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E-negotiation systems: Interaction of people and technologies to resolve conflicts [•]

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1. Introduction

The early 1980s saw the first negotiation support systems developed, used and studied. They were preceded by almost ten years of applied and empirical research on *computer-mediated communication*. The seminal study comes out of research concerning the deployment and the users' acceptance of the Emisari system on one hand, and the social and political implications of its use on the other hand in the 1970s (Hiltz and Turoff 1978).

Solutions that in the 1970s were used by a selected few have become ubiquitous and used by millions in their daily activities that include negotiation and conflict resolution. The potential and the limitations of computer-mediated communication for conflict resolution as well as the differences between face-to-face and computer-mediated communication have since then been studied. There is an agreement that the loss of some communication channels is, at least partially, offset by asynchronicity, storage, and access. These three aspects of the information and communication technologies (ICTs) coupled with the ease of use, led to both organized and spontaneous use of software in social and economic transactions, including negotiations and alternative dispute resolution.

ICTs, in addition to connecting people, and allowing them to store and access information, make it possible to use models and procedures to process this information. Software systems have been designed to support decision-making, solve difficult problems and suggest agreements. These systems were used in teaching and training and also in aiding negotiators in resolving their conflicts.

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Recently the term "e-negotiation" was introduced to describe the negotiation conducted with the use of electronic media (Bichler, Kersten et al. 2003). E-negotiation involves the use of ICTs to conduct some or all negotiation activities on-line.

The purpose of this paper is to:

1. Outline recent developments in e-negotiations and software systems used to conduct them;

2. Discuss selected studies of the use of software used in e-negotiations and its impact on the process and outcomes; and

3. Raise—in the context of the impact of software on negotiations—the issue of the relationship between the communication and support, and the potential of software to facilitate and mediate conflict resolution.

Section 2 gives an introduction to negotiation support and e-negotiation systems, and presents their functions and categorizations. In this section passive, active and pro-active systems are distinguished. An example of the active system is given in Section 3. Studies of the impact of the users' culture and other characteristics on e-negotiation process and outcomes are also discussed in this section. A comparison of a passive and active system and their impact on the e-negotiation efficacy is given in Section 4. In section 5 two pro-active systems are discussed and Section 6 presents conclusions.

2. Negotiation, mediation and computer support

2.1 Systems and processes

Negotiation support systems (NSSs) and decision support systems (DSSs) that are designed to support an individual negotiator may be categorized in several ways. Categorization can be based on the technical and methodological aspects, such as, the classes of models embedded in the systems (i.e., descriptive, prescriptive and normative models) or the models types (e.g., mathematical programming models, models based on single- and multi-attribute utility theory, and multi-criteria decision making models).

For the negotiators the role a negotiation system plays in the process may be a more important categorization criterion. Such categorization has been proposed by Starke and Rangaswamy (1999); they distinguish two types DSSs and NSSs: (1) preparation and evaluation systems; and (2) process support systems.

This categorization may be further extended if both the users and the process are considered. There are two groups of users: the negotiators, and the third party. Taking into account the user group and the phase of the negotiation process, the following four types of systems are proposed:

1. *Planning systems* – designed to help one party to organize private and public information, specify the set of alternatives that are acceptable to this party, determine the utility function or another scheme, and prepare negotiation strategies and tactics. Planning systems may also be used to assess the opposing parties and their interests. They are used during the negotiation planning phase.

2. *Assessment systems* – designed to construct alternatives and evaluate their implications, select an alternative to be proposed as an offer and evaluate offers proposed by the counterparts.

These systems are used by a single party. They are enhanced DSSs that allow the consideration of other parties' interests (objectives, preferences and constraints). Assessment systems can be used during all or selected negotiation phases.

3. *Intervention systems* – either enhanced DSSs or special purpose NSSs designed to support one person who acts as a negotiation mediator or arbitrator, or play one of these roles. An enhanced DSS allows the intervening person to input the available information about parties (e.g., their final offers, objectives, preferences and/or constraints) in order to suggest or impose an agreement. The special purpose NSS is used as a replacement of a mediator or, in an extreme case, an arbitrator. The parties communicate with the system and the system suggests or imposes an agreement. Such a system may also be used by a human mediator or arbitrator; the parties input information directly to the system and the intervening person uses it to help or force the parties to reach an agreement. Intervention systems are used in phases: agenda setting and exploring the field, exchanging offers and arguments and reaching agreement.

4. *Process systems* – designed to aid the negotiators in both individual and joint activities; they are used as a bargaining table. These systems influence the negotiation dynamics and procedures. At the very least they provide electronic communication media (e.g., email, chat, electronic whiteboard and video). They may also provide all these support tools that the planning, assessment and intervention systems are equipped with. They may also provide additional support tools facilitating the participative decision-making and aiding the parties in reaching an efficient agreement. Process systems can be used during all or selected negotiation phases.

The above categorization is not limited to DSSs and NSSs. Other systems coming from artificial intelligence (AI) and those in which Internet technologies are implemented can be similarly categorized based on the users they support and the negotiations phases in which they are used. These systems are discussed in the following chapters.

2.2 E-negotiations

Internet and new computing and communication technologies introduced new opportunities for the design and deployment of software capable of supporting negotiators, mediators and arbitrators. Negotiations conducted over the Web are commonly called *e-negotiations* which use *e-negotiation systems* (ENSs).

ENSs are Internet-based systems which differ from other information systems in several key aspects. They are network-centric and rely on ever-present Internet connectivity. They allow for tight integration of inter- and intra-enterprise business processes (e.g., value chain and supply chain management systems) and a large number of people accessing systems from anyplace. Their user interface is provided by the web browsers; it is easy to understand and common to many different applications. Internet popularity stimulated the development of new technologies, including software agents and search engines.

Negotiation systems deployed on the Internet are unlike the previous systems deployed on stand-alone computers or local- and even wide-area networks in terms of the implemented mechanisms and employed technologies. Some of these systems facilitate communication (Yuan 2003), others are active mediators (Kersten and Lo 2003). There are also systems that facilitate joint preparation of documents' content (Schoop and Quix 2001), and systems that allow the negotiators to enter offers which are forwarded to human experts (Cybersettle 2000; NovaForum 2000).

The common feature of the software specifically designed for e-negotiation and systems which have e-negotiation components is that they are deployed on the web and capable of supporting, aiding or replacing one or more negotiators, mediators or facilitators. They are called *e-negotiation systems* (ENS) similarly as e-commerce, e-business and e-market systems.

An *e-negotiation system* (ENS) is software that employs Internet technologies, is deployed on the web, and has one or more of the following capabilities:

1. Supports decision- and concession-making;
2. Suggests offers and agreements;
3. Assesses and criticizes offers and counteroffers;
4. Structures and organizes the process;
5. Provides information and expertise;
6. Facilitates and organizes communication;
7. Aids agreement preparation; and
8. Provides access to negotiation knowledge; experts, mediators or facilitators.

Defining ENSs as software deployed on the web and capable of aiding one or more negotiators, mediators or facilitators allows us to include email, chat and streaming video (Moore, Kurtzberg et al. 1999; Lempereur 2004), and software for automated negotiations and auctions (Zlotkin 1996; Jennings, Faratin et al. 2001).

E-negotiation is a process that involves people and ENSs. In some processes the ENS's role is passive; i.e., email and streamed video. More advanced systems actively participate in the process including the assessment of offers' implications, suggestions for new offers and agreements and critique of counter-offers. E-negotiations conducted via such ENSs are an example of a socio-technical system.

A *socio-technical system* is a system that comprises people and technological solutions–both actively involved in the processes–rather than a social system that is facilitated with technology (Ropohl 1999). In a socio-technical system, people, practices, technologies and values interact in a given setting (Nardi and O'Day 1999). The overall role and behaviour of an ENS in a negotiation is a key consideration in its design and use. While passive systems can be seen as fast and sophisticated messengers, active systems can facilitate, support and mediate. The systems that can access and process knowledge and are able to work independently of their users, that is, they have a certain degree of intelligence and can be proactive. From this perspective we can distinguish three broad classes of ENSs:

1. *Passive systems* that facilitate communication and interaction of the users located in different places, and presentation of their ideas, offers and arguments. These systems may also provide support for the storage, organization and retrieval of information. Passive systems, such as email and chat, are not concerned with the way this content is produced and with the use of resources required for production. Their functions are the first three types of activities listed in Table 1.

2. *Active facilitative-mediation systems* aid the users in the formulation, evaluation and solution of difficult problems, concession-making and construction of offers, and assessment of the process and agreement. These systems typically follow a process model of the negotiation that users need to conform to. They also have components for problem structuring and solution components, and for offer assessment and counter-offer construction. The models embedded in the active systems are models of the problem, the negotiators and the process (Table 1).

3. *Proactive intervention-mediation systems* have the same capabilities as the active facilitative-mediation systems, but they also are capable of coordinating the negotiators' activities, cri-

tiquing their actions, and making suggestions as to what offer should be made or what agreement should be accepted. To provide these capabilities the active intervention-mediation systems access and use knowledge-bases and employ intelligent software agents that monitor the negotiation process and the negotiators' individual activities. These systems have all the functions listed in Table 1.

Table 1. ENSs functions and activities

Function	**Activities**
	Communication, presentation and interaction
Transport and storage	Transport of information among heterogeneous systems; storage in distributed systems; security.
Search and retrieval	Extraction, selection, comparison and aggregation of distributed information.
Formatting, presentation and interaction	Data formatting for other systems use; data visualization, alternative data presentation, user-system interaction.
	Decision problem and negotiators
Decision problem formulation	Formulation and analysis of the decision problems; feasible alternatives; decision space, measurement.
Decision-maker specification	Specification of constructs describing decision makers; preferences, measures for alternative comparison; negotiators' models and styles.
Strategies and tactics	Evaluation and selection of the initial strategies and tactics.
	Process
Offer and message construction and evaluation	Formulation of offers and concessions; analysis of messages and arguments; argumentation models.
Counterpart analysis	Construction and verification of models of negotiation counterparts; evaluation and prediction of their behavior
What-if, sensitivity and stability analyses	Analysis of offers and counter-offers; equilibrium analysis; assessment of the potential agreements.
	Knowledge
Process, history and their assessment	Construction of the negotiation history; process analysis; progress/regress assessment; history-based predictions.
Knowledge seeking and use	Access to and use of external information and knowledge about negotiation situations and issues arising during the process; comparative analysis.
Negotiation protocols	Specification of, and adherence to, the negotiation agenda and rules.
Strategies and tactics	Assessment of counterparts' strategies and tactics; modification of strategies and tactics.

The use and impact of the passive systems on the negotiation process and outcomes has been studied and a number of recommendations proposed (Valley, Moag et al. 1998; Croson 1999; Kopelman, Rosette et al. 2001; Thompson and Nadler 2002). Studies of email negotiation noted that the narrow communication bandwidth has adverse effects on the process and the bandwidth should be augmented with, for example, telephone conversation. These studies also recognized the importance of non-task related activities on the relationship and the negotiation outcomes.

The non-task related activities are of particular significance for negotiators who need to establish rapport, trust and reduce the social-distance with the other party, and who employ positive or negative emotional style as opposed to the rational style. Other researchers observed biases affecting email negotiation, that is, temporal synchrony, burned bridge, squeaky wheel and sinister attribution (Thompson and Nadler 2002).

Negotiations conducted via both email and mail, use a post-office system. Although there are differences between these two forms of the negotiation, for example, time between exchanges, the concept of exchanging written messages in an asynchronous mode is the same. In both, the communication bandwidth is narrow, the written (typed) medium reduces engagement in non-task related activities, a number of confrontational tactics, e.g., demanding immediate answers, are not effective, and there is more opportunity for a careful consideration of the process.

The potential of ICT is much more than just communication. In the next two sections active and proactive systems are discussed. The focus is on their use and contribution to the negotiation process efficacy.

3. Negotiations via Inspire

3.1 The Inspire system

The Inspire system was developed in 1995 as part of the InterNeg research program (http://interneg.org). Since 1996 it has been used to conduct anonymous bilateral negotiations; the system address is http://interneg.org/inspire.

The system implements a three phase-model of negotiations: pre-negotiation, negotiation, and post-settlement (Figure 1). In the pre-negotiation phase the users analyze the case and specify their preferences. During the negotiation phase the system provides utility values of decision alternatives considered by the user and offers submitted by both parties. The post-settlement phase is used if the parties achieve an inefficient compromise; the system presents up to five efficient alternatives and the negotiators may continue their negotiation until they reach an efficient compromise.

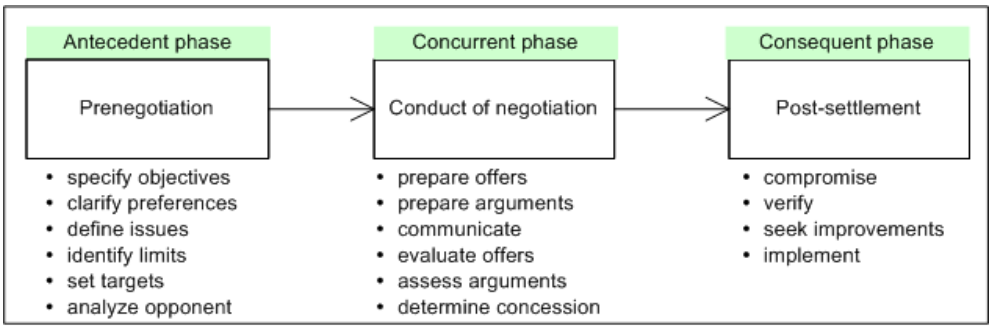


Figure 1. Negotiation phases and activities supported with Inspire (Kersten and Lo 2003)

The Inspire system has been used in teaching and training. The use of the system is free providing that the users agree to fill in two questionnaires and that the developers can use the information they exchange for research purposes. A number of results has been published (Kersten and Noronha 1999; Kersten 2003; Kersten, Köszegi et al. 2003; Kersten and Zhang. 2003; Köszegi, Vetschera et al. 2004; Vetschera, Kersten et al. 2004).

3.2 Negotiation cases

Typical Inspire negotiations involve a negotiation case in which the negotiators represent two companies: Itex Manufacturing, a producer of bicycle parts, and Cypress Cycles, which builds bicycles. Both sides negotiate over four issues: the price of the bicycle components, delivery schedules, payment arrangements and terms for the return of defective parts. There are between 3 and 5 predefined options for each issue, so there are altogether 180 complete and different potential offers (Figure 2).

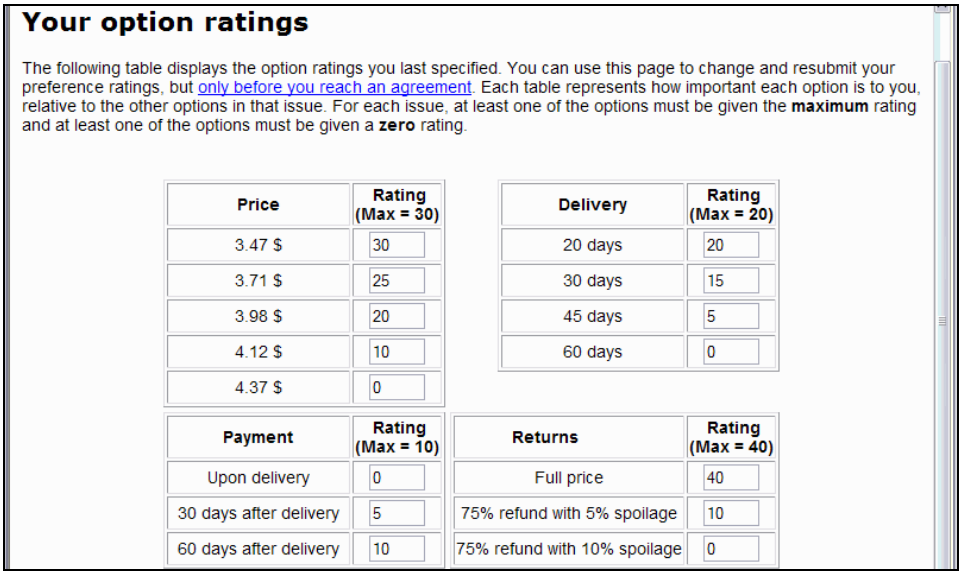
The case is fairly simple, well structured and fits within one and a half pages. Users from almost any country are familiar with such a negotiation situation so an extended contextual explanation is not required. The research purpose requires the use of the same case description and the same decision alternatives in all negotiations.

In addition to the Itex-Cypress negotiations Inspire has been used with more complex cases. The case describing negotiations between teachers' union and the management of a school district has seven issues and 8,100 alternatives. (The negotiation issues for this case are listed in Figure 3.)

The most complex and highly specialized case involves the negotiation between a health management organization (HMO) and a hospital. This case has seven issues and 105,000 alternatives.

3.3 Inspire process

Typical Inspire negotiations are scheduled for three weeks. If both users agree, they may request the deadline extension.



Your option ratings

The following table displays the option ratings you last specified. You can use this page to change and resubmit your preference ratings, but only before you reach an agreement. Each table represents how important each option is to you, relative to the other options in that issue. For each issue, at least one of the options must be given the **maximum** rating and at least one of the options must be given a **zero** rating.

Price	Rating (Max = 30)
3.47 $	30
3.71 $	25
3.98 $	20
4.12 $	10
4.37 $	0

Delivery	Rating (Max = 20)
20 days	20
30 days	15
45 days	5
60 days	0

Payment	Rating (Max = 10)
Upon delivery	0
30 days after delivery	5
60 days after delivery	10

Returns	Rating (Max = 40)
Full price	40
75% refund with 5% spoilage	10
75% refund with 10% spoilage	0

Figure 2. Ratings of issue options (Itex-Cypress case)

Inspire users begin their negotiations by reading the case description. They are provided with information about the side they are asked to represent. After reading the case the users are requested to fill in the pre-negotiation questionnaire in which, among other things, they specify the expected outcome and the worst acceptable offer. Subsequently, they are asked to decide about their preferences. They rate

issues, issue options and packages (alternatives) by filling in simple tables, and verify ratings of system-selected offers. An example of the rating process is given in Figure 2.

Specification of the user preferences enables the system to construct the user's utility function (explained to users as offer rating). The straightforwardness and simple informational requirements make the system easy to use for people from different educational, professional and cultural backgrounds.

Every time the user logs in to the system she/he is provided with the list of the negotiation phases and steps. The phases and steps that the user completed are marked. The page shown in Figure 3 was displayed to the user "Manag01" who completed the negotiation preparation phase.

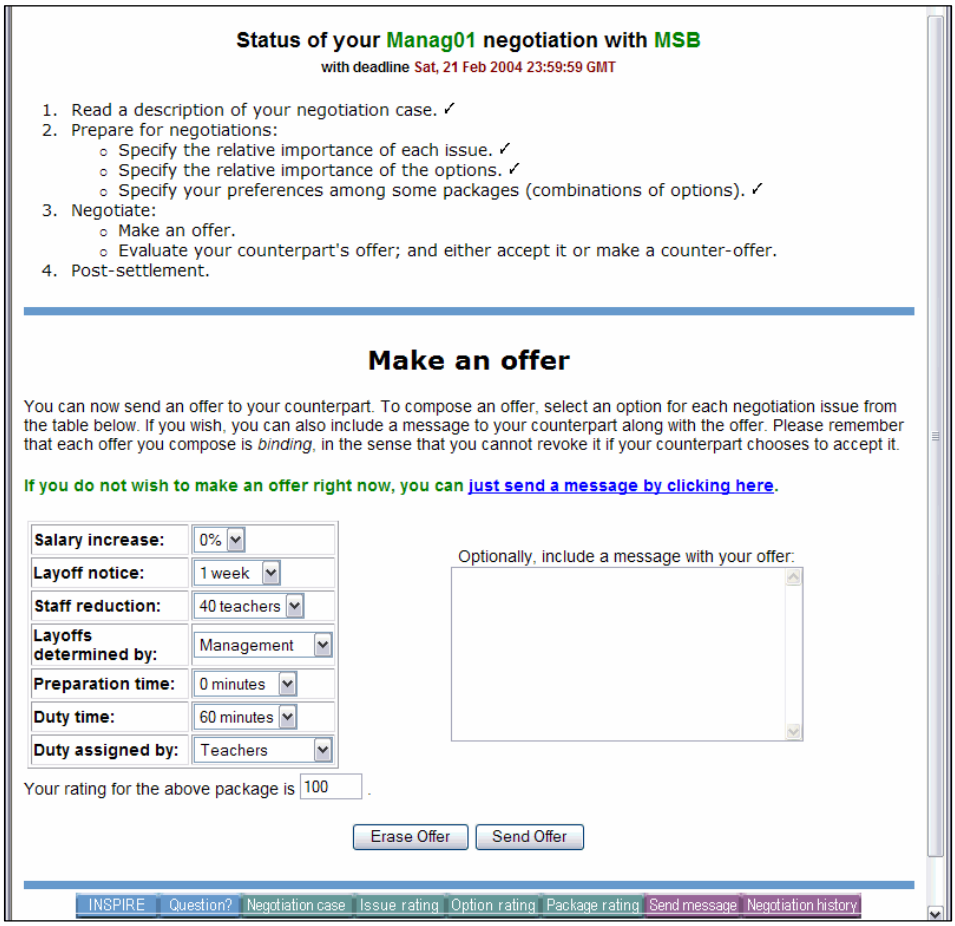


Figure 3. Using Inspire to construct an offer (Union-Management case)

Negotiation preparation leads to the offer construction activity depicted in Figure 3. There are two parts to offer construction: a table in which issues and options are given (options are drop-down lists) and a box in which the user can write a message. The user selects the value for each issue and the systems give the utility value (rating) for the package. Users may compare this rating with ratings of the preceding offers. Verbal messages allow the negotiators using different pressure tactics to influence their counterparts' decisions and "wrinkle out" any outstanding issues. The negotiators may also use a separate form and send a message which is not related to any offer.

An example of offers and messages exchanged by two Inspire users is presented in Figure 4. It contains the history of one Itex-Cypress negotiation. As mentioned above, the users can attach text messages to offers, exchange offers without messages and exchange messages without offers. This opportunity for enriched communication not only makes the negotiation process more realistic, but also helps situating the negotiation for both parties. By exchanging information about attitudes and expectations, negotiators can more easily create a positive atmosphere and develop a personal relationship based on mutual understanding and trust, or exert pressure on negotiation partners.

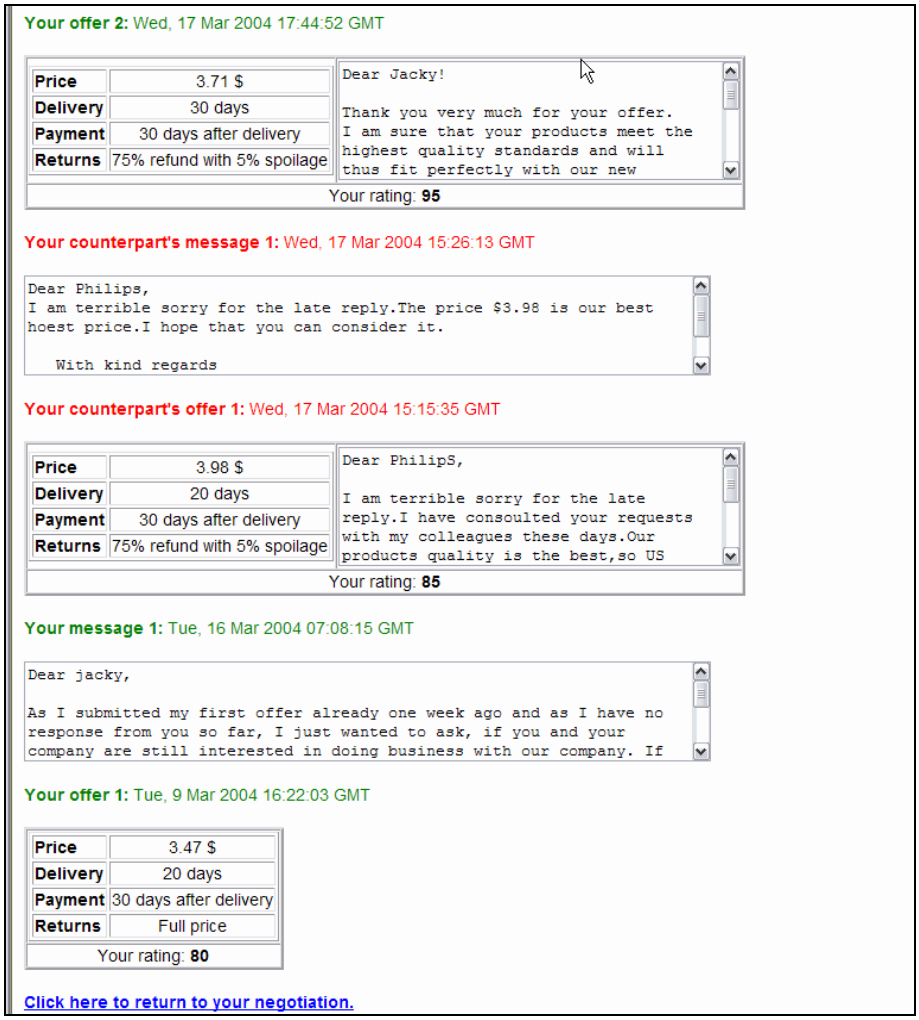


Figure 4. History of offers and messages (Itex-Cypress case)

During the negotiation the participants can check the history of offers and counter offers as shown in Figure 4. They can also see a graphical representation of the history of offer exchanges (Figure 5). The graph presents process information to both parties in a symmetric manner. Each party can see only their own ratings (utilities) and the color-coding is uniform: green for the supported user and red for the opponent. Figure 5 presents two graphs; one for “mirovich” and another for “Peggy” who is his partner. The graph presents the negotiation dynamics in each user’s utility (rating) space.

After the parties agree upon a compromise, the system determines whether the achieved compromise is non-dominated (efficient). If the compromise is inefficient, the system suggests a post-settlement

phase. This phase begins with the computation of efficient alternatives, which dominate the achieved compromise.

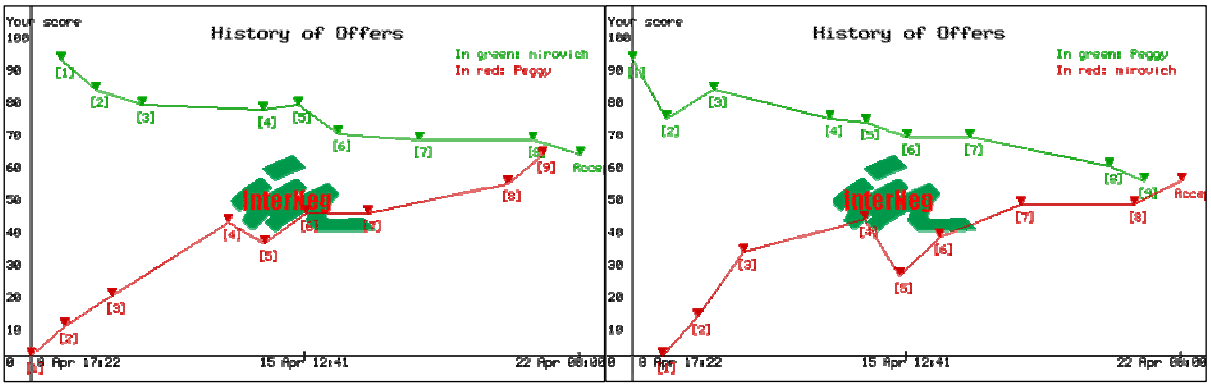


Figure 5. History graph: (a) From “mirovich” perspective; and (b) From “Peggy” perspective

The history graphs are constructed during the process and they illustrate the negotiation in one negotiator’s utility space; each negotiator may review the process and see how close they parties are to the consensus measured with her/his utility (rating) value. Figure 5 illustrates the situation when both parties achieved a compromise.

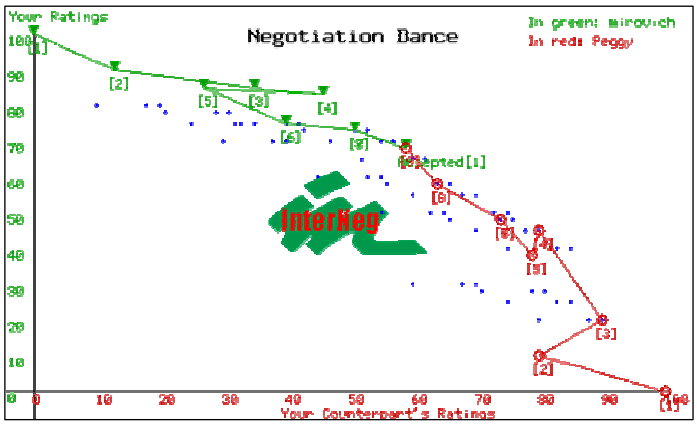


Figure 6. Negotiation dance graph of negotiation between “Peggy” and “mirovich”

The parties, after the negotiations have been completed, may agree on revealing their preferences to the other side. This allows the system to construct the negotiation dance graph which is presented in Figure 6. Because “Peggy” and “mirovich” achieved an efficient agreement no further improvement was required.

3.4 Inspire users

Between 1996 and May 2004, 6,126 people from 62 countries negotiated via the Inspire. Most of the users are students, managers, lawyers, engineers and physicians. 96 percent of the 3,195 users who filled in the post-negotiation questionnaire said that they would use such a system to improve their negotiations skills. 84 percent of the users would use the system to prepare for actual negotiations and 62 percent – to conduct actual negotiations. Taking into account the fact that Inspire is a fairly simple

system, is limited by the Internet technologies that were available in mid 1990s, and has limited capabilities, these responses can be considered very positive.

4. Culture and e-negotiations

We have collected and used data from Inspire negotiations to study the impact of the users' culture, gender, age and other characteristics on the process and outcomes of e-negotiations (Kersten and Noronha 1999; Kersten, Köszegi et al. 2003; Köszegi, Vetschera et al. 2004). In one study we estimated individual and simultaneous multivariate general linear models (GLM) for dependent variables: perceptions of the system's usefulness, its ease of use, the usefulness and actual use of the system's message system, and the usefulness of its analytical features. Gender, occupation, culture, and previous use of NSS were factors while age, present Internet access and previous negotiation experience were variates (Köszegi, Vetschera et al. 2004).

Apart from country of residence, only two user characteristics had significant impact on the perceived usefulness, ease of use or actual use. Previous negotiation experience had a positive influence on perceived ease of use with a parameter estimate. Present Internet access significantly influenced actual use, i.e. the more frequent the user accesses the Internet, the more often he or she actually sends messages or offers.

The only consistent influence on all four dependent variables was the user's country of residence. Figures 7-9 give an overview of the means of all four dependent variables across eleven countries that are grouped in five ethno-linguistic groups.

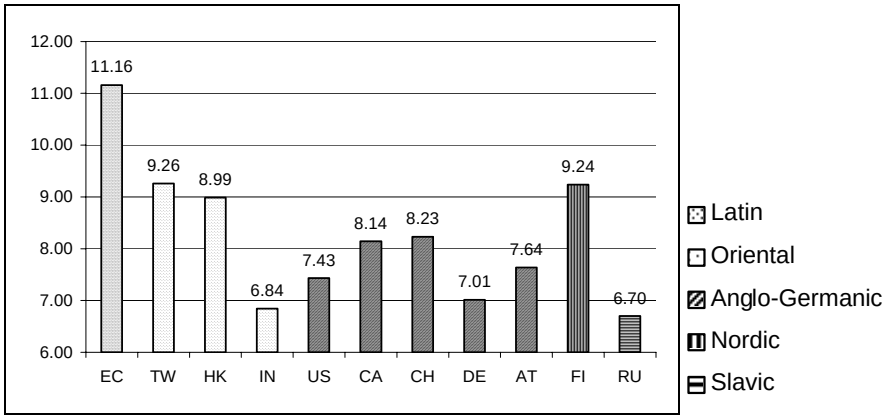


Figure 7. Verbal communication: Mean no. of messages exchanged (Köszegi, Vetschera et al. 2004)

The mean number of messages (with and without offers) sent by users from each of the eleven countries is given in Figure 7. Ecuadorians (EC) sent over 11 messages on average, followed by Taiwanese (TW), Finns (FI) and users from Hong Kong (HK). Swiss (CH) sent over 8 messages on averages and users from the USA (US), Austria (AT) and Germany (GE) sent over 7 messages on average. The smallest number of messages (app. 6) was sent by Indians (IN) and Russians (RU).

It is interesting to compare the actual use of verbal communication (Figure 7) with its perceived significance (Figure 8). Finns and Ecuadorians who sent a significantly higher number of messages than other users perceived these messages being significantly less useful than the others. Users coming from Anglo-Germanic countries (with the exception of Austrians) assign the highest importance to

verbal communication but use it significantly less frequently than users from Latin and Oriental cultures. Estimation a GLM on the aggregated level of ethno-linguistic groups shows a significant difference in the perceived importance.

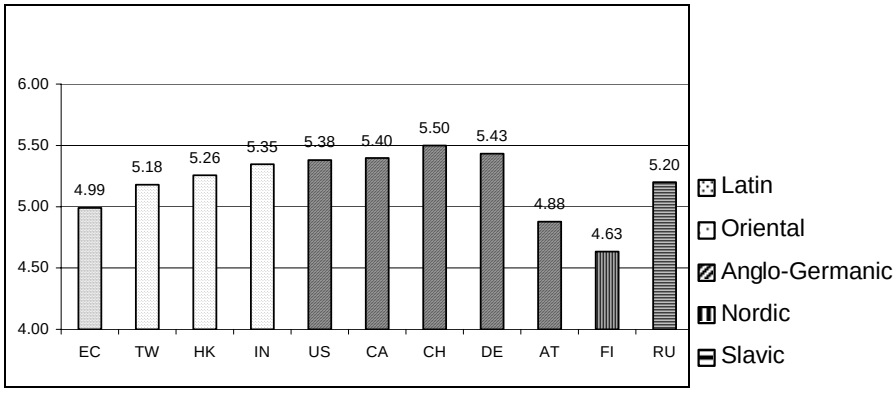


Figure 7. Perceived importance of verbal communication (Köszegi, Vetschera et al. 2004)

In Figure 9 the perceived importance of Inspire analytical tools is shown. The pattern is quite different than the one based on the perceived importance of verbal communication. Users from Ecuador perceived this feature less useful than other users. Also users from Taiwan, Hong Kong and Russia evaluated the usefulness of the analytical feature lower than the average, although the difference to the mean is not significant. But when we compare users from Taiwan to users from the USA, the difference becomes significant.

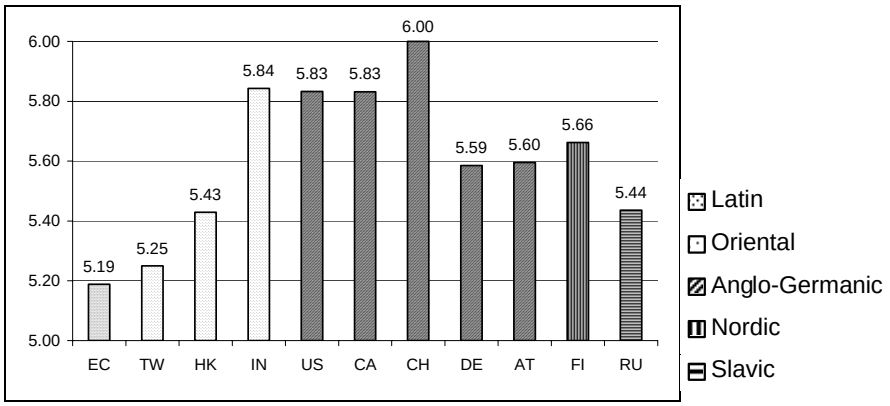


Figure 9. Perceived importance of analytical tools (Köszegi, Vetschera et al. 2004)

Users from USA, Canada, and India evaluate the usefulness of analytical features significantly higher than the average. Swiss users evaluated usefulness also relatively high, although the difference is statistically not significant. When we compare variances of ethno-linguistic groups, we find a significant difference. Especially the Anglo-Germanic group perceived this tool significantly more useful and the Latin group perceived it significantly less useful. Between low and high context cultures the difference in perceived usefulness is significant, i.e. users from low context cultures assessed the analytical support function of Inspire significantly better than users from high context cultures.

The above discussion illustrates the type of studies we conduct and it gives grounds for the statement that:

> "E-negotiation systems are used and perceived differently by users coming from different countries and therefore the users' culture should be considered in the systems' design."

Other studies with the Inspire data show that cultural factors have a significant effect on:

- Utility of the expected and achieved agreement,
- Utility of the worst acceptable compromise, and
- Expected friendliness of the negotiation.

Gender also plays a difference; we have found that in negotiations between anonymous partners:

- Males are somewhat less likely to reach agreements than females.
- Agreement achieved by females has a significantly lower utility value than achieved by males.

The study of the use and perceived usefulness of verbal communication and analytical tools that allow constructing and assessing offers was based using data only from Inspire. This allows for the consideration of the users and their characteristics but not the impact of the different tools on negotiations efficacy. Such a comparison is discussed in the following section.

5. Comparison of two systems

5.1 SimpleNS

Beginning with the Mehrabian's (1971) widely quoted study the importance of nonverbal communication has been widely recognized. Researchers consider his assertion of 93 percent of communication being nonverbal too high, but they universally accept the importance of the "other-than-words" communication. Recent studies approximate nonverbal communication at 60 percent (Hickson, Stacks et al. 2004). One may note that the context, in which people communicate, the task, purpose and subject may strongly influence the importance of verbal and nonverbal communication. This is not to say that nonverbal communication is not relevant but that the percentage may be very different in various situations.

Notwithstanding the above caveats, nonverbal communication does play a role in negotiations. It has been therefore concluded that, compared to face-to-face communication, narrow bandwidth communication channels make it more difficult to establish rapport and trust, and achieve desired outcomes (Valley, Moag et al. 1998; Croson 1999). One limitation of these and other studies is that they compared email with face-to-face negotiations. Clearly the use of ICTs to exchange messages severely restricts the negotiators' ability to express their ideas and opinions. But, as Inspire and other ENSs show, ICT can be used to aid and support their users, which obviously a passive system like email cannot do. The question remains: Is there a difference between the use of passive and active ENSs? To study this question we built a passive system called SimpleNS.

The SimpleNS system, contrary to Inspire, does not impose on the participants the requirement to formulate and exchange complete offers. It does not ask for the user's preferences, construct the utility function and displays negotiation graphs. It is a little more convenient than an email system because it allows for the separation of offers and messages, and the whole negotiation history is easily accessible and presented in chronological order on one page.

There are only three pages in SimpleNS: the case description page, the data input page and the negotiation history page. The data input page is presented in Figure 10. It is comprised of two boxes, the message box (on the left-hand side) and—next to it—the offer box. However, the system does not enforce the use of the space given in each box and does not display the negotiated issues and their options. This makes it possible that, for example, an offer can be written in the message box, separately or embedded in a message.

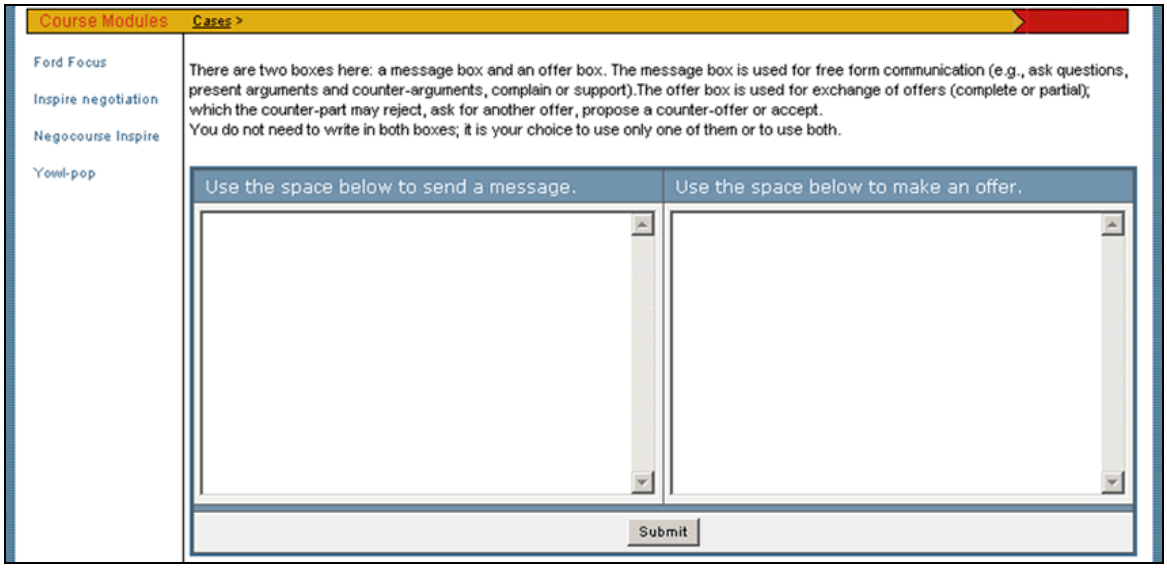


Figure 10. SimpleNS data entry screen

An example of the negotiation history is presented in Figure 11. From Figures 10-11 it can be observed that the system provided more capabilities than a standard email system. However, SimpleNS being a passive ENS has no analytical tools and its capabilities are limited to the storage, retrieval, organization and display of information.

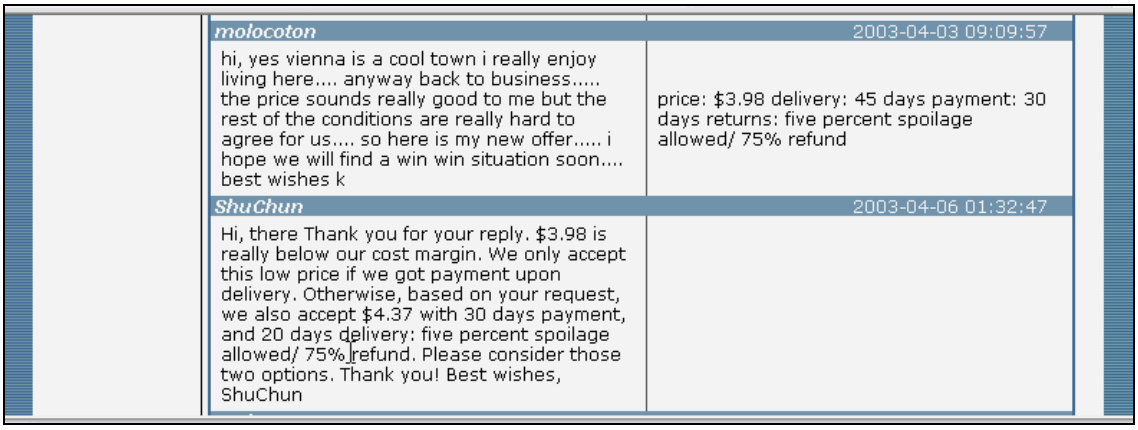


Figure 11. An example of SimpleNS negotiation history

Two exchanges between SimpleNS users are presented in Figure 11. The user who is called “molocoton” separated his message from his offer (top part of Figure 11). His counterpart called “ShuChun” formulated an offer together with the message rather than using the offer box.

The flexibility of entering offers and messages allows the users make more than one offer in one exchange. "ShuChun" makes two offers (bottom part of Figure 11), he proposes a modification of his counterpart's offer and also presents another offer.

5.2 Effectiveness of two systems

We have conducted an experiment that involved 80 MBA students from Austria and Taiwan. 30 students used the Inspire system and 50—the SimpleNS system. Both groups used the Itex-Cypress negotiation case.

No significant difference was found between the Inspire and SimpleNS users regarding their satisfaction with the process, agreement and their own behavior. Also, no significant difference was found in the users' perception of the counterpart's negotiation approach. Users of both systems required the same, on average, 24 days to achieve an agreement.

Although the Itex-Cypress negotiation case is quite simple, it appears that the cognitive effort required to conduct the negotiation is different for the two systems. Inspire reduces the effort required to make personal and interpersonal tradeoffs (logrolling) and to make the comparison of offers and counteroffers. This difference in the cognitive requirement imposed on the Inspire and SimpleNS users may be behind the Inspire users showing more positive emotions. Inspire users disclosed their identity more often and provided and requested more personal information than the SimpleNS users.

The cognitive effort may also be the reason for the Inspire users exchanging significantly more offers and more messages than SimpleNS users. However, I need to point out that there was no significant difference in total number of words exchanged by the users of the two systems.

Perhaps the most important result is that users who negotiated via Inspire achieved significantly more agreements (14 of 15 dyads) than those who used SimpleNS (17 of 25 dyads). That is, the agreement rate in Inspire negotiations is 93 percent as compared to 68 percent in SimpleNS negotiations.

We plan to continue this study and further verify the results. Notwithstanding the relatively small sample, it is interesting that even in a fairly simple case we find the positive influence of the analytical tools on the relationship between the negotiators exemplified with their positive emotions, interest in the counterparts and information disclosure. We also plan to study the relationship between the task (case) complexity, the process and its outcomes, and the efficiency of the negotiated agreements.

Earlier studies undertaken in laboratory settings and highly stylized negotiation situations show that analytical support leads to higher joint outcomes (Rangaswamy and Shell 1997), solution quality (Poole, Shannon et al. 1992), and equity and fairness (Perkins 1996) as compared with face-to-face and unsupported negotiations. Our study, if confirmed, indicates the positive impact of analytical tools on the use of the integrative negotiation approach and on the e-negotiation effectiveness.

The existing ICTs limit the use of support that utilizes analytical models to highly structured verbal communication. For the support to be effective, the information provided by the users has to be entered in the proper form and type. Voice and image recognition systems together with machine learning and other methods coming from artificial intelligence will in future allow for the analysis of various modes of communication. At present however, we are more limited by the support technologies than the communication bandwidth.

The question that needs be addressed is whether this limitation has a positive or negative impact on the efficacy of negotiations in which active ENSs participate. The assumption that a significantly increased

communication bandwidth that allows for nonverbal communication has a positive effect needs to be verified. Earlier studies with NSS confirm our results that the organization of exchanges, problem structuring and provision of tools that help the negotiators to learn about their needs and preferences may more than offset the reduction in the communication bandwidth.

6. Proactive support

In section 2.2 three types of e-negotiation systems are introduced. SimpleNS is an example of a passive system and Inspire is an example of an active system. We have also developed pro-active systems which employ software agent technologies (Kersten and Lo 2003; Chen, Kersten et al. 2004).

6.1 Aspire = Inspire + Atin

One proactive system is Aspire and it extends Inspire with a software agent called Atin (Kersten and Lo 2003). The Atin negotiation software agent retrieves information from the negotiation knowledge base, and provides advice to the negotiator. The advice is based on the rules of negotiation derived from literature, the status of the current negotiation process and the information about the negotiators stored in one user's database.

Each user, at the beginning of the negotiation conducted via Aspire, decides if she/he wishes to use Atin's services. If this is the case, then an agent is constructed for this user. The user's agent can access only data that is available to this user and its knowledge-base; private data of the counterpart is not accessible.

Atin continuously monitors the negotiation progress. This allows the agent to warn the user about actions that the user undertakes and which may have negative impact on her/his situation. Atin uses simple road signs to provide the user with its general assessment of the current situation. A green sign indicates that there is no warning, yellow indicates a warning, and a red sign (Figure 12) means that Atin sees the user's particular move as incorrect. The three signs show the type of the message that Atin may have ready for display.

An example of a suggestion made by Atin in a situation when the user violates one of the issue ratings rules is presented in Figure 12. In the negotiation case the user represents Itex, the seller, and he is given information regarding this firm's preference directions. Figure 12 illustrates the situation after the user indicated that he considers every issue equally important. Because this contradicts the role of the seller, the agent displays a red sign. Subsequently, the user opens Atin's window (in the lower right-hand corner) in which reasons for the display of the red sign and suggestion for a remedy are given.

The user may also ask the agent for assessment of past activities and for advice regarding possible moves. In order to provide suggestions, Atin may request some additional information from the user (e.g., negotiation strategy, willingness to make a concession, etc.). These inputs from the user will help the agent to filter out irrelevant information, and display the most appropriate advice.

The user may ask Atin for advice regarding possible strategies. The agent displays a list of strategies together with explanations about their positive and negative aspects. An example of a suggestion from Atin is presented in Figure 13. This suggestion is based on the user's earlier decision to negotiate using hard positional bargaining strategy and his request for a possible opening offer. Based on this strategy requirement Atin presents an extreme offer and suggests that the user appends a message supporting this offer. Atin also proposed the structure of the message and its main arguments.

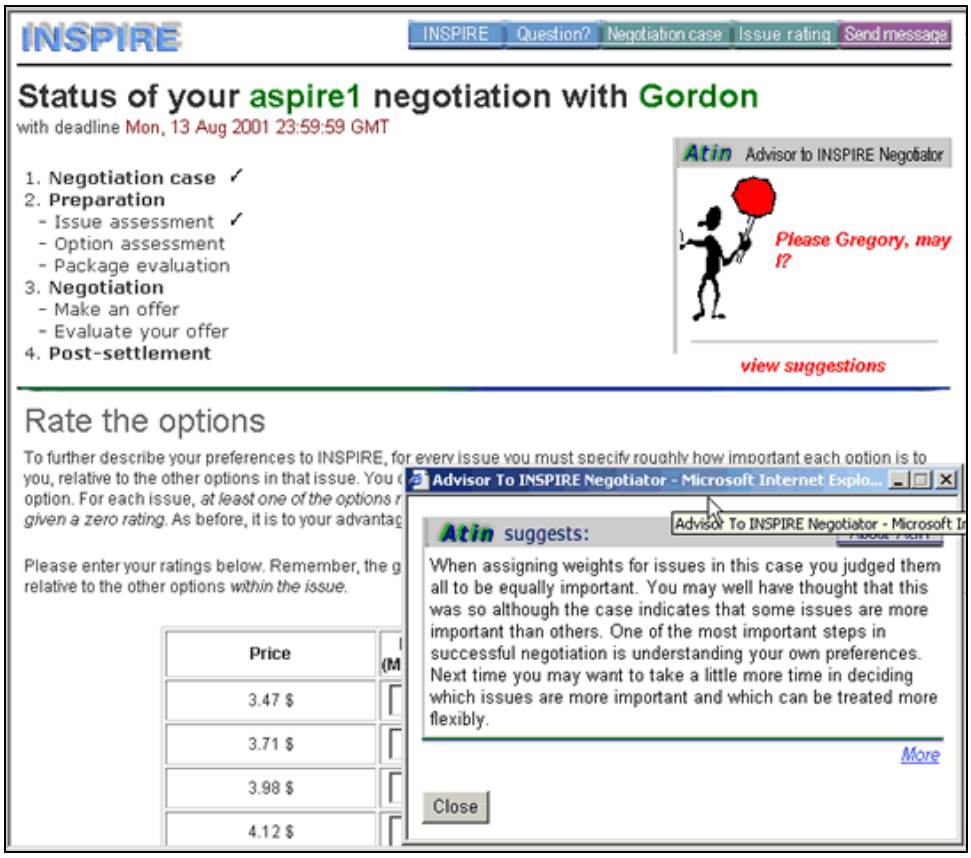


Figure 12. An example of Atin's advice in pre-negotiation phase (Kersten and Lo 2003)

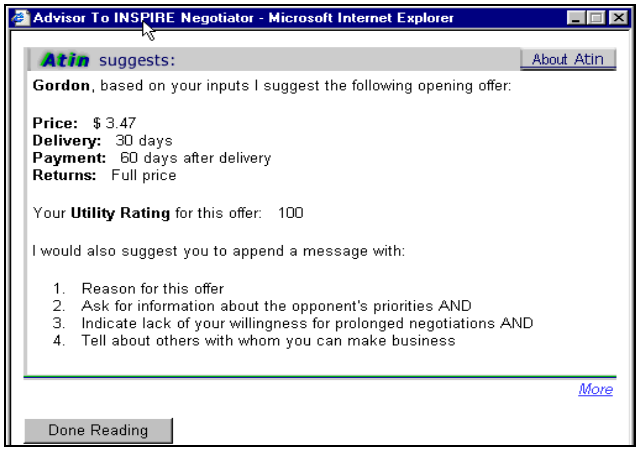


Figure 13. Atin suggests an opening offer (Kersten and Lo 2003)

The Aspire system was tested with two groups of users each comprising 16 students. The first group has used the original Inspire system within the last 12 months. The second group has never used Inspire or another ENS. Both groups used the Itex-Cypress case.

The overall feedback from the users was favourable. For people who have used the Inspire system before, 87% found that the Aspire system provided more support and it was much easier to use compared

to the original Inspire system. This confirms our expectation that Web-based negotiation becomes easier with the aid of an agent.

The users were also asked in the survey whether they feel in control during the negotiation. 24 users, i.e., 75% of all users stated that they were in control of the negotiation process. All users who previously used Inspire noted that Atin assists the negotiation without taking over the control from them. Again, this confirms our expectations: an agent can provide support and advice to the user whenever required, but it does not take over the control of the negotiation.

We were interested in users' perception of Atin adding value to the process and their requirements in that regard. Interestingly, 25% of the users suggested a more structured process-type support. Users' evaluations of Aspire proved that an ENS aided by an active software agent may add to the users experience, help better understand negotiation methodology, and make decision grounded in this methodology. At the same time an active agent does not take control over the system and the negotiation.

6.2 eAgora

The eAgora system is an ENS prototype that provides an electronic marketplace for users to negotiate buying and selling of goods. The system's services include a software agent that generates offers and critiques offers made by the buyer (seller) and their counterparts (Chen, Kersten et al. 2004).

If the user activates the software agent, the agent requests information about the user's negotiation approach and strategy. This information, together with the offers and counteroffers exchanged during the negotiations (if any) is used to determine several possible offers (packages). This list is presented to the user; in Figure 13 five possible offers are listed below the offer made by the negotiation partner (shown in the top table). The user may select one of the suggested offers or construct their own offer and submit it to the counterpart.

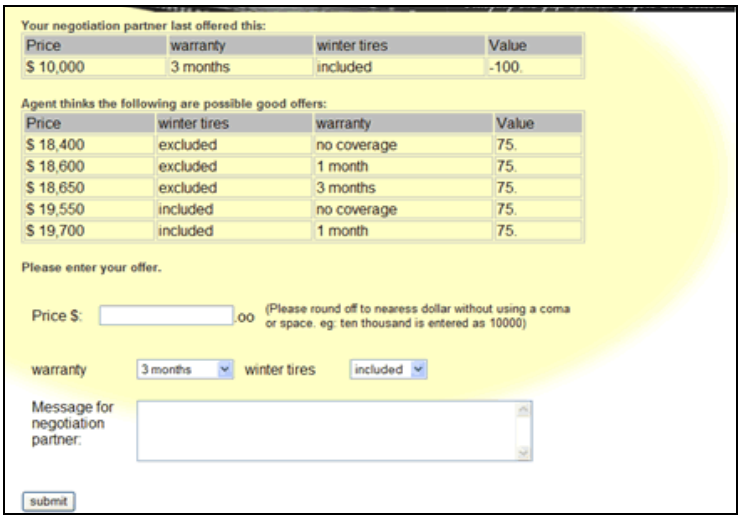


Figure 13. Suggested offers by the agent and offer construction facility (Chen, Kersten et al. 2004)

The agent uses information about the user, his approach, preferences and reservation levels to evaluate the offer that the user wants to propose and offers that the user receives. If the user wants to propose an offer that violates an issue reservation levels or it is not in line with the selected negotiation strategy (e.g., a competitive user makes a significant concession), the agent warns the user and criticises the

offer. It also criticizes the user's attempt to accept an offer that does not meet his reservation level. This example is illustrated in Figure 14. The agent's critiquing ability helps the user to realize the possible deviations from the strategy and preferences that were first adopted, and the need for their revision.

The system's usability testing was conducted with a small group of twelve users who were divided into six buyer-seller pairs. The sellers constructed their own negotiation problem consisting of two to five issues. Each pair first conducted a negotiation using eAgora without an agent, and then they were requested to start a new negotiation with the agent's involvement.

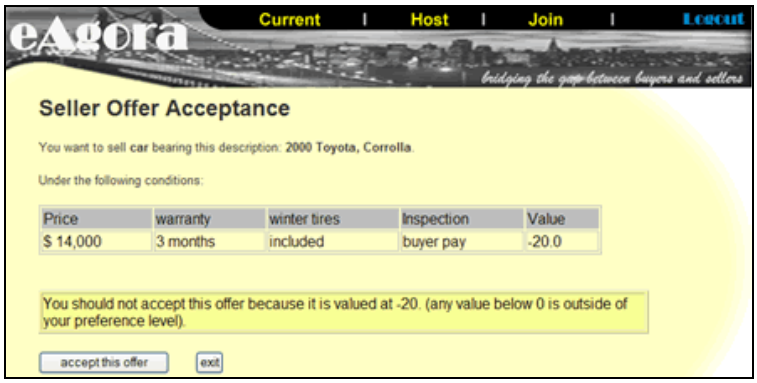


Figure 14. The agent's warning the user not to accept an inferior offer (Chen, Kersten et al. 2004)

The small sample of the users and experiment's focus on the system's usability does not allow discussing the results in terms of their statistical significance. Thus we stress that the results are preliminary and need be confirmed with a larger sample and an experiment designed for this purpose. These results showed that 92 percent accepted the agent's services. 83 percent of users noted that the agent provided helpful advice and everyone expressed the opinion that with the agent they felt in control of negotiations at all times. The intriguing result that we plan to turn our attention to in future experiments is that the use of the agent increased agreements by 17 percent as compared with the negotiation conducted without the agent.

7. Conclusions

Many models embedded in the early negotiation support systems were based on unrealistic assumptions or required analytical skills from their users. The majority of e-negotiation systems do not have these limitations because they are designed for the negotiators rather than analysts. These ENSs are active or pro-active; they participate in the conflict resolution process undertaking activities that traditionally were in the domain of facilitators, mediators and arbitrators.

The activities of intermediaries are often highly complex, fluid and difficult to formally represent. In some situations mediators and facilitators need to deal with emotions and negative attitudes; they need to create an atmosphere of cooperation and problem-solving. This raises such questions as: Can ENSs be used for conflict resolution? What should their role be? Should ENSs cooperate mostly with the third parties, the negotiators or both? The first two questions were raised during the closing session at the *13th Symposium on Conflict Resolution* in Ottawa (Feb. 06, 2004). Many disputants stated that there is no place for "faceless and soulless" technology; that mediation has to be done face-to-face because it demands compassion and understanding.

The importance of negotiations and problem-solving in all aspects of human endeavour engendered vast literature on face-to-face negotiation. ICTs make it possible to solve conflicts remotely and asynchronously. These technologies—as most participants of the *Third Annual Forum on Online Dispute Resolution* in Melbourne (July 5-6, 2004) agreed—allow the conflicting parties to communicate with facilitators and mediators and seek their advice. Is it necessary, however, for all online conflicts to be facilitated or mediated by a human? It appears that many of the Forum's participants would have given a positive answer to this question.

Clearly the new modes of negotiations are impoverished by the absence of human contact and non-verbal communication. This is not necessarily detrimental to conflict resolution. Narrow communication bandwidth may—on its own merit—reduce the cognitive effort; ENSs users can interpret only 40 percent of communication, namely, its verbal portion. The asynchronous communication mode may help the users to be well prepared and reduce their anxiety and apprehension.

One of the purposes of this paper is to note that there is a trade-off between the loss of communication bandwidth and the gain of processing capability. Verbal and structured communication can be enriched by powerful and fast analysis, simulation and visualization tools, and access to knowledge and expertise of others. It enables automatic capturing, storing and processing of exchanged information, as well as detailed comparison with precedents, models and prescriptions. The scope and depth of the analysis that is becoming available could have an effect similar to that of large teams of analysts. There exist ENSs that allow domain experts unfamiliar with modelling techniques to build analytical models, determine solutions, and conduct sensitivity analysis.

Systems that help users formulate and solve problems, assess offers, and propose concessions and agreements increase and enrich peoples' abilities and thus empower them. These systems guide and help the negotiators to learn about the problem, themselves and their counterparts. This can have the double effect of increasing the negotiators' access to knowledge and freeing up time for the central activity of decision-making and relationship-building. These systems, perhaps paradoxically, may be able to help their users in establishing rapport and trust, and reduce social-distance with the other party. They may facilitate employing the rational problem-solving approach together with counterpart-oriented positive emotional style.

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