Negotiations in Electronic Commerce: Methodological Misconceptions and a Resolution[1]

Gregory E. Kersten[1] and Sunil J. Noronha[2]

[1]International Institute for Applied Systems Analysis, Laxenburg, Austria (kersten@iiasa.ac.at)

[2] Concordia University, Montreal, Canada.

[3] IBM T. J. Watson Research Center, Yorktown Heights, USA. (noronha@watson.ibm.com)

Abstract

We contrast the software agent and decision support based approaches to negotiation in the context of electronic commerce, and explore their respective limitations. The software agent literature on negotiations shows several misconceptions about the nature of negotiations, interdependencies between goals and issues, the significance of different types of processes and representation schemes, etc. Particularly important among these misconceptions are those involving the distinction between distributive ('win-lose') and integrative ('win-win') negotiations, and we observe that almost all negotiating software agent approaches support only the former type. We resolve these inconsistencies and suggest how decision support based approaches may be used to shift agent negotiation processes into integrative modes. The discussion of the characteristics of negotiations leads us to suggest an resolution in which both integrative and distributive activities can be used, and to propose an e-commerce infrastructure in which negotiators interact with decision support systems which in turn interact with negotiating software agents.

---

[1] We wish to acknowledge the contribution of Gordon Lo to this paper. Ideas presented by Prof. Mel Shakun in his numerous publications and discussions with Prof. Jeff Teich helped us clarify our views. This work has been partially supported by the Social Science and Humanities Research Council of Canada, the Natural Sciences and Engineering Research Council of Canada, and the International Institute for Applied System Analysis.

1. Introduction

Negotiations between buyers and sellers, both institutional and individual, involve several activities grouped in the value chain (Runyon and Stewart, 1987). The availability of electronic commerce tools allows individual and organizational customers to search for suppliers anywhere and make deals electronically. Companies aggressively try to attract customers; in conjunction with the expansion of the markets, this sharply increases the number of companies customers may have to deal with for their success. Business decision making and negotiations (conducted both by individuals and organizations) become increasingly complex as access to markets becomes faster and wider, and the amount of interaction shoots up almost uncontrollably.

Current work on the technologies that support consumers and businesses in making purchasing decisions is in the development of software agents and Web-based decision support systems (DSS) populated by multiple interacting agents. These programs are generally very simple from the point of view of decision making and negotiations. Most of them do not allow multi-party and multi-issue negotiations, typically employ one mechanism for offer evaluation and do not account for behavioral and process aspects of negotiations.

DSS and software agents are two technologies that share a number of similarities. Although DSS had already been proposed in the mid-seventies, data warehousing, OLAP and data visualization techniques have only recently led to their widespread use in business. While DSS have their roots in business and management information systems they often contain significant knowledge and model components. Their aim is to support decision makers and in that they rely heavily on user's input, especially about goals. To effectively solve difficult problems and provide meaningful advice they need to be personalized and reactive, and to a large extent, express semi-autonomous behavior. These are also the qualities expected from software agents, which, in addition, are expected to run continuously, and often be mobile and "social" as well (Franklin and Graesser 1996; Guttman, Moukas et al. 1998).

The ability to obtain from a user the information that is necessary to solve a decision problem, and personalization, are key issues in decision support. The focus is on the users; on their abilities to provide input and their information requirements, cognitive abilities, and output expressiveness. A significant effort has been made to construct representational models of decision-makers ranging from purely rational to heavily descriptive, and from analytic to holistic.

Software agents can perform a multitude of functions ranging from information search and messaging to acting as users' representatives and intermediaries. In these roles they are considered to be crucial in all aspects of electronic commerce, including negotiations (Sandholm, 1999). If, however, negotiation software agents (NSA) are to represent and act on behalf people and organizations they must be able to communicate with them (directly or via DSS) and to use their expertise and knowledge.

Search, auction and preference-elicitation agents have already been successfully introduced into e-commerce (for a review, see Teich, Wallenius et al. 1998). Experimental studies are being conducted towards developing negotiating software agents (NSA) that are capable of conducting business negotiations (Guttman and Maes 1998; Maes, Guttman et al., 1999; Guttman, Moukas et al. 1998; Moukas, Guttman et al. 1999; Sandholm, 1999). Some of these systems are based on theoretical frameworks that are only partially relevant to negotiations. Despite the claims made by the NSA developers, the use of negotiation methodologies is often overly simplified and reduced to one form of negotiation. This may lead to a false impression that NSA are not capable of engaging in, and supporting, context rich and complex negotiations.

We argue that, in commerce activities that require negotiation-like capabilities, both software agent and DSS technologies need to be utilized. Review of the NSA literature shows misconceptions about the nature of negotiations. This paper is based on the premise that although negotiation is an important business activity, its significance in electronic commerce has not been studied and adequate tools are not available. Further, we argue that:

- Despite the claims to the contrary, DSS and NSA support and conduct only distributive negotiations.
- There is a need to develop tools and infrastructure that can support and conduct both distributive and integrative activities. Support for the latter type is especially important in light of the globalization of electronic commerce, because many non-U. S. cultures reject contract-centered and depersonalized forms of negotiation[2].
- In business-to-business negotiations flexible and extensible tools are needed to support both integrative and distributive activities. These tools have to be highly interactive and competent at managing the complexity of multilateral business-partner relationships, especially since

[2] The importance of process in decision making including negotiation is now gaining prominence also be-

each business negotiation tends to be different from all the others, in small, but important, ways.

- Systems that communicate with humans have to be based on a behavioral negotiation methodology and be capable of representing and adapting to cultural (both national and organizational) and other characteristics (e.g., business processes, cognitive limitations) of their governing stakeholders.

Over Sections 2, 3 and 4, we identify and discuss the fundamental issues behind the two forms of negotiation, and resolve common inconsistencies as we proceed. We debate their respective benefits and costs in Section 5. With this perspective, we briefly review negotiation processes and their support requirements in Section 6. Our analysis finally leads in Section 7 to the beginnings of a negotiation support framework that facilitates both integrative and distributive negotiations.

2. Distributive negotiations

There are two main forms of negotiations: distributive and integrative. Distributive negotiations are usually perceived as involving a single-issue; however they may also involve multiple issues. We analyze several key aspects of distributive negotiations in the following subsections, before doing the same for integrative negotiations in Section 4.

Most people have an intuitive understanding of negotiations, as everyone negotiates almost daily. "We may all be negotiators, yet many of us don't like to negotiate. We see negotiation as stressful confrontation." (Ury 1993, p. 5). This statement reflects distributive negotiations in which parties divide a pie; the negotiation is 'win-lose', that is, a concession made by one party is necessarily a gain for the other (Lewicki, Saunders et al. 1997).

Fisher, Ury and other behavioral scientists contrast the popular perception of negotiation as a distributive (win-lose) process with integrative (win-win) negotiations (Fisher and Ury 1983; Ury 1993; Fisher, Schneider, and Kopelman 1994). The distributive view of negotiations is typical for traditional economics but not for negotiation theory and practice, yet it underlies many of the approaches taken in the decision and computer sciences. It appears that the main reason is a blind

---

tween North American managers and executives (Chan Kim and Mauborgne, 1999).

assumption that a move from an inefficient to efficient compromise satisfactorily implies the integrative character of negotiations. In this section we dispute this assumption.

2.1 Issues, objectives, opposition and aspirations

Negotiations are conducted over *issues* and a compromise means that the parties agree on the same value for each issue. Parties engage in the process because they have certain *objectives* whose achievement depends on the values of the issue.

We consider bilateral negotiations between two parties A and B who exchange offers. An offer $\boldsymbol{x}$ is a vector of n issues $\boldsymbol{x} = [x_1, x_2,\ldots, x_n]$, where $\boldsymbol{x} \in X$ and X is the set of possible issue values. The issue space X may be a subset of a space of real numbers R^n or a discrete space. We assume here that issues take numerical values. Further, in this section we assume that the issue space X is the same for both parties and static. This is not necessarily the case in real-life negotiations. The parties may initiate negotiations with different issues and they may add or remove them during the process.

Each party has certain objectives that are functions of the issues; we assume, without losing generality, that both parties want to achieve their objectives at the highest possible levels. We denote $\boldsymbol{o}_A$: X $\rightarrow O_A$ and $\boldsymbol{o}_B$: X $\rightarrow O_B$, as the objective functions mapping issues into objectives. We assume that the set of attainable objectives is a subset of real space, i.e., $O_A \subset R^{n_A}$ and $O_B \subset R^{n_B}$, where n_A (n_B) is the number of objectives of party A (B). If the parties can specify their preferences, we assume that a *utility function* can be constructed. This function maps the objective space into the utility space, i.e., u_A: $O_A \rightarrow U_A \subset R$ and u_B: $O_B \rightarrow U_A \subset R$.

Parties may have *aspiration levels* defined on their objectives and/or issues. These levels are the values that the parties want to achieve. Negotiators may have several aspiration levels for the same issue (objective). They may also specify *reservation levels* defining the minimum acceptable issue and/or objective values.

Issues, objectives, utilities and aspirations characterize each party separately. The negotiation process may be characterized by the exchange of offers (issue values) and the *opposition* between the parties. Opposition in a general sense refers to relationships between the parties' objectives and utilities with respect to each other (Kersten and Noronha 1998). Intuitively, the strength of opposition is the level of (dis)agreement between the parties at any point $\boldsymbol{x} \in X$. Strict opposition

describes a situation in which any gain for one party can be achieved only at a loss for another party. At the other extreme, weak or a complete lack of opposition means that both parties simultaneously achieve either losses or gains.

2.2 Single issue negotiations

In this section we assume that the negotiation is described by a single issue and, possibly, one or more objectives. The preferences and utilities are not considered here. This assumption is relaxed in the next section.

Negotiations over a single issue x, ($x \in X \subset R$) are often assumed to be distributive (Guttman and Maes 1998; Guttman and Maes 1998; Thompson 1998). This is indeed true providing that one of the following three cases holds:

1. the issue is equivalent to each party's objective and the opposition is not weak,
2. each party has only one objective and they are strictly opposing, or
3. the parties have several strictly opposing objectives.

The first two cases are trivial. The third case is a generalization of the previous two. We obtain the first case for $n_A = 1$, $n_B = 1$, $o_{A1}(x) = x$, $o_{B1}(x) = x$. The second case takes place if $n_A = 1$, $n_B = 1$, $o_{A1}(x) = -k_1 o_{B1}(x) + k_2$. Therefore, the third case can be used to define single-issue distributive negotiation in the issue and/or objective spaces.

Definition 1: The negotiation between A and B is distributive if $\forall x_1, x_2 \in X$ we have either

$$\boldsymbol{o}_A(x_1) \geq \boldsymbol{o}_A(x_2) \Rightarrow \boldsymbol{o}_B(x_1) \leq \boldsymbol{o}_B(x_2)$$

or

$$\boldsymbol{o}_A(x_1) \leq \boldsymbol{o}_A(x_2) \Rightarrow \boldsymbol{o}_B(x_1) \geq \boldsymbol{o}_B(x_2),$$

where $\boldsymbol{o}_i \geq (\leq) \boldsymbol{o}_j$ means that at least one component of vector $\boldsymbol{o}_i$ is greater (smaller) than the component of $\boldsymbol{o}_j$ and none is smaller (greater).

The above definition clearly meets the distributive negotiation condition that "a concession made by one party is necessarily a gain for the other". If one of the conditions is not met then a single issue negotiation is not distributive because there is a possibility for partial gains and losses. There are several possibilities for such a situation including weak opposition between some ob-

jectives of the parties and strong between others, conflicting objectives of one or both parties, and non-monotonic objectives.

As an example consider a negotiation between a trade union and the management of a firm over salaries. Generally, the union wants higher salaries and the management - lower, but both parties also have other objectives. The management is interested in the increased productivity due to higher wages. The union representatives want to achieve a good settlement and to avoid a strike in order to increase their popularity among the membership. These two objectives may cause the management to want an increase in salaries within some range, and the union to be uninterested in a salary increase above their aspiration level. This implies that there is a region where both parties are interested in the salary increase. That is there is a possibility of simultaneous improvements in this region of the single issue, salary. We discuss this further in Section 3.1.

2.3 Multiple issues and utility

Distributive negotiation is often, but inappropriately, understood only as bargaining over a single issue (Guttman and Maes 1998, p. 4) implying that multiple issue negotiations are integrative. However, multiple issue negotiations may be distributive. This is the case, for example, when the parties have conflicting objectives and their preference structure mirrors each other. This case can be easily shown if, in Definition 1, we replace a single issue x with a vector of issues $\boldsymbol{x} \in X \subset \mathrm{R}^{\mathrm{n}}$ and set the preference value of $1/\mathrm{n}$ for each objective.

Single- and multiple-issue negotiations can also be analyzed in the utility space U. Consider two parties (A and B) negotiating over two issues $\boldsymbol{x} = (x_1, x_2)$. Assume, for simplicity, that the issues are equivalent with objectives. Each issue takes only two values $x_1 = \{x_{11}, x_{12}\}$ and $x_2 = \{x_{21}, x_{22}\}$. Assume further that party A has a utility function $u_{\mathrm{A}}(\boldsymbol{x}) = 2\, u_{\mathrm{A1}}(x_1) + u_{\mathrm{A2}}(x_2)$ and party B utility is $u_{\mathrm{B}}(\boldsymbol{x}) = u_{\mathrm{B1}}{}^2(x_1) + u_{\mathrm{B2}}(x_2)$. The parties' partial utilities (part-worths) are strictly opposing: A: $u_{\mathrm{A1}}(x_{11}) = 10$; $u_{\mathrm{A}}(x_{12}) = 5$; $u_{\mathrm{A}}(x_{21}) = 1$; $u_{\mathrm{A}}(x_{22}) = 4$ and B: $u_{\mathrm{B}}(x_{11}) = 3$; $u_{\mathrm{B}}(x_{12}) = 6$; $u_{\mathrm{B}}(x_{21}) = 4$; $u_{\mathrm{B}}(x_{22}) = 1$. The resulting utilities of the various alternatives (offers) utilities are given in Table 1.

Table 1. Parties' utilities

Offers	(x_{11}, x_{22})	(x_{11}, x_{21})	(x_{12}, x_{22})	(x_{12}, x_{21})
U_{A}	24	21	14	11
U_{B}	10	13	37	40

We see that every alternative is efficient. The movement from any alternative to another requires a concession of one party and yields a gain for the other party. In other words, if one party achieves more it has to be at the expense of the other party and vice versa. The negotiation is thus distributive.

In single issue negotiations the concessions and gains can be approximated with the change in the issue value (e.g., price value). We have not defined the specific values for issues x_1 and x_2 only their partial utilities. The gain and loss is measured with the parties' utilities and not the issue value. Nonetheless, the negotiations are distributive; they are over a "two dimensional pie" rather then a "one dimensional pie". Further increase of the dimensions is not a sufficient condition for integrative negotiations.

Definition 1 does not take into account trade-offs between objectives. Therefore, the overall gain for one party could not be achieved at a cost of lowering values some objective for this party. Considering distributive negotiations in the utility space a weaker condition can be formulated allowing for trade-offs between the party's objectives.

Definition 2: The negotiation between *A* and *B* is distributive if either

$$\forall\, \boldsymbol{x}_1, \boldsymbol{x}_2 \in X,\ u_A(\boldsymbol{o}_A(\boldsymbol{x}_1)) > u_A(\boldsymbol{o}_A(\boldsymbol{x}_2)) \Rightarrow u_B(\boldsymbol{o}_A(\boldsymbol{x}_1)) < u_B(\boldsymbol{o}_A(\boldsymbol{x}_2))$$

or

$$\forall\, \boldsymbol{x}_1, \boldsymbol{x}_2 \in X,\ u_A(\boldsymbol{o}_A(\boldsymbol{x}_1)) < u_A(\boldsymbol{o}_A(\boldsymbol{x}_2)) \Rightarrow u_B(\boldsymbol{o}_A(\boldsymbol{x}_1)) > u_B(\boldsymbol{o}_A(\boldsymbol{x}_2)).$$

It follows from the definition that in distributive negotiations every possible compromise (alternative) in *X* is efficient, that is, it lies on the contract curve (Kersten and Noronha 1998).

In the above example we have shown that it is not the number of issues that define the type of negotiations. Further, it is not the goals' "mutual exclusivity" that matter, but the nature and strength of opposition that define the type of negotiations (Kersten and Noronha 1998). Assume that party *B* has now different evaluation of the issue partial utilities, that is: $u_B(x_{11}) = 1$; $u_B(x_{12}) = 2$; $u_B(x_{21}) = 10$; $u_B(x_{22}) = 6$. The parties' goals remain mutually exclusive in the sense that for each issue both parties have opposing preferences. However, the alternative $\{x_{11}, x_{21}\}$ is now preferred by both parties over the alternative $\{x_{12}, x_{22}\}$ because $u_B(x_{11}, x_{21}) = 11 > u_B(x_{12}, x_{22}) = 10$ and $u_A(x_{11}, x_{21}) = 21 > u_A(x_{12}, x_{22}) = 14$. Similar effects may be obtained by fiddling with the relative weights given to the two issues; the goals may still be mutually exclusive, but the ne-

gotiation changes character.

Another concept that has been used to distinguish integrative from distributive negotiations is that the issues and/or objectives are interdependent in the former but not in the latter form (Guttman and Maes 1998; Guttman and Maes 1998). The very nature of every negotiation, however, is interdependence; one party needs some goods that the other party has, and is willing to give some other goods in return (Lewicki and Litterer 1985). Our above examples show that in distributive negotiations, achievement of one party's objective depends on the other party's achievements.

3. Improvements and information

Developers of negotiation support systems (NSS) and software agents often characterize their results in terms of the type of negotiation. While in most cases they acknowledge the dynamic nature of negotiations they also resort to two extreme types, i.e., distributive and integrative. Often, however, negotiations cannot be ascribed to either type alone, rather they involve activities typical to both types. If system developers do not realize this and try to support or conduct only one type of activity they may end up designing systems that are rigid and simplistic despite utilizing sophisticated (intelligent) technologies. In this section we extend the notion of distributive negotiations and present aspects that are, often incorrectly, attributed only to the integrative type.

3.1 Simultaneous improvements

Simultaneous improvements are possible if there exists an offer that is better for the negotiating parties, i.e., yields higher utility values, than the offer(s) discussed. Even in a single-issue negotiation with no conflicting objectives, inefficient alternatives are possible. Consider a negotiation over splitting a metaphorical pie. This negotiation is considered distributive. Suppose, an alternative that the pie be destroyed is added, and both parties see this alternative as inferior (inefficient) to any other alternative. Does this make the negotiation integrative? If the answer is yes, then it implies that every negotiation can be trivially considered either integrative or distributive. Firstly, it is typical that negotiations are conducted so that the parties improve their status quo. Hence, every negotiation would be integrative. Secondly, depending on the alternatives that both parties dislike; spurious alternatives can trivially be introduced to make distributive negotiations look "integrative".

In other words, everything else being equal, the distributive/integrative nature of negotiations would depend solely on the set of alternatives. This undermines most notions of rationality in ne-

gotiations in the same manner that dependence on irrelevant alternatives undermines the use of utility. In negotiations, the feasible set *X* may contain both efficient and inefficient alternatives. Such negotiations are often considered integrative because they allow for a simultaneous improvement; both parties can move from an inefficient to an efficient alternative. However, it is also possible that initially the set comprises only efficient alternatives. During negotiations the parties may discover new inefficient alternatives that are also feasible.

The possibility of moving from an inefficient compromise to an efficient one has been considered indicative of integrative negotiations (Thompson 1998, 48). This may have its roots in an influential paper on negotiation analysis by (Sebenius 1992). He briefly discusses the "changing the game" condition that—as we claim in Section 4—is paramount to integrative negotiations. However, he does not offer any analytical approach to represent this condition and concentrates on simultaneous improvements for negotiation situations defined in utility space. Further, while he discusses many features of integrative negotiations, the analysis focuses on the distributive type. This has led to the development of systems and agents that are supposed to support or conduct integrative negotiations by facilitating the selection of an efficient compromise (Anson and Jelassi 1990; Thiessen and Loucks 1994; Guttman and Maes 1998; Guttman, Moukas et al. 1998; Lotov, Bushenko et al. 1998).

Negotiations that are conducted within the efficient set are distributive. The problem is to select an alternative that yields the highest joint utility value. A difficulty arises due to the requirement of interpersonal comparison of utilities especially in the case of multilateral multiple-issue negotiations. This problem has been studied in philosophy and some authors provide arguments that such a comparison is possible. Formal approaches based on Nash-solution, ratio- and marginal-values have been proposed and they can be used to reduce multiple issues to a single-issue negotiation (Fang, Hipel et al. 1993; Raiffa 1996). If these arguments are accepted, fully automated distributive negotiations are possible.

3.2 Information revelation

Rational parties are expected to achieve an efficient compromise. However, an obstacle to this is that they usually do not share all the relevant information. Partial information may lead to the choice of an inefficient agreement and the parties may not even know that an improvement is possible. In a single-issue distributive negotiation partial information does not pose difficulties if each party’s objectives are not conflicting. The exchange is only about the alternatives that con-

stitute the issue, given the usual case that objective functions are monotonic over the issue. In the case of multiple-issues the difficulty arises from the fact that parties do not want to fully disclose their utilities, and communication between the parties is often limited to an exchange of alternatives (offers).

Negotiation theory suggests several strategies to facilitate the achievement of an efficient compromise (Lax and Sebenius 1986; Fisher, Kopelman et al. 1994; Lewicki, Saunders et al. 1997). A strategy called hard (positional) bargaining suggests that the party should start with the extreme position that maximizes their own utility function, make small concessions on the least valued issues for this party, conceal own interests, minimize the benefits of the other's concessions, and argue forcefully on behalf of principles that imply favorable settlements. Identifying their BATNA, reservation and aspiration levels allow the party to reject any compromise that is clearly inefficient. The use of techniques that allow assessment of the counterpart's strength of opposition may help to determine directions for simultaneous improvement (Kersten and Noronha 1998). These approaches do not assure selection of an efficient compromise because the parties may engage in strategic misrepresentation and gaming.

Hiding relevant information and focus on self-interest are assumed typical of distributive negotiations (Fisher, Kopelman et al. 1994; Lewicki, Saunders et al. 1997). It may also take place in integrative negotiation (Wetlaufer 1996). However, if the parties hide relevant information, misrepresent their interests and make strategic offers then there is no method (we believe) that would guarantee an efficient agreement. It is not even possible to assess whether the achieved compromise is inefficient.

Information exchanged during the negotiation, even if it is limited to offers, convey more than the offers themselves. Those who advocate pure optimization approaches such as hard bargaining have completely forgotten that there are unspoken messages (psychological connotations) that are carried along with the explicitly represented options specified in an offer. This information can be viewed as "meta-level" offers; an offer to be cooperative may be signaled via a friendly first offer, versus an extreme offer to indicating a hard positional bargaining. In other words, the parameters (characteristics) of a negotiation process are themselves negotiable in real life, although these are not explicitly represented and transmitted by today's software agents. And that is precisely the point of failure of distributive negotiation schemes such as hard bargaining. To support win-win negotiations, we need to capture these process parameters and factor them into our choice of a first offer, and into subsequent concessions.

In sections 2 and 3 we presented arguments and examples supporting the following:

- Single-issue negotiations may allow for simultaneous improvements.
- Multiple-issue negotiations may be distributive.
- The existence of inefficient alternatives or the lack of them makes no difference to the negotiation's distributive character.
- Information revelation is critical for the achievement of efficient compromises and compromise assessment.

4. Integrative negotiations

4.1 Key issues

Following the negotiation literature, we argue that the difference between distributive and integrative negotiations lies not in the number of issues, the existence of inefficient alternatives, or of a process that allows for simultaneous improvements within a given set X of alternatives. The key issues that distinguish integrative negotiations are: *creation of value, focus on interests and not positions, openness and exchange or relevant information, learning and problem restructuring* (Fisher and Ury 1983; Lax and Sebenius 1986; Sebenius 1992; Raiffa 1996).

4.2 Creation of value

In distributive negotiations the parties can *claim value* and yet achieve local improvements. That is, they can move from inefficient to efficient alternatives while requesting a bigger share of the pie. In integrative negotiations the parties engage in a process that creates value. The exchange of information allows for the realization of possibilities and improvements that would otherwise not have been available. The parties attempt to expand the pie during the negotiation process. Assume that the set of feasible alternatives comprises different divisions of the pie. Its expansion does not mean selection of a division that dominates other divisions, e.g., that each party chooses half the pie instead of choosing a quarter. Rather, it means that during the negotiations the parties are able to redefine the concept of the pie and add to the bargaining table additional issues (dimensions) and alternatives (expand the set *X)* of interest to both of them.

New issues and options are invented during, and because of, the negotiation. One of the key differences between the two types of negotiations is in the set of feasible alternatives *X*. In the distributive case *X* is process independent; at best, inefficient alternatives are added. In integrative

negotiations the set X is modified as an integral part of the negotiation process. Its dimensions and/or cardinality change. This distinction has been introduced in the negotiation literature (Fisher and Ury 1983; Lax and Sebenius 1986) and confounded in the literature on negotiation analysis (Sebenius 1992; Thompson 1998), and in management science methods and support systems (Anson and Jelassi 1990; Lotov, Bushenko et al. 1998).

Modifications of X and of the efficient frontier become possible only if the parties exchange information about their true interests rather than positions (offers) alone. However, the parties often view the problem as a conflict in selection of alternatives, and their goal as agreeing upon one alternative. They may then consider negotiation as the process of information exchange about the alternatives. This may lead to breakdown of the negotiation unless they begin talking about their interests. Interests are what the parties truly want achieve, not positions. As Fisher and Ury state, "for a wise solution reconcile interests, not positions" (Fisher and Ury 1983).

The use of objectives and mapping issues to the objective space allows the parties to consider their interests and the tradeoffs between them. They have a more direct and firmer understanding of their objectives and needs, than of the complex constraints over the alternative space that define their conceptions of the feasible set X.

4.3 Focus on interests

The acceptance that the interests precede positions and that the goal of negotiation is to realize the parties' interests changes the nature of negotiations. Interests reflect objectives; the parties need to achieve their objectives at a certain level. That is they are often able to define their aspiration levels $\boldsymbol{o}'_A$, ($\boldsymbol{o}'_A \in O_A$) and $\boldsymbol{o}'_B$ ($\boldsymbol{o}'_B \in O_B$) reflecting their aspirations. This is not to say that a trade-offs between these levels are not possible; they can be determined with the use of utility function, that is party A accepts a position $\boldsymbol{x}$, for the objective levels which $u_A(\boldsymbol{o}_A(\boldsymbol{x}) \geq u(\boldsymbol{o}'_A)$.

There are often many different positions that allow achieving objectives on the same levels. Discussion about the objectives allows focus on what is important and disregard what is not important, that is, issues. This requires openness and exchange of relevant information. In the extreme case this concept takes the form of the FOTE (full, open, truthful exchange) condition (Raiffa 1996, p. 6).

The parties enter negotiations with an understanding of their objectives, that we assume are time independent. Above we have defined objectives $\boldsymbol{o}$ on the set of feasible alternatives. A key issue

to integrative negotiations is that there are different sets of feasible alternatives that allow for the achievement of objectives at the required levels. Initially a party may consider the set X. With the progress of the negotiation this set may change but the objectives remain the same. Taking this into consideration we can define integrative negotiations as follows.

Definition 3: The negotiation between A and B is integrative if A and B search for an alternative $\boldsymbol{x'} \notin X$, such that $\boldsymbol{o}_A(\boldsymbol{x'}) \geq \boldsymbol{o}'_A$ and $\boldsymbol{o}_B(\boldsymbol{x'}) \geq \boldsymbol{o}'_B$, or $u_A(\boldsymbol{o}_A(\boldsymbol{x'})) \geq u_A(\boldsymbol{o}'_A)$ and $u_B(\boldsymbol{o}_B(\boldsymbol{x'})) \geq u_B(\boldsymbol{o}'_B)$.

Note that this definition does not assure efficiency of the compromise, only the realization of aspirations. If the parties want to improve the settlement, i.e., increase the objective values, they may continue negotiation in the post-settlement phase. If the new feasible set and the objective functions are known the specification of efficient alternatives that dominate $\boldsymbol{x'}$ may only be computationally difficult.

Definition 3 describes only one form of integrative negotiations because learning is limited to a set of alternatives. During the information exchange the parties may also modify their aspiration levels and the objectives. These changes may lead to the selection of an alternative $\boldsymbol{x} \in X$ that earlier was considered unacceptable.

The search for an alternative $\boldsymbol{x'} \notin X$ does not necessarily mean that such an alternative can be found. The parties may realize that there are no alternatives available other than those in X. Hence, it may not be possible to create additional value during negotiations. Real-life situations show that this is rare if the parties adhere to the remaining key concepts underlying integrative negotiations (see Section 4.1).

4.4 Process and outcomes

There are significant differences between distributive and integrative negotiations in terms of the process and exchange of information. In the former each party engages in the process in order to achieve the best possible settlement. They exchange offers and make concessions in order reduce the differences and determine an acceptable offer. Each party is interested to learn the preference structure of the other because this allows for logrolling and the achievement of a compromise that better meets the parties' interests than without knowledge of the preferences. The difficulty, in distributive bargaining, is that the parties hide their objectives and preferences and expose them only indirectly through the issue values.

In integrative negotiations the process is often as much an outcome as is the compromise. This is not just typical of some cultures with high collectivism and femininity indices (Hofstede 1989; Hofstede 1991). It also takes place in negotiations between business partners, companies that want (need) to maintain a good long-term relationship, and buyer-seller negotiations in which the relationship extends beyond the act of the sale. Culture and other issues that make people focus on the process are often behind their willingness to discuss their interests. The negotiation literature, provides both theoretical justification and numerous examples supporting the use of integrative rather than distributive negotiations, on all occasions.

5. Integrative and distributive activities: benefits and drawbacks

The negotiation literature (which includes the analysis of real-life negotiations), unequivocally states that parties should attempt to conduct integrative negotiations (Fisher and Ury 1983; Lax and Sebenius 1986; Sebenius 1992; Ury 1993; Fisher, Kopelman et al. 1994; Lewicki, Saunders et al. 1997). Discussions and analysis of real-life negotiations in business and trade, high-stake and small stake, inter-organizational and intra-organizational, cross-cultural and intra-cultural negotiations show the importance and benefits of this type of activities. It is now conventional wisdom that opportunities for integrative negotiations are widely available but often unrecognized and not exploited, consequently with the negative results for the parties. The benefits of integrative negotiations are taught in law and business schools, and in seminars for executives. Yet, many, if not most, real-life negotiations are neither distributive nor integrative.

We agree with authors who stress the benefits of integrative negotiations. However, we agree with Wetlaufer (1996) that the arguments for this type are less persuasive than has been claimed. The distributed type has its benefits and in some situations may be the preferred negotiation type. In this section we discuss the benefits and drawbacks of the two negotiation types and we argue for the use of activities and tactics typical for both types depending on the context, available resources, expectations, and requirements. The discussion leads to the formulation of certain DSS/NSA requirements.

5.1 Resources

It is rare for even the most important negotiation to be the only activity that engages an organization or individual. There may be many other activities that compete for the same resources (time, money, and effort). These resources are limited and only some may be allocated to negotiation

activities.

From the above discussion it follows that integrative negotiations may require more resources than distributive ones. They are conducted in a fixed context, and the sets of issues, objectives and preferences are given. However, the collaboration that is typical of the integrative type may allow the negotiation to finish sooner, reduce the number of issues found irrelevant and determine objectives that the parties share thus making their efforts easier.

In the distributive type, the negotiators often engage in a fairly routine exchange of offers and arguments. The latter are used to indicate their reservation and aspiration levels, and the importance of the issues. The process may take several exchanges because the information is often given in an indirect manner, and the negotiation is sequential (issues are discussed one at a time). In addition, lack of trust and knowledge of the parties' interests often leads to small concessions and prolongs the process.

The routine aspect of distributive negotiations allows one individual to be engaged in several negotiations simultaneously. When the stakes are small the effort required for discovery of the parties' objectives and preferences, and the detailed specification of the set of feasible alternatives may exceed the potential gains. Furthermore, other activities that require the negotiators' attention and resources may be of greater importance. Search for an efficient compromise may be considered too costly to be undertaken. It has been shown, both in real-life negotiations and experimental studies, that negotiators are often content with inefficient compromises and do not wish to improve them even if they can do so but have to spend additional time and effort (Kersten and Mallory 1999). NSAs may play a role if they engage in the post-settlement activities and suggest efficient compromises.

In distributive negotiations additional resources may be needed if the parties resort to threats, coercion and bluffing. These tactics require analysis of possible implications of threat acceptance or rejection, search for countering actions, efforts to cope with coercion, etc. The use of negotiation methodology, including such constructs as BATNA and reservation and aspiration levels allows to alleviate the negative impacts of the distributive tactics.

Integrative negotiations may require the parties to secure their positions because they, especially in the initial stages, cannot be certain that their counterparts will not resort to distributive tactics endangering their bargaining powers. Time and effort are required to inform and learn about each other's interests, search for commonalties and differences, discuss possible expansion of the issue

set, limitations, etc. These discussions require the establishment of an atmosphere of trust, openness and understanding, which may require additional effort. However, if the parties trust the underlying computing infrastructure, systems and agents may help in the establishment of the common basis and provide the parties with additional tools for conflict resolution. An example, here are the services provided by the Web site Cyber$ettle.com to which the parties submit three offers. If any of the offers are within an agreed upon formula (30% of each other) then the case settles immediately for the average of the two amounts. While these services do not promote integrative negotiations, they provide a formula for using the Web in a single issue negotiation without endangering the parties' bargaining powers.

It is clear that integrative negotiations may bring significant and unexpected benefits. Although unexpected, these benefits may not outweigh the additional costs. This depends on the subjective importance of the negotiated decision and on the other decisions and activities that the negotiator undertakes.

5.2 Rituals

Negotiation is a process deeply rooted in culture, customs, and organizational and individual characteristics. It is a process that has apparent or real built-in inefficiencies that have little to do with the negotiated issues and a lot with the context and rituals.

Time and other resource constraints, under which both individual and organizational customers operate, requirements imposed by businesses, and technological advancements introduce pressures to conduct effective and efficient negotiations. The preferred type of negotiations should be, in this situation, an efficient exchange of precise information leading to the best compromise within allocated resources. It should be more of a joint decision that is achieved quickly than a prolonged process that involves posturing, bluffing, learning and other costly activities. However, even in a low-context, small power distance and efficiency-oriented society like the American, such a form of distributive negotiation has been rejected (Lewicki, Saunders et al. 1997). The parties expect an engagement in the "negotiation step dance" and adhere to traditions and rituals.

Globalization of trade and business make negotiations more complex because of the diversity in national and organizational cultures. Individual customers and businesses of any size may now come from any corner of the world, with very different expectations, norms and behaviors. While progress has been made in software internationalization and Web-based cross-cultural negotiations (Hall and Hudson 1997; Kersten and Noronha 1999; Mohan, Kersten et al. 1999), it seems

to have had little impact on electronic commerce research and applications.

There are no established rituals and traditions in negotiations conducted via the Internet and extranets. However, this does not mean that the current practices of individuals and organizations can be ignored. The DSS and NSA that have been proposed so far aim to increase efficiency and effectiveness, and may play a role in very simple negotiations. Because they are often not based on a sound methodology and ignore cultural, ritual and other characteristics of the process, they hardly can be of use for complex business-to-business or even business-to-consumer negotiation.

5.3 Engagement

Routine distributive negotiations facilitate depersonalization and disengagement thus making it easier to cope with conflict. On the other hand, the integrative type allows for conflict reduction through discussions about the parties' true interests and aspirations.

The distributive type may be preferred when the parties view a negotiation as a short-lived one-time deal; a contract that should not be related to previous or future encounters but judged on its own merits. Highly mobile employees and their organizations may prefer distributive negotiations if the inter-organizational relationships are not judged on any particular negotiation but by all negotiations taken together.

Negotiators often fear that engaging in integrative actions weakens their position, makes them vulnerable, and eventually leads to inferior compromises. Systems and agents may be used to help them to learn more about themselves, their strengths and weaknesses. They may also help negotiators by directing attention to opportunities and providing information about past cases.

5.4 Complexity

The preoccupation with distributive negotiations appears to be true of most work on electronic commerce and, with few exceptions (Bui 1996; Explorer 1999), on negotiation support systems. In a sense this is paradoxical considering that these systems and agents have been developed with the intention of helping people and organizations cope with complexity, facilitate information exchange, and strengthen their positions. If they focus on the distributive aspects these tools simply increase the efficiency of one form of negotiations and provide superficial gains.

We are concerned here with bilateral negotiations. One can assume that in multilateral negotiations there may be a need to retain a simple distributive model that can be shared among many

parties. This might be true in the case of auctions with the intention of raising the level of competitiveness among the bidders. This is not true, however, if the negotiations are conducted between business organizations and involve multiple issues (Raiffa 1996). Multilateral negotiations introduce an additional level of complexity. Therefore support tools and systems are all the more necessary.

Electronic commerce allows consumers and businesses to engage in many individual transactions at any given time. Both have access to information that was previously unavailable; data about consumers' patterns and behaviors can now be obtained very quickly, individual consumers can be targeted, organizations may access new markets and deal with many more suppliers than before. It is impossible for individuals to effectively use the available information and to engage in many transactions despite their potential benefits. One may expect that this is an area where DSS and NSA may provide significant benefits and facilitate the conduct of simultaneous negotiations, assess their progress and possible implications.

6. Negotiation support processes

From the discussion of distributive and integrative negotiations it follows that negotiators require different interactive and flexible forms of support at the computational and cognitive levels. It also follows that DSS and NSA that interact with humans have to be based on a behavioral negotiation methodology and allow for the different contexts and characteristics of the various individuals and organizations that comprise the end-users.

6.1 Direct and representative negotiations

We have discussed two types of negotiations based on the degree of collaboration among the parties. From the point of view of the use of DSS and NSA another classification is also important, namely, *direct* versus *representative negotiations*. In direct negotiation the parties communicate directly with each other; they prepare and exchange offers, and provide supporting argumentation. They may use a negotiation support system for help with construction of individual offers, tactics and strategy preparation, analysis, and assessment of counter-offers. They may also use an agent or an expert but they have no decision-making powers.

Representative negotiations involve not only the main parties (the principals) but also agents who act on their behalf. The negotiations are more complex as there are two-level interactions: between principals and their agents, and among the agents. The most significant effect of using

agents is the complication of the transaction (Rubin and Sander 1988). One of the reasons for using this type of negotiations is that the agents have expertise that the principals lack.

The functions that DSS and NSA can perform depend on the type of negotiations. DSSs and NSAs can participate in both direct and representative negotiations but their roles, autonomy and level of support is different. In Section 7 we discuss different functions depending on the negotiation type.

Irrespective of the negotiation type, there are three major phases in any negotiation, namely preparation, offer exchange, and post-settlement, although the relative emphasis given to these phases varies considerably according to context and culture.

6.2 Preparation

In this phase the parties discuss and agree on the terminology and the issues to be resolved. The discussion revolve around the decision attributes, the hard constraints that are acceptable to the parties, and may also include a discussion about their objectives and interests.

The activities of this phase set the stage for the subsequent phases, and are considered the key to "correct" decision processes. They involve the construction of, at least, a partial problem representation by each party separately or jointly (Buchanan and Henig 1996). The representation embedded in a DSS can be used for the specification of possible efficient solutions and the critical constraints and objectives.

The parties formulate BATNAs, establish reservation values and aspiration levels for their issues and objectives, assess their counterpart and the degree of opposition between them, and decide on the initial strategies. DSSs are often used in this phase for the purpose of simulation and analysis of the implications of decision alternatives. Analytical and simulation models allow for the assessment of the decision situation, the participants' behavior and evolution of the process (Kersten and Szapiro 1986; Holsapple, Lai et al. 1991; Aaron 1995; Holsapple, Lai et al. 1995).

Preparation is considered the most important phase, since it sets the ground for effective negotiation. If the preparation is thorough and detailed it provides each party with a good understanding of their position and strength. It is often the case that parties who do not make the effort to prepare for negotiations resort to the distributive process. If the parties have established their BATNAs and reservation levels and fully understand the implications of accepting a BATNA then they can discuss their interests in an open and substantive manner. They can engage in integrative

negotiations because they have a well defined fall-back position.

6.3 Exchange of offers and discussion about interests

An understanding of the others' limitations, aspirations and objectives, and knowledge about efficient solutions and their outcomes, is achieved and refined through intensive exchange of information. The parties realize the potential of a compromise and can assess its main features. This allows them to identify the key issues and critical areas of disagreement, and exchange specific and substantive proposals. The analysis of the negotiation may focus on the selection and verification of strategies, the determination of concessions and revision of aspiration levels, and on the restriction of efficient solutions to those acceptable to all the parties. This can be supported with systems using MCDM-based methods (Kersten, Michalowski et al. 1991; Fang, Hipel et al. 1993; Teich, Wallenius et al. 1994; Bui 1996).

Expansion of the set of feasible alternatives may occur either by softening constraints, or by explicitly formulating and discussing new alternatives. Analysis and support tools may be used to identify the critical constraints, demands, and degree of opposition between parties. On several occasions, we have mentioned the measure called "opposition" as an important indicator for negotiations. We considered opposition to be more fundamental than utility in that sense that it can be more easily estimated (by examining neighboring points), even when utility functions are not available. Formal analysis of opposition has only recently been proposed and it requires further studies (Kersten and Noronha 1998).

It is worth mentioning that opposition may be quite significant to the identification of integrative negotiations. The analysis of the opposition provides a quick advance warning of how antagonistic the negotiation might be. Thereby it may imply that drastic steps are needed to change the character of the negotiation. Further, opposition provides information about the direction in which a party should look for improvements (e.g., which constraints need to be relaxed; note that working jointly on constraints is key to integrative negotiation). Furthermore, it is easy to recompute whenever learning occurs, and when new issues are being considered for introduction into the negotiation (thus providing a measure of the value of the issue in changing the character of the negotiation). Conveying semi-quantitative information such as a preferred direction of improvement may enhance openness (compared to conveying full utility functions that are usually created artificially, especially when interpersonal comparisons are involved).

Successful identification of the critical issues and areas of disagreement, development of joint

proposals or joint softening of limitations, leads the parties or group members to a limited number of possible compromises. At this stage, the parties or group members may have already agreed on some issues with only a few issues outstanding.

6.4 Post-settlement analysis

If the achieved compromise is inefficient, analytical tools may be used to identify efficient ones that benefit all the parties. The same methods that are used in the earlier phases can be used to determine an efficient alternative to the achieved compromise, that is, "post-settlement settlement" (Raiffa 1982; Sebenius 1992; Kersten and Noronha 1999).

7. Negotiation support systems and software agents

Negotiating software agents (NSA) should not be discussed with the focus solely on the agents' abilities and behavior, and without consideration of their principals. The NSA acts on behalf of the principal, communicates with the counterpart, and has significant autonomy in decision making. This is the case of representative negotiation. In contrast, DSSs have limited autonomy and their purpose is to help the principals understand the problem and support and to support the exchange process. That is, DSSs support direct negotiations; most of the information that is exchanged is provided by the principals, who make decisions and agree on a compromise. NSAs also can be used in direct negotiation. In the later case NSA acts as a messenger and/or provider of information about the counterpart and the problem.

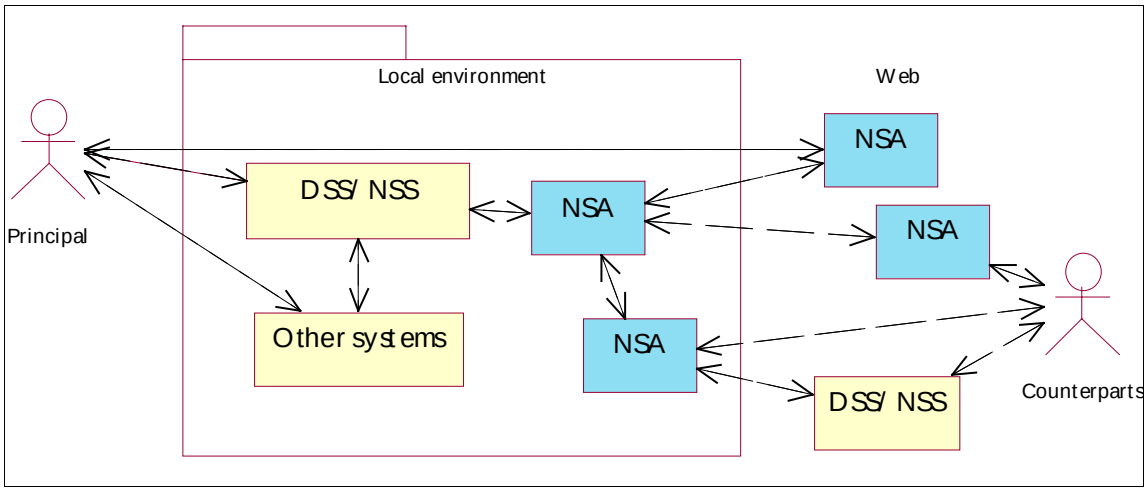

Figure 1. Principal, DSS and NSA configurations

A particular architecture depends on, among other things, the complexity of interactions with the principal, level of support required, and the requirements for information processing by other systems (e.g., financial, marketing and production). In Fig. 1 we present a high-level architecture in which the negotiation environment comprises a principal, DSS, function-specific systems and two software agents. One of the key configurations, which is especially relevant to the design of digital marketplaces and other electronic environments comprising economic agents, is that of autonomous software agents performing well-structured tasks, controlled by DSS performing relatively ill-structured tasks, which are in turn controlled interactively by humans. This recognizes the fact that there are activities that each of the three system types does so well that an alternative type of system cannot replace it.

7.1 NSA/DSS in direct negotiations

NSA can be used in electronic commerce for both representative and direct negotiations. The possible functions of the agents largely depend on their degree of autonomy, the type of the negotiation, and the specificity of the principal's directives. The functions depend also on the agent's interactions with other systems and agents. The agent may be highly specialized and co-operate with other agents, interact directly with the principal, or it may communicate via a DSS.

The simplest case is a search or match-making agent. For example, the agent finds potential business partners and provides the principal with a list. A somewhat more complex situation is when the agent gathers intelligence (Jango 1999). The agent assesses the partners' reliability and their past activities, and provides the principal with a ranking. The principal interacts directly with the shortlist of partners. Within this category are agents that act on behalf of the vendor and suggest products to buyers that they may be willing to purchase, i.e., `personalized shopping assistants.' The objective of such agents is to construct and use the buyers' profile.

The personalization and profiling functions may, in direct negotiations, be extended to the construction of the counter-parts' profiles during the negotiation. The techniques used have to be more complex than database indexing as is usually the case with product recommendation. Estimation of the counterpart's interests, strength of opposition, assessment of their utilities, BATNA and reservation values is needed.

Multiple and conflicting definitions of software agents make it difficult to distinguish between existing DSS/NSS and NSA. Systems that perform DSS functions but are Web-based are considered to be agents, e.g., (Personalogic 1999). They communicate directly with the principal, facili-

tate the selection of relevant attributes, construction of a utility function and support the choice of a product. They are simplified versions of well-known DSS that use MAUT or MCDM methods. The main difference is their accessibility and linkage to the product database.

There are a number of DSS that provide a service similar to Personalogic, e.g., (Expert Choice, 1999; Lumina, 1999; Which and Why, 1999). Their weakness is lack of mobility and of access to the up-to-date resources that the agents have. Their strength is in their flexibility (e.g., users can choose different data entry and presentation forms, different aggregation methods), and sensitivity analysis which in many cases is the most important feature. Co-operation between DSS and NSA may alleviate the weaknesses of both.

Direct communication with principals requires their time and effort and is not always necessary. The agents residing on the Web may communicate with agents on a local system (Kersten and Szpakowicz 1998) through protocols such as P3P, facilitating information assessment. Therefore in Fig. 1 we suggest an architecture with local and web-based agents collaborating with DSSs. This also allows for the use of production, marketing, accounting and other business systems during negotiations and is of particular utility in business to business transactions.

NSA may exchange preliminary communications with the potential business partners and verify their interest in engaging in the negotiation. This requires the presentation of the issues of interest to the principal and the collection of the counterparts' responses. To increase autonomy the agent requires more information from the principal. In this situation the agent also needs to have an ability to categorize issues and offers in a semantically meaningful manner. That is, it requires an ontology; the agents need to refer to the same goods and be able to exchange meaningful information (Beam, Segev et al. 1996). The functionality of such agents can be positioned between direct and representative negotiations.

Complex and difficult negotiations require a significant amount of preparation. This is especially the case with integrative negotiations as we mentioned above. DSS and NSA have been successfully used for interactive development of problem representation. Construction of goal hierarchies or cognitive maps has been successfully used in resolution of conflicts in both individual and group settings, e.g., (Saaty and Alexander 1989; Bui 1996; Explorer 1999). The flexibility of these methods allows for interactive sensitivity analysis, assessment of the relationships between goals and issues, and problem restructuring. DSS may provide the expertise required to construct problem representation, and to conduct analysis and structural assessment.

In integrative negotiations support is needed for re-evaluation of the problem and search for issues and options that were not previously considered. Here there is a potential for NSA to search for expertise, past cases, and the histories of negotiations. An agent may use case based reasoning to select similar cases or construct a negotiation situation that principals use for restructuring of their own problem.

Post-settlement analysis requires revealing of interests with the potential for joint improvements. In this phase both DSS and NSA may play a role in providing the principal with suggestions for improvements based on previous negotiations and assessment of the strength of opposition at the point of compromise.

7.2 NSA/DSS in distributive activities

Negotiations may be fully automated with intelligent agents making decisions on the user's behalf. These agents negotiate with others in the marketplace, trying to get the best deal subject to a set of user-specified constraints (Chavez and Maes 1996). The agent may have full autonomy and conclude deals on the party's behalf. The principle is that a buyer communicates with an NSA. The agent then performs the buyer's activities autonomously. The agent gives the buyer information needed to complete those steps of the value chain model for which it was designed.

Beam and Segev have recently modified their research paradigm regarding the use of negotiation mechanisms in electronic commerce and concluded that negotiations can be replaced with auctions because auctions allow for efficiencies obtained via market forces (Beam and Segev 1998). Since the Web allows for anonymous and large markets, values may be established much more efficiently. This is an example of the consequences of thinking within the domain of simple distributive negotiations as opposed to integrative ones. The efficiencies sought relate solely to issues such as price, transaction time, and product fit. It appears that Beam et al. make the assumption that well-structured transactions (such as single- or multi-dimensional auctions) via the Web will replace the role of semi-structured or free-form negotiations as a vehicle for exploring and establishing new business relationships, learning about the negotiating partners, using persuasion (rather than market mechanisms) to achieve one's objectives, carrying traditions, cultural traits, and so on. We think that a vision of a world in which humans are no longer heavily involved in buying and selling decisions (thus permitting negotiation to be viewed as a problem of maximizing efficiency rather than one of persuasion and joint problem solving) is an implausible view of e-commerce.

Indeed, as Roth (1995) points out, bargaining is precisely the opposite of the idealized "perfect competition" among infinitely many traders in terms of which economists often think about commerce. Thus there are many reasons for e-commerce to thrive under `inefficient' protocols. The current movement towards personalization and mass customization (which runs counter to the commoditization required for mass auctions) underscores this point. We believe that many viable negotiation mechanisms throughout Roth's spectrum will continue to coexist and thrive, and the current popularity of electronic auctions is not a "new paradigm." The ontology and strategy issues continue to be important problems for electronic negotiation.

Electronic auctions have become very popular as they provide a market mechanism for goods that previously had to be negotiated because their price was unknown and/or there were few sellers and buyers. Transactions via electronic auctions are easy to set up and are inexpensive, which has contributed to their success. The fact that electronic bidding allows for anonymity and entertainment is also significant here. In a small market with few buyers and sellers who know each other negotiations may be a necessary form for doing business due to the necessity to maintain good relationships among them. Even on the New York Stock Exchange, the classic double auction, high-volume traders actually negotiate deals with each other in highly unstructured ways that derive from their intimate knowledge of each other's holdings, stakeholders, capabilities (BATNAs), and background; it is implausible that this system could be automated solely through autonomous software agents..

Thus auctions cannot replace negotiations between businesses and other organizations, customers who need or want to engage in influencing and persuading their counterparts, individuals and organizations seeking understanding and rapport for future collaboration. Negotiations can be used in markets that are small, populated by participants with unequal powers, and who have both conflicting and complementary objectives. We have said that negotiations have built in inefficiencies and that attempts to remove them have been unsuccessful. DSSs and agents may be used to help and facilitate negotiations, and increase their effectiveness and resource requirements.

7.3 NSA/DSS in integrative activities

We argue that in difficult multiple-issue negotiations with outcomes of significance to the principals, engaging in distributive activities most often leads to a waste of opportunities on one hand, and resources on the other. "There is a frequent criticism that negotiators, particularly Americans ones, do not engage in adequate preparation." (Lewicki, Saunders et al. 1997). The use of DSS

and NSA that cannot facilitate integrative activities can only reinforce this situation. The usual approach to the construction of utility functions based on feasible alternatives, with the disregard to the principals and their counter-parts is mechanistic. It is simple and requires little effort but has all the negative results inherent to distributive negotiations.

It is also worth mentioning that while at present North America leads in the use of Internet and Web-based systems this is not necessarily a permanent situation. In many cultures the process of negotiations is considered as important as the achieved compromise and it would be an error to assume that organizations in these cultures will accept the distributive form and agree on the reduction of the process to an exchange of offers. Further, there is a significant effort underway to teach integrative negotiations in business schools and in executive training programs.

Integrative negotiations impose an additional set of requirement on NSA. At the same time there is a potential to develop tools that reduces the principals' efforts, helps them to gain confidence, provides constructive suggestions, and makes facilitates the process. Integrative negotiations are likely to be direct but with the heavy involvement of NSA and DSS. This is the configuration that is depicted in Fig. 1. An intelligent agent is required to provide information and knowledge (e.g., statistics and inferences) about past negotiations and other marketplace activities, search through the negotiation transcripts and other process descriptions, compare situations, interests and issues of the problems solved in the past and the current problem. Such NSAs need to collaborate with DSSs that support the principals in the construction of problem representations, their assessment and modifications, suggest new issues, and innovative (for the principal) approaches to cope with conflict Negotiation records need to be continuously compared and evaluated and effort made to provide the principals with constructive criticism and opportunities for the expansion of the "pie" and the enhancement of the process. NSA may also help in the improvement of BATNA by searching for alternatives that are not known to the principal.

8. Conclusions

The explosive growth in electronic commerce has not reduced the complexity of negotiations conducted over the Web, partly due to human factors, and partly because the underlying economic models remain unchanged, despite the increase in speed, reach, and computational efficiency. The excitement and hype associated with the growth of the Web has engendered many hasty conclusions and misconceptions about the nature of Internet-based negotiations, and we have attempted to dispel many of them. Negotiations are really collaborative problem solving

mechanisms, especially when viewed from an integrative perspective, and as such cannot be reduced to optimization problems relating to the efficient distribution of value. The integrative nature of negotiations derives from the human ability to change the game, reformulate the issues, construct deep models of each participant's interests and world-views, and ultimately create new value beyond that anticipated through the initial model of the negotiation. Invariably, the negotiation process is itself negotiable.

These characteristics pose serious challenges to the design of autonomous software agents. The challenges cannot be scoped away by focusing on fully structured negotiation protocols such as auctions. For each economic model that drives a particular structuring assumption (e.g., manufacturers wish to reach a broader pool of customers, so they will structure their ontology (product description) to facilitate match-making via search agents), there is another economic model that has an destructuring effect (manufacturers wish to avoid competing on price and will personalize products—create product discrimination to prevent match-making by independent parties). This richness in economic models and negotiation mechanisms implies that any e-commerce infrastructure designed to support constantly changing business environments must be designed from the bottom up to address the challenges raised in this paper.

The first step is to recognize that an effective infrastructure must support the creation and activity of both autonomous agents and DSS. This is required in order to exploit the power of the computational and communications infrastructure via the NSA (since they possess the advantage of speed, and can construct offers in milliseconds), and at the same time the intelligence of the humans through the DSS (since they have the robustness required to support problem restructuring and game changes). Moreover, humans often need to be in the loop to ensure that the negotiations are truly representative. We have therefore emphasized the importance of hybrid NSA—DSS architectures, anticipating that the former type of system will be spawned or controlled by the latter.

We have explored the relative costs and benefits of distributive and integrative negotiations, and concluded that there while the latter are generally to be preferred, there may indeed be practical tradeoffs to be resolved. We have also touched upon fundamental concepts such as opposition, which hold the potential to support integrative negotiations in circumstances in which utility functions are not meaningful or acceptable. However, full-fledged theoretical underpinnings based on these concepts, tools, methodologies, and systems for automated integrative negotiations are lacking, continue to remain as major research challenges.

Bibliography

Aaron, M. C. (1995). “The Value of Decision-Analysis in Mediation Practice.” *Negotiation Journal* 11(2): 123 - 133.

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

Beam, C. and A. Segev (1998). "Automated Negotiations: A Survey and the State of Art". Berkeley, CA, Haas School of Business.

Beam, C., A. Segev, et al. (1996). "Electronic Negotiation through Internet-based Auctions". Berkeley, University of California.

Buchanan, J. and M. Henig (1996). “Solving MCDM Problems: Process Concepts.” *Journal of Multiple Criteria Decision Analysis* 5(1).

Bui, T. X. (1996). “Negotiation Processes, Evolutionary Systems-design, and NEGOTIATOR.” *Group Decision and Negotiation* 5(4 - 6): 339 - 353.

Chan Kim, W. and R. Mauborgne (1999). “Fair Process: Managing in the Knowledge Economy.” *Harward Business review*, 75(4): 65-75.

Chavez, A. and P. Maes (1996). "Kasbah: An Agent Marketplace for Buying and Selling Goods". *First International Conference on the Practical Application of Intelligent Agents and Multi-Agent Technology*, London.

Explorer, D. (1999). "http://www.banxia.com/", Banxia Software.

Fang, L., K. W. Hipel, et al. (1993). *Interactive Decision Making. The Graph Model for Conflict Resolution*. New York, Wiley.

Fisher, R., A. K. Schneider, and E. Kopelman. (1994). *Beyond Machiavelli. Tools for Coping with Conflict*. Cambridge, MA, Harvard University Press.

Fisher, R. and W. Ury (1983). *Getting to Yes Negotiating Agreement Without Giving In.* New York, Penguin Books.

Franklin, S. and A. Graesser (1996). "Is it an Agent, or just a Program?: A Taxonomy for Autonomous Agents,". *Proceedings of the Third International Workshop on Agent Theories, Architectures, and Language*, Springer-Verlag.

Guttman, R. H. and P. Maes (1998). "Agent-mediated Integrative Negotiation for Retail Electronic Commerce". *Workshop on Agent Mediated Electronic Trading (AMET'98)*, Minneapolis, MN, (http://ecommerce.media.mit.edu/papers/amet98.pdf).

Guttman, R. H. and P. Maes (1998). "Cooperative vs. Competitive Multi-Agent Negotiations in Retail Electronic Commerce". *Second International Workshop on Cooperative Information Agents (CIA'98)*, Paris: (http://ecommerce.media.mit.edu/papers/cia98.pdf).

Guttman, R. H., A. G. Moukas, et al. (1998). “Agent-mediated Electronic Commerce: A Survey.” *Knowledge Engineering Reviev* 13(3).

Guttman, R. H., F. Viegas, et al. (1999). "Tete-a-Tete", http://ecommerce.media.mit.edu/tete-a-tete/. 1999.

Hall, P. and R. Hudson (1997). *Software without Frontiers*. New York, Wiley.

Hofstede, G. (1989). “Cultural Predictors of Negotiation Styles”, in *Process of International Negotiations*. F. Mautner-Markhof. Boulder, CO, Westview Press: 193-201.

Hofstede, G. (1991). *Cultures and Organizations: Software of the Mind.* London, McGraw-Hill.

Holsapple, C. W., H. Lai, et al. (1991). "Negotiation Support Systems: Roots, Progress, and Needs." *Journal of Information Systems* 1(4): 233-247.

Holsapple, C. W., H. Lai, et al. (1995). "Analysis of Negotiation Support System Research." *Journal of Computer Information Systems* 35(3): 2-11.

Jango, (1999). http://www.jango.com.

Kersten, G. E. and G. R. Mallory (1999). "Rational Inefficient Compromises in Negotiations." *Journal of Multi-criteria Decision Analysis*, (to appear).

Kersten, G. E., W. Michalowski, et al. (1991). "Restructurable Representations of Negotiation." *Management Science* 37(10): 1269 - 1290.

Kersten, G. E. and S. Noronha (1999). "Negotiations via the World Wide Web: A Cross-cultural Study of Decision Making." *Group Decision and Negotiations*((to appear)).

Kersten, G. E. and S. J. Noronha (1998). "Rational Agents, Contract Curves, and Non-Efficient Compromises." *IEEE Systems, Man, and Cybernetics* 28(3): 326-338.

Kersten, G. E. and S. J. Noronha (1999). "WWW-based Negotiation Support: Design, Implementation, and Use." *Decision Support Systems* 25 135-154.

Kersten, G. E. and T. Szapiro (1986). "Generalized Approach to Modeling Negotiations." *European Journal of Operational Research* 26(1): 142-149.

Kersten, G. E. and S. Szpakowicz (1998). "Modeling Business Negotiations for Electronic Commerce". *Intelligent Information Systems*, Malbork, Poland, IPI PAN: 17-28.

Lax, D. A. and J. Sebenius (1986). *The Manager as Negotiator*. New York, The Free Press.

Lewicki, R. J. and J. A. Litterer (1985). *Negotiation*. Homewood, IL, Irwin.

Lewicki, R. J., D. M. Saunders, et al. (1997). *Essentials of Negotiations*. Boston, MA, McGraw-Hill.

Lewicki, R. J., D. M. Saunders, et al. (1997). *Negotiation. Instructor's Manual*. Boston, MA, McGraw-Hill.

Lotov, A. V., V. A. Bushenko, et al. (1998). "Water Resource Conflict Resolution Based on Integrative Tradeoffs Display", in *Restoration of Degraded Rivers: Challenges, Issues, and Experiences*. D. P. Loucks. Netherlands, Kluwer.

Maes, P., R. H. Guttman, et al. (1999). "Agents that Buy and Sell." *Communication of the ACM*, 42(3): 81-91.

Mohan, M., G. E. Kersten, et al. (1999). "Learning Business Negotiations with Web-based Systems: The case of IIMB" in *Decision Support Systems for Sustainable Development: A Resource Book of Methods and Applications*. G. E. Kersten, A. Gar-On Yeh and Z. Mikolajuk (ed.), Dordreht, Kluwer: 215-238.

Moukas, A., R. Guttman, et al. (1999). "Agent-mediated Electronic Commerce: An MIT Media Laboratory Perspective." *Journal of Electronic Commerce*: to appear.

Personalogic (1999). "http://www.personalogic.com", AOL.

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

Raiffa, H. (1996). *Lectures on Negotiation Analysis*. Cambridge, MA, PON Books.

Roth, A. E. (1995), “Bargaining: Economic theories of bargaining,” Social Science Encyclopedia, 2nd Edition, Adam Kuper (ed.), London, Routledge. http://www.pitt.edu/~alroth/barg.html

Rubin, J. Z. and F. E. Sander (1988). “When should we use agents? Direct vs. Representative Negotiation.” *Negotiation Journal*(October): 395-401.

Runyon K. E. and D. W. Stewart (1987), *Consumer Behavior*, Ohio, Merrill Publishing Company.

Saaty, T. L. and J. M. Alexander (1989). *Conflict Resolution: The Analytic Hierarchy Approach*. New York, Praeger.

Sandholm, T. (1999). “Automated Negotiation.” *Communications of the ACM*, 42(3): 84-85.

Sebenius, J. K. (1992). “Negotiation Analysis: A Characterization and Review.” *Management Science* 38(1): 18-38.

Smith, K., R. H. Guttman, et al. (1999). "Kasbah", http://ecommerce.media.mit.edu/Kasbah/. 1999.

Teich, J., H. Wallenius, et al. (1998). "Multiple Issue Auction and Market Algorithms for the World Wide Web". *5th DAS Workshop*, IIASA, Austria.

Teich, J. E., H. Wallenius, et al. (1994). “Advances in Negotiation Science.” *Transactions in Operational Research* 6: 55-94.

Thiessen, E. M. and D. P. Loucks (1994). "ICANS: Interactive Computer Assisted Negotiation Support". *Computer Assisted Negotiation and Mediation: Prospects and Limits*, Harvard, Harvard Law School, Cambridge, MA.

Thompson, L. (1998). *The Mind and Heart of the Negotiator*. Upper Saddle River, NJ, Prentice Hall.

Ury, W. (1993). *Getting Past No. Negotiating your Way from Confrontation to Cooperation*. New York, Bantam Books.

Wetlaufer, G. B. (1996). “The Limits of Integrative Bargaining.” *Georgetown Law Journal* 85: 1-25.