages the interaction between users and the system. This subsystem provides interfaces for the users, such as: User Menus, Comment Editor, Hot Line, Log-on Form, and various windows to accommodate message exchange during the negotiation.

The **Data Manager** manages the data created during the usage of the program. Each dialogue window is associated with one text buffer. Each time the user types a message or a note, the Data Manager will put the data into the right buffer, and each time a window is refreshed, it will select the right buffer to be displayed on that window. The Data Manager also intercepts incoming messages from the Communication Manager to be recorded in the right buffers.

The **Communication Manager** manages data communications through the Internet. The main functions of this component are: to receive messages from the server and to deliver these messages either to the Dialogue Manager or Data Manager, and to send messages received from either Dialogue Manager or Data Manager to the server.

4. Experimental Design, Hypotheses and Data Analysis.

4.1 Experimental Design

An experiment was designed to permit a comparison between CBSS and FTF (face-to-face) negotiation and to test the efficiency and effectiveness of CBSS. It included three independent variables (the bargaining format, the team's role, and the bargaining task), each with two treatments respectively (CBSS or face-to-face negotiation, management or union role, first collective agreement or renewal collective agreement). Sixty six subjects voluntarily participated in the experiment. They were students enrolled in an upper-level undergraduate Collective Bargaining course. Some of the participants were part-time students who worked in industry. The students were divided into 22 teams (3 members each) participating in 11 simulated negotiation settings. Each setting involved a management team and a union team. The teams were selected randomly for the negotiation settings.

The experiment was performed in two rounds. In the first round of the experiment, 5 pairs of teams (management team and union team) were assigned to use CBSS and 6 pairs of teams were assigned to use face-to-face (FTF) negotiation. In the second round, the bargaining format changed -- the pairs using CBSS in the first round used FTF in the second round, and vice versa. The roles of the teams in each pair were also rotated in the second round, such that management teams in the first round became union teams in the second round, and vice versa.

Two sets of simulated negotiation issues (bargaining tasks) were given to the negotiation dyads: one set for the first round, and the other set for the second round. The first round simulated the negotiation of a first collective agreement and included four issues: wages, contract duration, call-in provision, and union security. The second round involved a renewal collective agreement and covered three issues: seniority, layoffs, and union representation (The details of the bargaining tasks are provided in the Appendix). Case materials were given to the students several weeks prior to conducting the simulations to allow them sufficient time to research the issues. The experiment is

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a three-factor 2 x 2 x 2 design (two bargaining formats, two negotiating roles, and two bargaining tasks).

Two questionnaires were prepared to assess CBSS. The design of these questionnaires was based on questions contained in Carmel et.al [1993] and Foroughi et.al [1995], and on the objectives of this research. The first questionnaire (Q1) contained questions concerning CBSS as a support tool for negotiations. It was given to the students who conducted negotiations with CBSS in the first round. The second questionnaire (Q2) contained questions comparing CBSS and FTF. It was given to the students after both methods were used by each team in the second round. There were 96 questionnaires distributed to the students (30 of Q1 were distributed in the first round, and 66 of Q2 were distributed in the second round). The students filled out the questionnaires independently. A total of 81 questionnaires were returned (27 of Q1 and 54 of Q2).

4.2 Hypotheses

Five hypotheses were formulated in this research concerning the validity of CBSS to be used as an alternative in a collective bargaining process, the time efficiency of using CBSS compared to the face-to-face (FTF) process, and the effectiveness of CBSS as a negotiation tool. Consideration was also given to whether CBSS is a better negotiating process than FTF negotiation and whether CBSS has a negative affect on negotiation outcomes.

Each hypothesis was examined by analyzing responses to several questions in two questionnaires (Q1 and Q2) collected from the users after the experiment. The hypotheses and their corresponding questions are as follows:

Hypothesis 1: Negotiating with CBSS is acceptable as an alternative to FTF negotiation.

This hypothesis was tested based on student responses to the following questions:

$H_{1.1}$: I prefer to use CBSS to negotiate rather than a FTF meeting (Q2-18).

$H_{1.2}$: I prefer to use CBSS combined with a FTF meeting (Q2-19).

$H_{1.3}$: I prefer to use CBSS if an FTF meeting is not possible (Q2-20).

These three questions represent the different degrees of acceptance of CBSS, ranging from the strongest (unconditional) to weakest (conditional).

Hypothesis 2: Negotiating with CBSS is slower than FTF.

This hypothesis was tested based on student responses to the following questions:

$H_{2.1}$: The process with CBSS was more efficient in time usage than the FTF process (Q2-4).

$H_{2.2}$: The process with CBSS was faster than FTF because of this software (Q2-7).

$H_{2.3}$: Compared to FTF, CBSS slowed down the negotiation process (Q2-12).

$H_{2.4}$: CBSS made the process slower than the traditional FTF (Q2-16).

These questions were asked after both methods had been used by each team in the second round of the experiment.

Hypothesis 3: CBSS is an effective support tool for negotiation.

This hypothesis was tested based on student responses to the following questions:

$H_{3.1}$: CBSS helps me in preparing the final contract agreement (Q1-5).

$H_{3.2}$: CBSS made a valuable contribution to the negotiation outcomes (Q1-6).

$H_{3.3}$: CBSS made the negotiation process easy to organize (Q1-8).

$H_{3.4}$: CBSS is a user-friendly computer software (Q1-12).

$H_{3.5}$: CBSS may be used for real bargaining situations (Q1-13).

$H_{3.6}$: CBSS is the kind of software that I would avoid using (Q1-14).

The first four questions address different benefits the CBSS may provide, and the last two represent the user's intention of using CBSS. These questions were asked for those teams which used CBSS in the first round. There is no comparison involved between CBSS and FTF.

Hypothesis 4: Negotiating with CBSS is a better process than FTF negotiation.

This hypothesis was tested based on student responses to the following questions:

$H_{4.1}$: the CBSS process was more successful than the FTF process (Q2-1).

$H_{4.2}$: The process with CBSS was better in attaining my team's goal than the FTF process (Q2-2).

$H_{4.3}$: The process with CBSS gave a more satisfying contract outcome than the FTF process (Q2-3).

$H_{4.4}$: The process with CBSS was more effective than the FTF process (Q2-5).

$H_{4.5}$: The process with CBSS was easier than FTF because of this software (Q2-6).

$H_{4.6}$: The process with CBSS was better overall than the FTF process because of this software (Q2-8).

These questions were designed to compare CBSS with FTF after each team had used both methods.

Hypothesis 5: CBSS does not negatively affect bargaining outcomes.

H_5: Median grade with CBSS was equal to the median grade with FTF.

This hypothesis was tested based on the grades received by the teams using CBSS vs using FTF. The grades were assigned by a teaching assistant based on the team's bargaining outcome reports.

4.3 Data Analysis

The first four hypotheses were tested by analyzing questionnaire results. As noted above, each hypothesis consists of several sub-hypotheses and each sub-hypothesis corresponded to a particular question in the questionnaire Q1 or Q2. These two questionnaires used a Likert scale ranging from 1 to 5, where 1=strongly disagree, 2=disagree, 3=neutral/undecided, 4=agree, and 5=strongly agree. We tested these sub-hypotheses individually by using a one-tail Wilcoxon Signed Rank test (Sprent [1989], Weiers [1991]). In each case, user reaction was compared with the scale

midpoint of neutral/undecided (=3). The critical value chosen for p was 0.05 for all hypothesis test

The null and alternate sub-hypothesis are stated as follows:

Null sub-hypothesis ($H_{oi,j}$) : $M_{i,j} \leq 3$ (or $M_{i,j} \geq 3$, depending on the question)

Alternate sub-hypothesis ($H_{ai,j}$) : $M_{ij} > 3$ (or $M_{ij} < 3$, depending on the question)

where Mij is the estimated sample median responses to question j of hypothesis I.

The reason for using the sample median instead of the sample mean was that the median represented the percent of responses that agreed or disagreed with the question. Median = 3 meant a neutral or mixed response (half agreed and half disagreed). Median > 3 meant that more than half agreed, and median < 3 meant that more than half disagreed.

Hypothesis 1: Negotiating with CBSS is acceptable as an alternative to FTF negotiation.

Hypothesis H1 was examined in three questions which addressed the preference for using CBSS rather than FTF. The statistical results for these individual questions are shown in Table 1.

<Table 1 is about here>

The null hypothesis for $H_{1,1}$ could not be rejected (p = 0.099). We could not conclude that CBSS was preferable to FTF. In fact, the responses to Q2-18 were mixed, with some respondents favouring FTF and others favouring CBSS. The null hypotheses for $H_{1,2}$ and $H_{1,3}$ however, were rejected at p = 0.005 and p = 0.000 respectively. These results indicate that negotiating with CBSS is preferred when it is used in combination with FTF (as per $H_{1,2}$) or when FTF is not possible (as per $H_{1,3}$). It appears that CBSS is not unconditionally preferred to FTF, but it is preferred in certain

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circumstances.

Hypothesis 2: Negotiating with CBSS is slower than FTF.

The null hypotheses for the four sub-hypotheses were rejected (see Table 2).

<Table 2 is about here>

The conclusion is that negotiating with CBSS is slower than FTF. This result confirms the result reported by Foroughi et.al [1995] that "...the negotiation time was greater for NSS dyads than for non NSS dyads..." but in different settings.

There are some reasons why negotiators perceive CBSS to be slower. Unlike face-to-face meetings, negotiators may not receive quick responses from the other party through CBSS. Although typing and reading messages may slow down the communications, the major cause of delay was associated with conducting informal caucus meetings and searching for carefully worded responses. It should be noted that while CBSS was associated with response lags, these delays may have some positive side effects, e.g. fewer emotional and repetitious messages than found in FTF negotiations. This is consistent with the expectation that electronic communication will encourage greater clarification of thoughts and minimize nonrational escalation of conflict (Foroughi et al. 1995).

Hypothesis 3: CBSS is an effective support tool for negotiation

The test results for Hypothesis H3 are listed in Table 3.

<Table 3 is about here>

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The statistical analysis shows that all the null hypotheses were rejected. Respondents agreed that CBSS was an effective tool because CBSS helped them in preparing the final contract agreement ($H_{3.1}$), and CBSS made valuable contributions to the negotiation outcomes ($H_{3.2}$). Respondents also agreed that CBSS made the negotiation process easy to organize ($H_{3.3}$), it is user friendly software ($H_{3.4}$), and it may be used for real bargaining situations ($H_{3.5}$). Respondents disagreed that CBSS is the kind of software that they would avoid using ($H_{3.6}$). Based on these results, we conclude that CBSS is perceived as an effective support tool for negotiation.

Hypothesis 4: Negotiating with CBSS is a better process than FTF negotiation.

Whereas Hypothesis 3 sought to evaluate CBSS alone, Hypothesis 4 compares CBSS with FTF. Hypothesis 4 was examined with the six questions shown in Table 4.

<Table 4 is about here>

As we can see in Table 4, the sample median for all the questions was 3, except for the question Q2-5 (median = 3.50). This means that a little more than half of the respondents believe that CBSS is more effective than the FTF process.. However, for all the questions, the null hypotheses could not be rejected. Since about half of the respondents were in favour of CBSS and half were in favour of FTF, the overall responses were neutral. Accordingly, hypothesis H4, which states that negotiating with CBSS is better process than FTF negotiation, could not be supported. The result of hypothesis test H4 is broadly consistent with the results reported above. The respondents perceive advantages (effective support tool) and disadvantages (slowness) of CBSS, and recognize it to be a valid negotiation tool under specified circumstances.

Hypothesis 5: CBSS does not negatively affect the bargaining outcome.

Hypothesis H5 was tested by analysing the grades assigned to the teams based on their reports submitted after the experiment. In the final reports, each team described its bargaining strategy, the initial demand (initial offers to the opposite party), the resistance point (minimally acceptable offers from the opposite party), and the final outcome for each bargaining issue. A mark for each issue was assigned by a teaching assistant based on the following rules:

1) If the final outcome was worse than the resistance point then the mark = 0,

2) If the final outcome was better than the resistance point but worse than the initial demand then the mark = 2, and

3) If the final outcome equals the initial demand then the mark = 5.

The team's grade was the average mark for all the issues negotiated. In order to test hypothesis H5, we compared the grade received for the teams using CBSS and the teams using FTF. A non- parametric two-sample test (Wilcoxon rank sum test) was performed. The results are shown in Table 5.

<Table 5 is about here>

The null hypothesis, which states that the median grade of teams using CBSS is equal to the median grade of teams using FTF, could not be rejected. In other words, there is not enough evidence to support the conclusion that CBSS had either a positive or a negative effect on the bargaining outcome.

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4.4 User Comments

Perhaps the best source for explaining the test results is user comments. Users were asked to provide additional comments on the CBSS in the questionnaires, after using the system. There were 96 sheets of questionnaires distributed to the students (30 sheets with questionnaire Q1 and 66 sheets with questionnaire Q2). Among the sheets received, forty one responded with satisfied comments, fourteen with frustrated comments, and four had mixed feelings. Table 6 shows the categories of the comments and their quoted examples.

<Table 6 is about here>

Most of the satisfied comments appreciated the fact that: CBSS separates people from the problem, CBSS gives them the chance to conduct group discussions without being watched by the opposing group, CBSS relieves them from intimidation, CBSS prevents personality interference, CBSS gives them time to think before replying, and CBSS retains the discussion documents such that they can go back to the previous arguments whenever they need those arguments.

Among frustrated comments, most complained about the response time. They complained that CBSS was slower than FTF, and they were unable to see the facial expressions of the opposing group members while negotiating.

A few subjects had mixed feelings about CBSS. They liked the fact that CBSS provided documentation and reduced personality issues, but they did not like the fact that CBSS was slower than FTF.

Overall, the comments were quite consistent with the test results.

5. Conclusion

We have successfully developed CBSS, a Web-based negotiation support system. CBSS is the first process support NSS implemented in the World Wide Web environment, which makes CBSS widely accessible and easy to extend. An experiment was conducted to evaluate and compare CBSS with face-to-face negotiation. The results show that CBSS is a valid alternative to face-to-face negotiation. Although bargaining processes supported by CBSS are perceived to be slower than face-to-face negotiation, CBSS is an effective tool for negotiation and did not have a negative impact on the final negotiation outcome in our simulated bargaining experiment.

The current implementation of CBSS is a text-based system which restricts negotiators to communicate with each other with only typed messages. Although it is slower than spoken communication, most people are more careful in writing than in speaking. For example, during the experiments it was observed that CBSS users performed proof-reading to make sure their messages were clear, understandable, and relevant to the issue discussion, before sending the messages to the other party. They also read messages very carefully before making a reply. In contrast to FTF, team members have more time and freedom to think and discuss before responding. In this case, CBSS could improve the quality of discussion and make the discussion more thoughtful than in FTF negotiation.

In addition, CBSS provides structured documentation so that negotiators can review the discussion log easily. In this case, CBSS allows negotiators to do more extensive study and to analyze their bargaining concessions or their bargaining strategies. In face-to-face negotiation, it is

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more difficult to trace previous discussions.

A third party mediation function has already been built into the system. It allows the negotiators to consult a mediator during the negotiation process without being noticed by the opposite party. It also allows a mediator to observe the negotiation process and provide suggestions to one or both parties. Due to time restrictions, this feature has not been tested yet. Further experimentation is needed to test its usefulness.

Besides being a system to support remote negotiation process, CBSS can also be used as an educational tool, especially for laboratory experiments on the negotiation process. The mediation function allows an instructor to watch the negotiation process quietly without interfering with it. The very detailed documentation provides the opportunity for an instructor to do sophisticated analysis on the negotiation strategies used by negotiators.

Current implementation of CBSS does not include DSS (Decision Support Systems) modules. However, separate DSS tools such as spreadsheets can be used easily in parallel with CBSS under a Windows '95 multi-tasking environment. Further development may be needed to add security control, audio and video communication, multimedia document sharing, and fuzzy negotiation models. Security control may be used to protect documentation and the negotiation process from unauthorized access. Audio and video communication may enrich information exchange among the parties. Multimedia document sharing may be used to show pictures, graphs, and other supporting documents. Since CBSS was developed in the Web environment, all these features can be easily added by using existing and future Web technologies. In addition to existing negotiation models, a fuzzy negotiation model may represent preferences and solutions in linguistic

terms, based on fuzzy set theory and approximate reasoning. It will allow solution generation based on human perception, beyond the manipulation of the numerical parameters used in most mathematical decision models. Further experimental studies on the impacts of these potential functions are necessary. The next major step would be to use CBSS in a real negotiation environment, since negotiator reaction in a real situation may be different from a simulated situation.

As pointed out by Andriole [1996]: "It appears that we are on the verge of major changes in the way individuals, groups, and even nations negotiate. Today's information and computer technology can support major negotiations processes and steps; tomorrow's technology will support "virtual" continuous interactive negotiations ". The development of Web-based CBSS is a step in that direction.

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Appendix: Collective Bargaining Simulation

General Background Information

<u>The Ontarioville Municipal Collective Bargaining Simulation</u>

Ontarioville is a small but growing city (pop. 50 000) near Oakville, Ontario. The city currently employs 1 000 workers. Of these, 200 are full-time outside employees. The duties of the outside workers include public park and winter ice rink maintenance, snow plowing, and garbage collection (among others). It is an exciting time for the outside employees because they have just become certified as the city's first municipal union, CUPE Local 1498.

It is now time for the two parties to go to the bargaining table. There is a great deal of uncertainty over what will happen during the negotiations, partly because the process and outcomes of first-contract negotiations have important implications for the future bargaining relationship. Because the former NDP Government's Social Contract legislation (which expired March 31, 1996), employees have been without a pay increase for nearly four years. Recent cutbacks in transfer payments by the Harris' Government has exacerbated the city's budget situation. The city is pessimistic about future revenue projections. The citizens of Ontarioville have formed a Taxpayers Coalition in response to what they feel are needlessly high property taxes, and they have made it clear that they will not tolerate another increase in assessments in the next year.

The unemployment level in Ontarioville has closely parallelled the provincial average since 1990.

Negotiations (First simulation)

While a number of issues have to be resolved through formal negotiations, the parties have already agreed upon a number of items. Some of them are: union recognition, management rights, job classifications, hours of work and breaks, seniority, grievance and arbitration procedures, holidays, uniforms, and maintaining existing fringe benefits.

Management and the Union agreed to submit their positions on the remaining items by mail. This has been done and the following is a synopsis of the demands (you may assume that all matters previously agreed upon are not to be subject of negotiations):

<u>Union Demands</u>

1. Wage parity with a comparable bargaining unit in a nearby city called Oakville:

Classification	Ontarioville Current Rate*	Oakville Current Rate
Job Group A (50 employees)	$ 11.88	$ 14.86
Job Group B (75 employees)	$ 12.70	$ 15.58
Job Group C (50 employees)	$ 12.96	$ 16.20
Job Group D (25 employees)	$ 13.62	$ 17.03

*NOTE: For the purpose of negotiations, there are 1875 hours in one work year (37.5 hours per week * 50 weeks per year).

2. A one-year contract.

3. A "call-in" provision: an employee called back to work shall be guaranteed a minimum of four hours of paid work and all call-in hours shall be paid at overtime rates.

4. Union security: a union shop.

Company Demands/Offer

1. A wage rollback of five percent, followed by a freeze for the remainder of the collective agreement.

2. Contract duration of 3 years.

3. The employer proposes that employees be paid only for the call-in hours they work. Overtime entitlement will not accrue unless employees work in excess of the hours specified in the Employment Standard Act.

4. The employer opposes a union shop.

Negotiation (Second simulation)

The first collective agreement between the parties has expired. All of the major economic issues have been settled. However, the union is seeking to address a number of major concerns that it did not push hard in the interest of achieving a basic first collective agreement. For its part, the employer continues to trim costs as it struggles under cuts in provincial transfer payments and its inability to generate new revenue sources. The following issues have not been resolved. There is no need to cost the second collective agreement.

Union Demands

1. Seniority: A sufficient ability clause for all promotions and transfers.

2. Layoffs: The current agreement does not deal with layoffs and the union indicates it will submit language for a layoff procedure that provides comprehensive job security protection.

3. A union representation clause that provides that members of the union negotiating committee will be paid for time spent in negotiations during regularly scheduled working hours.

Employer Demands

1. Seniority: maintain the current relative ability clause for promotions and transfers.

2. Layoffs: The employer opposes any restrictions on its right to determine the size of the workforce.

3. The union shall reimburse the employer for all time paid to members of the negotiating committee while not at work.

Table 1. Statistical analysis result of questions in hypothesis H1.

Hypothesis	Question	N	Median (M)	Hypothesis Test	W	p	Reject H0?
$H_{1.1}$:	I prefer to use CBSS to negotiate rather than a FTF meeting (Q2-18).	43	2.5	H0: M ≤ 3 H1: M > 3	366	0.099	No
$H_{1.2}$:	I prefer to use CBSS combined with a FTF meeting (Q2-19).	46	3.5	H0: M ≤ 3 H1: M > 3	779	0.005	Yes
$H_{1.3}$:	I prefer to use CBSS if FTF meeting is not possible (Q2-20).	44	4	H0: M ≤ 3 H1: M > 3	945	0.000	Yes

Table 2. Statistical analysis results of questions in hypothesis H2

Hypothesis	Question	N	Median (M)	Hypothesis Test	W	p	Reject H0?
$H_{2.1}$:	Process with CBSS was more efficient in time usage than FTF process (Q2-4).	48	2	H0: M ≥ 3 H1: M < 3	215	0.000	Yes
$H_{2.2}$:	Process with CBSS was faster than FTF because of this software (Q2-7).	42	2.5	H0: M ≥ 3 H1: M < 3	266	0.010	Yes
$H_{2.3}$:	Compared to FTF, CBSS slowed down the negotiation process (Q2-12).	45	3.75	H0: M ≤ 3 H1: M > 3	828	0.000	Yes
$H_{2.4}$:	CBSS made the process slower than the traditional FTF (Q2-16).	44	3.75	H0: M ≤ 3 H1: M > 3	780	0.000	Yes

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Table 3. Statistical analysis results of questions in hypothesis H3

Hypothesis	Question	N	Median (M)	Hypothesis Test	W	p	Reject H0?
$H_{3.1}$:	CBSS helped me in preparing the final contract agreement (Q1-5).	25	4.5	H0: M ≤ 3 H1: M > 3	325	0.000	Yes
$H_{3.2}$:	CBSS made valuable contributions to the negotiation outcomes (Q1-6).	26	4	H0: M ≤ 3 H1: M > 3	288	0.002	Yes
$H_{3.3}$:	CBSS made the negotiation process easy to organize (Q1-8).	23	3.5	H0: M ≤ 3 H1: M > 3	207	0.018	Yes
$H_{3.4}$:	CBSS is a user-friendly computer software (Q1-12)	24	4	H0: M ≤ 3 H1: M > 3	293	0.000	Yes
$H_{3.5}$:	CBSS may be used for real bargaining situations(Q1-13).	24	4	H0: M ≤ 3 H1: M > 3	238	0.004	Yes
$H_{3.6}$:	CBSS is the kind of software that I avoid using (Q1-14).	25	2	H0: M ≥ 3 H1: M < 3	8.5	0.000	Yes

Table 4. Statistical analysis results of questions in hypothesis H4

Hypothesis	Question	N	Median (M)	Hypothesis Test	W	p	Reject H0?
$H_{4.1}$:	CBSS process was more successful than FTF process (Q2-1).	37	3	H0: M ≤ 3 H1: M > 3	279	0.863	No
$H_{4.2}$:	Process with CBSS was better in attaining my team's goal than FTF process (Q2-2).	33	3	H0: M ≤ 3 H1: M > 3	316	0.283	No
$H_{4.3}$:	Process with CBSS gave me a more satisfying contract outcomes than FTF process (Q2-3).	35	3	H0: M ≤ 3 H1: M > 3	362	0.221	No
$H_{4.4}$:	Process with CBSS was more effective than FTF process (Q2-5).	43	3.5	H0: M ≤ 3 H1: M > 3	593	0.075	No
$H_{4.5}$:	Process with CBSS was easier because of this software (Q2-6).	44	3	H0: M ≤ 3 H1: M > 3	462	0.652	No
$H_{4.6}$:	Process with CBSS was better overall because of this software (Q2-8).	39	3	H0: M ≤ 3 H1: M > 3	334	0.785	No

Table 5. Two-sample Wilcoxon rank sum test of CBSS teams versus FTF teams

CBSS-Median (M1)	FTF-Median (M2)	N	W	p	Hypothesis Test	Reject H0?
3.33	3.75	22	434	0.15	H0: M 1 = M2 H1: M 1 ≠ M2	No

Table 6. CBSS user comments

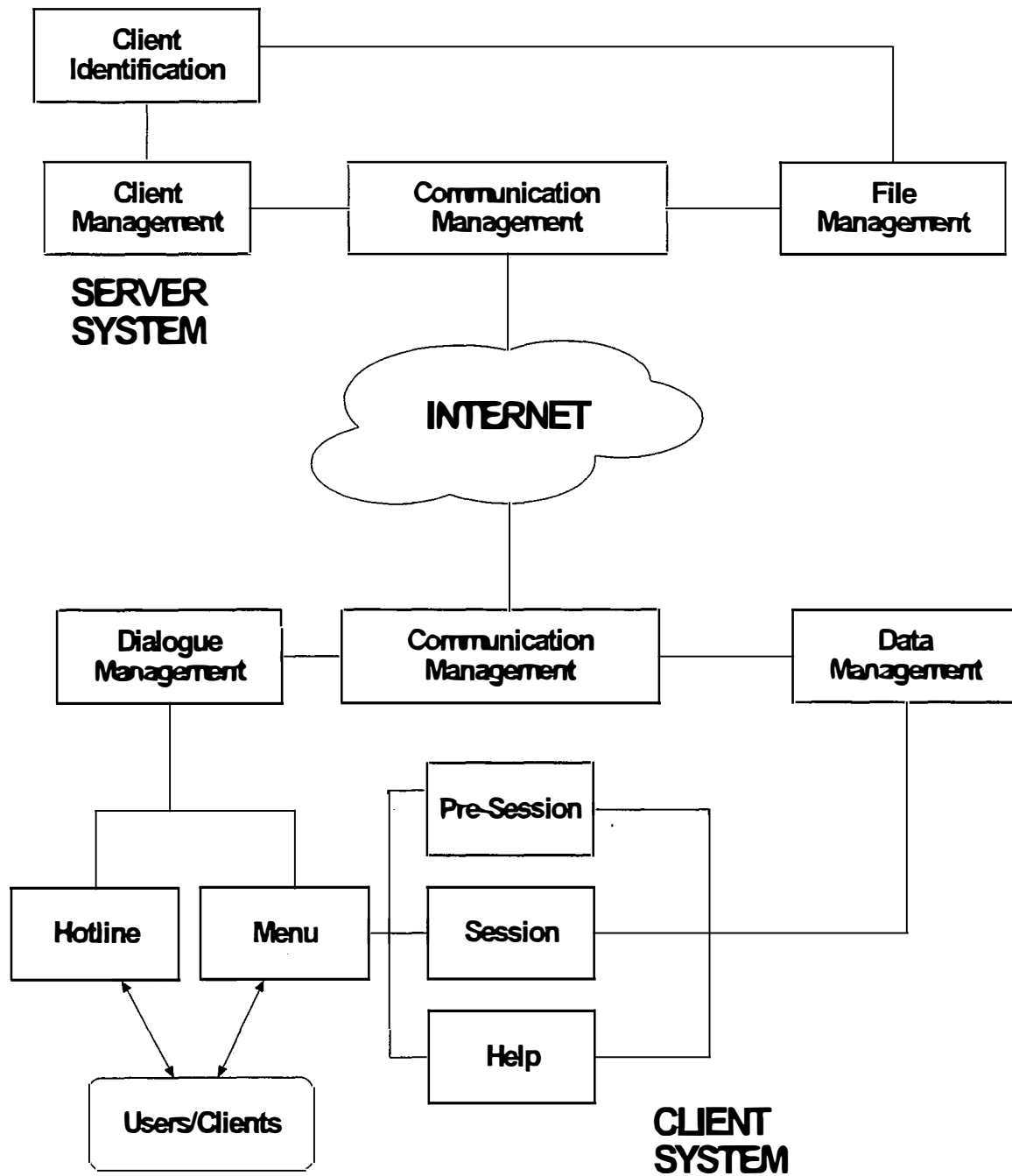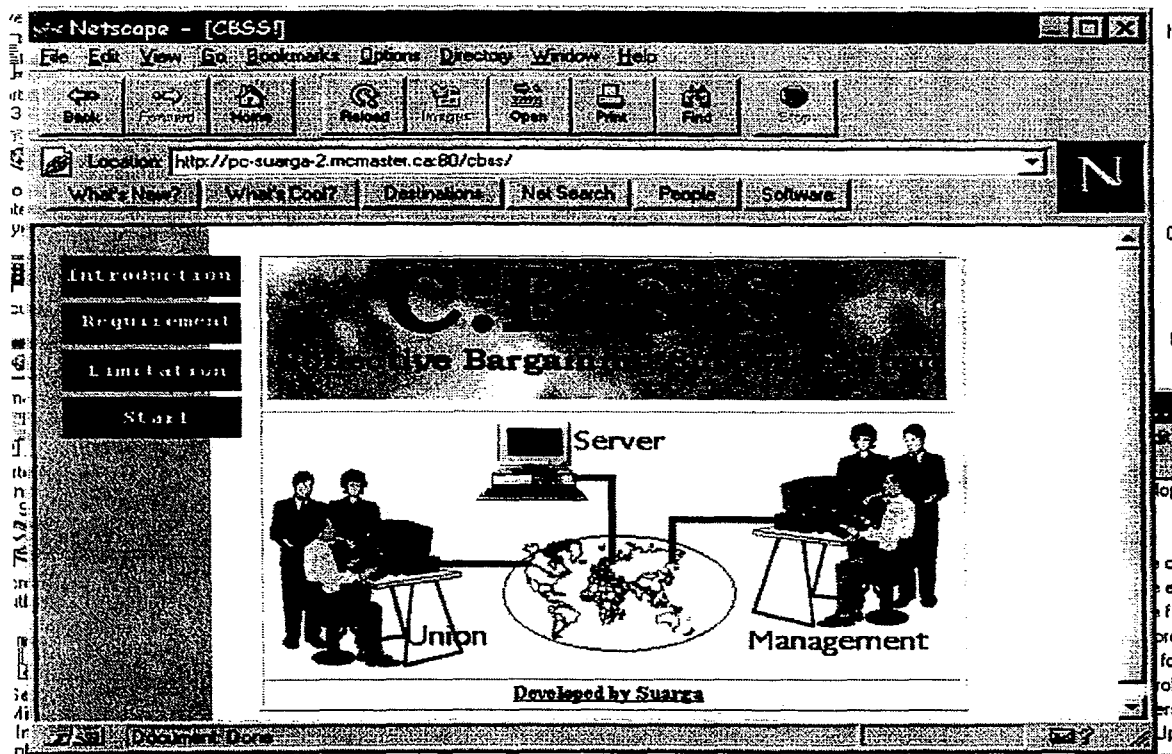| Category	Number of responses	Examples
Satisfied	41	"I liked the fact that the information we discussed was at our finger tips if we needed to see it again. Moreover, it gave us a chance as a group to collectively discuss our responses, basically letting us think before we talked. Furthermore, the system went smoothly without any problems. On the whole I liked it much better than the face-to-face bargaining." "I liked the computer bargaining because it allowed our team to discuss issues and analyse their position without feeling intimidated by opposing members. Also we could see the entire communications at any time, which made it helpful for when we forgot some positions or items. Good system!!!"
Frustrated	14	"I would rather perform face-to-face bargaining than CBSS. CBSS is more frustrating and stressful. CBSS is too time consuming." "Frustratingly slow process, long wait for responses, couldn't read reactions from bargaining partners. Unsure if arguments were received. Unclear response, couldn't tell if other parties understood communication. Very difficult to move and use flexibility in complex arguments, because of slow response time (because info had to be typed). Other party didn't have many arguments on disk, took a long time to think of responses and then type them in."
Mixed	9	"I think CBSS focus on the problem more if only tool used. I felt because I had FTF with other party I was already aware of personality issues. I believe that CBSS provides better documentation regarding analysis of negotiation strategies. I found that there was a disadvantage because you could not provide supporting document to help is swaying the opponent. Process slower because waiting for response also unaware if arguments received." "With using CBSS, we had time to discuss the issue with the group which was not possible in the face-to-face negotiations. It took longer using CBSS because of computer troubles, and in face-to-face it was much quicker."

Figure 1 - CBSS System Architecture
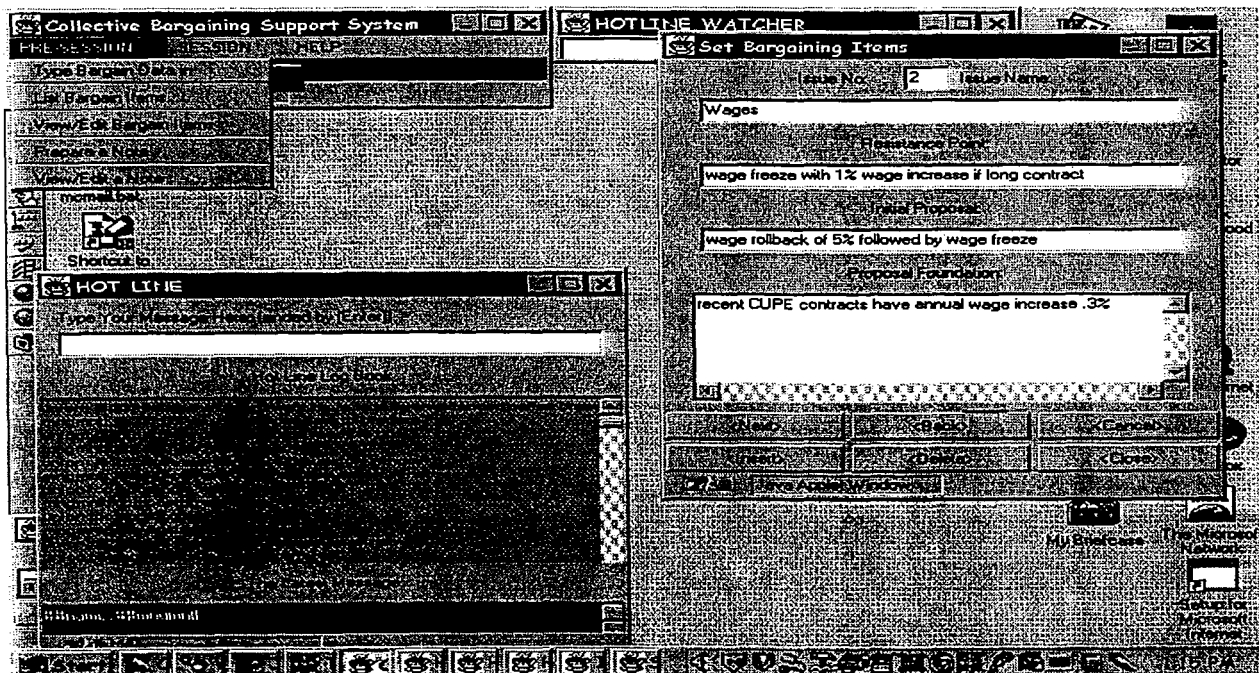
Figure 2 - The CBSS Home Page

Figure 3 - Pre-Session Menu, Hotline, and Set Bargain Items Window
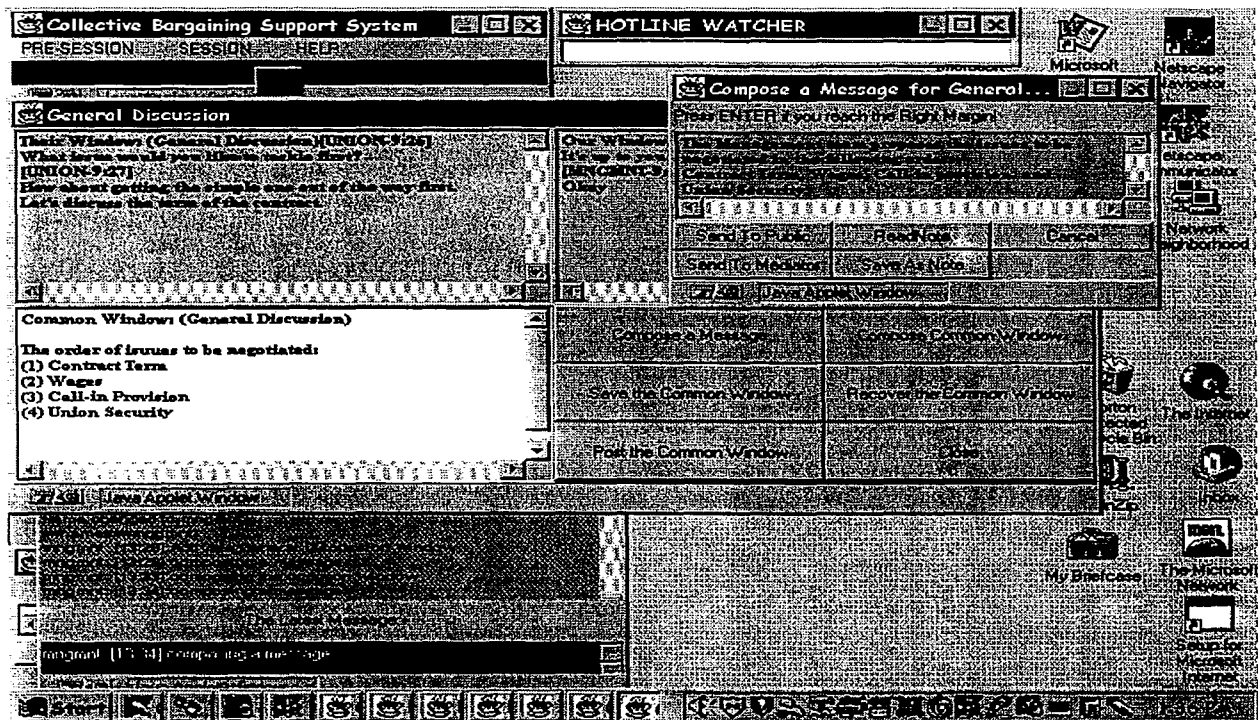
Figure 4 - General Discussion and Compose a Message Windows
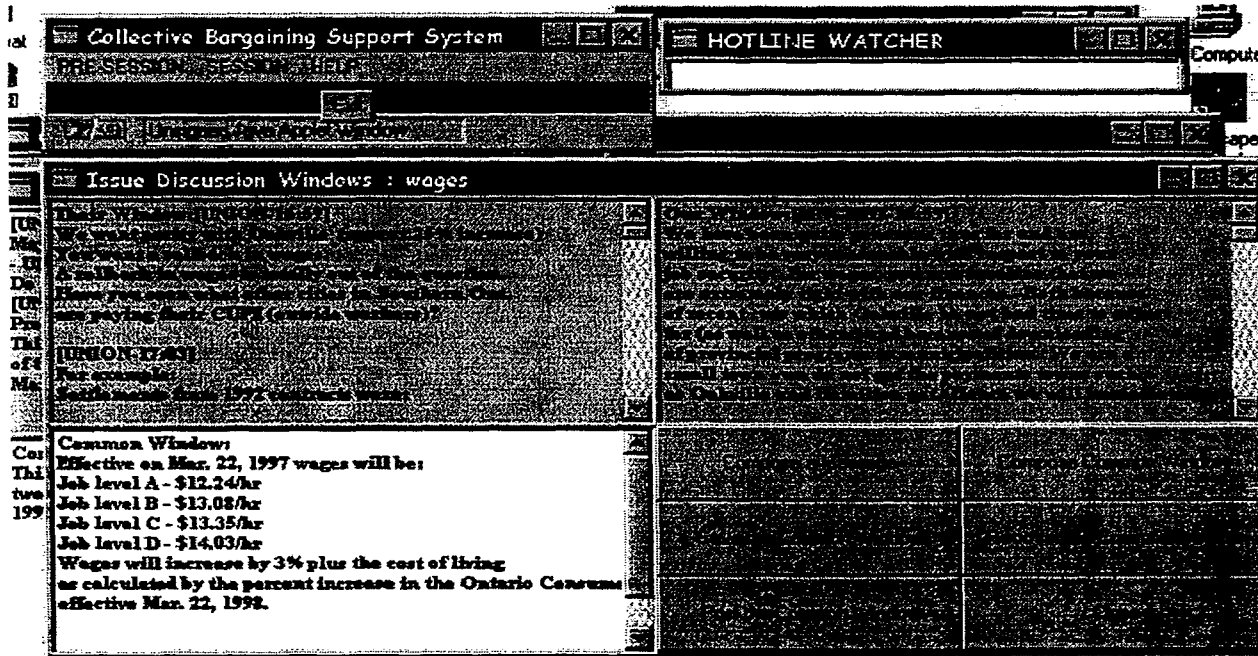

Figure 5 - Issue Discussion Window

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