

## B2B Negotiation Support: The Need for a Communication Perspective

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### **Abstract**

Negotiation support is an important challenge for business-to-business e-commerce that is still poorly supported in current information systems. One reason is that negotiation processes are much harder to formalize than the business processes in the fulfilment phase. The goal of this paper is to provide the basis for a formal analysis of different types of electronic negotiations which can help developers of future negotiation support systems. The analysis is performed from a communication perspective, in particular, Habermas' theory of communicative action. Using this perspective, a distinction can be made between norm-oriented, goal-oriented and document-based negotiation. Whereas traditional modeling methods take a data-oriented view, the theory of communicative action supports a communication-oriented view that provides more insight in the logic of negotiation processes. The analysis forms the basis for the negotiation support prototype implemented within the ESPRIT project MeMo (Mediating and Monitoring Electronic Commerce) which was aimed at B2B e-commerce for SMEs in Europe.

**Key words:** communicative action, deontic logic, e-commerce, MeMo, negotiation support systems

### **1. Introduction**

Negotiation is a key component in e-commerce. In automated negotiation, computational agents find and prepare contracts on behalf of the real-world parties they represent (Beam and Segev 1997). The automation saves human negotiation time and computational agents are sometimes better at finding deals in combinatorially and strategically complex settings. An example of a system supporting such agent negotiation is the e-Mediator system built at Washington University (Sandholm 1999). However, it is only in relatively well-structured areas that the use of automated negotiation pays off. In most business settings, ne-

gotiation will remain to be performed by humans (Schoop and Quix 2001b). In such a case, negotiation support systems can be of help. An example of an academic negotiation support system is the INSPIRE system built by G. Kersten at Carleton University (Kersten and Noronha 1997). Examples of commercially available business negotiation support systems are [www.tradeaccess.com](http://www.tradeaccess.com), [www.biosgroup.com](http://www.biosgroup.com), [www.smartsettle.com](http://www.smartsettle.com) and [www.moa.com](http://www.moa.com).

In e-commerce, market transactions are often supposed to consist of three phases (e.g., Lindemann and Schmid 1999; Schoop *et al.* 2001). In the *information phase*, customer and supplier find each other. When an offer is made, the *agreement phase* starts. The result of the agreement phase is a legally binding contract. In the settlement or *fulfilment phase*, the agreed-upon terms of the contract are fulfilled by delivery of products and payment. Sometimes, an after-sales phase is distinguished. In such a model, negotiation is located in the agreement phase.

In this paper, we first provide an overview of a recent European project in e-commerce called MeMo. It serves as a background against which the research took place. It provides the different types of negotiation that were taking place in this setting and that had to be supported in the MeMo system. This paper is not about the way these different modes of negotiation are implemented in the MeMo system, but will draw conclusions from this project on the theoretical level. In Section 3, we present an overview of the most important current perspectives on negotiation and discuss their relevance with respect to supporting B2B negotiation in electronic commerce as done in MeMo. The communication perspective is worked out in Section 4. In this perspective, a distinction between norm-oriented, goal-oriented and document-based negotiation can be made. Norm-oriented negotiation is the most common model and is described in Section 5. In Section 6, goal-oriented negotiation protocols are analysed and discussed. In Section 7, the same is done with document-based negotiation protocols. Finally, in Section 8, we give some conclusions and directions for further research.

## 2. Mediating and Monitoring Electronic Commerce

E-commerce is doing business via electronic networks such as the Internet and the World Wide Web (WWW). E-commerce can be seen as the successor of Electronic Data Interchange (EDI), but it goes far beyond EDI in that it aims at supporting complete external business processes. Information about potential business partners can be obtained through specialised databases, chambers of commerce, and lately also through the WWW. The fulfilment of transactions is also well supported. There exist many systems that support electronic payment, either directly or through some documentary credit facilities. Also the order control can be managed electronically through the use of EDI messages.

However, there is very little support for the agreement phase, which consists of contract negotiation. This stage has to be done manually which is a major obstacle for the uptake of electronic commerce by small and medium-sized enterprises (SMEs). Big companies can usually afford to undertake the time- and money-consuming enterprise of negotiating interchange agreements, because they can establish long-term relations with their suppliers (or customers) and they have the expertise in-house. The European project MeMo

(Mediating and Monitoring Electronic Commerce) aimed at designing and implementing an electronic marketplace that is particularly suited to the needs of SMEs. The MeMo system is one of the first solutions aimed at SMEs in which all three phases are supported and the agreement phase includes possibilities to negotiate beyond traditional auction mechanisms or requests for quotation followed by orders. We describe the main components, focusing here on the negotiation support.

### *2.1. Negotiation and contracting mechanism*

The Negotiation Module of MeMo supports business-to-business negotiation and contract building. The precondition for business relations is a relation of trust between all business partners (Schoop and List 2001). This relation of trust depends, on the one hand, on personal contact and, on the other hand, on contracts and legislation. The MeMo negotiation module does not replace human informal communication, but enables human agents to structure their communication using a Formal Language for Business Communication (Kimbrough 1998; Weigand and Hasselbring 2000). This is a language based on speech-act theory and formal logic, using XML syntax. Since the results of the negotiation are typically laid down in a contract, the negotiation module also offers a repository of standard contracts and a shared workspace in which a standard document can be adapted by the partners to their particular needs. The module facilitates different scenarios and provides SMEs with safe “negotiation rooms”.

Since language is often a serious barrier for international trade, especially for small companies in Europe, the negotiation module also contains a multilingual thesaurus in which key terms of international trade are given in multiple languages. In this way, it is possible for the human agents to personalise their MeMo interface to their particular language. Through all these means, MeMo is one of the first systems that can really facilitate business negotiation via the Internet.

### *2.2. User evaluation*

In order to involve a group of SMEs in the project, MeMo has formed round tables with SMEs in Spain, in Germany and in The Netherlands. These user group round tables provided the ideal environment to continually discuss the incremental developments and test the prototype with SME user companies. The most extensive evaluation of the system has taken place in the Dutch construction industry.

One of the results of this evaluation was that the results of traditional non-automated negotiations often contain many errors, resulting in high failure costs in the fulfilment stage. An integrated system like MeMo can help to reduce data errors. Another interesting result was that negotiation means quite different things for different roles in the value chain, and that a system such as MeMo must be adapted to a particular role before it can be used effectively. For example, a *wholesaler* negotiates with manufacturers about frame-contracts on a yearly basis. During and after the negotiations with the contractors, the whole-

saler forwards specific orders (electronically) to the manufacturers within the boundaries of the frame contract. Negotiation and fulfilment are not strictly separated, since contracts are modified and updated many times before the final delivery. *Contractors* negotiate with wholesalers on a project-basis, and do this typically by asking for quotes from several parties and then using this information in bargaining. The bargaining is seldom about the price only, but more often about delivery schemes and additional services (multi-criteria). The *manufacturer* is particularly interested in automating the ordering process and reducing his negotiation efforts.

The requirement analysis performed in cooperation with the users provides the empirical grounding of our work. The following section presents an overview of the most important theoretical models of negotiation on which to base future negotiation support systems.

### 3. Negotiation

There are numerous definitions of negotiation, of which we give three characteristic examples. Gulliver (1979, p. 79) defines negotiation as a process in the public domain where two parties, with supporters of various kinds, attempt to reach a joint decision on issues in dispute. Robinson and Volkov (1998) view negotiation as a process in which participants bring their goals to a bargaining table, strategically share information, and search for alternatives that are mutually beneficial. According to Putnam and Roloff (1992), negotiation is a special form of communication that centres on perceived incompatibilities and focuses on reaching mutually acceptable agreements.

Although the details of these definitions differ, there are some common elements that we use for our own definition of negotiation:

*Definition:* In a negotiation (1) there are two or more participants in a situation of some kind of interdependence, (2) each having some individual goals which may be partially incompatible. In some form of (3) the negotiation process, (4) alternatives are investigated, (5) of which one is mutually agreed upon as the acceptable outcome of the process. A business negotiation is a negotiation conducted by business partners.

A common distinction is between distributive and integrative negotiation (Walton and McKersie 1965). The objective of distributive negotiation is to achieve an efficient compromise. The objective of integrative negotiation is to create a solution that satisfies both parties. Fisher and Ury (1981) made a similar distinction between win-lose versus win-win negotiations and argue strongly in favour of the win-win approach. We will come back on this distinction after having introduced Habermas's notion of communicative action.

According to the definitions given above, auctions are also a kind of negotiations. We will not discuss auctions in this paper, although some auction format has been incorporated in the MeMo system. The theory for support of bidding strategies on auctions has been developed some way already, which is the main reason for the popularity of auctions on the Internet. However, auctions are mainly useful for negotiations that are about price only or where the decision criteria on what constitutes the best offer are fixed on forehand.

We follow (Kersten, Noronha and Teich 2000), among others, that not all negotiations can be represented by auctions. In particular auctions are always of a distributive nature. Therefore it is not possible to model integrative negotiations using auctions. Also because integrative negotiation is the most common in MeMo, we will ignore auction theory in this paper.

### *3.1. Negotiation models*

Negotiation models can be used for different purposes. An important distinction is whether they are used as descriptive or prescriptive models (Gulliver 1979; Kersten and Cray 1996). Descriptive models try to carefully describe what actually happens, whereas prescriptive models are normative in the sense that they prescribe what negotiators should do to achieve the desired result.

Kersten and Cray (1996) give some guidelines about what the role of both types of models in negotiation support should be. Any negotiation supporting method should first of all be based on a descriptive model that analyses and explains the cognitive perspectives and behaviour of the participants, without making unrealistic assumptions about their rationality. Only after this cognitive level has been described is it useful to provide predictive and prescriptive support at the instrumental level. Negotiation support should allow for contrasting descriptive representations to be developed. Then, predictions and prescriptions can be generated, based on an analysis of the needs of the opponent, the specifics of their situation, and decision making conditions. Instead of trying to fully predict outcomes, only the options for change for the various participants need to be identified. The participant then makes the actual decisions, based on his interpretation of rich, often unformalisable context knowledge.

#### *3.1.1. Prescriptive models*

Game-theoretical and economic models can both be considered to be different forms of prescriptive models. Key to such models is that some decision quality measure is developed (Kersten and Cray 1996), often based on utility functions. By assessing the values of different options, the best overall solution can be calculated. Such an approach assumes axiomatic rationality, meaning that participants will always choose the options that are in their best interests according to the particular quality measurement instrument chosen. One could have some doubts about this assumption, but it has been shown that the predictions have some empirical validity. For supporting real-world processes such as business negotiations, these models have a number of serious drawbacks, however (Gulliver 1979; Kersten and Cray 1996). The predictions are often too general or hypothetical, they are over-simplified and take into account too few variables. These models also ignore the process of the negotiation itself. They focus on the best outcome and not on the way to get to this outcome. Under the right conditions, these systems can support the decision making. However, even some strong supporters of utility-based approaches acknowledge that approaches based on another rationale, such as communications structuring systems, may be just as useful (Rangaswamy and Shell 1997).

### 3.1.2. *Descriptive models*

Quite different are the descriptive theories based on sociological and psychological theory, and on learning and joint decision making (Lim and Benbasat 1992). One of the classical theories in this group is Gulliver's theory of negotiation (Gulliver 1979). It consists of two models, together describing the negotiation process. The *cyclical model* describes how communication, cognition, and learning take place. Information is exchanged between the parties. The receiving party interprets this information and adds it to his/her stock of knowledge. In this way, participants learn both about their own expectations and preferences and those of their opponents, and about their common situation and potential outcomes. The *developmental model* consists of a series of overlapping phases describing the development of the initiation of a negotiation to the conclusion of an agreed outcome. Interestingly, these two models come back in the two abstraction layers of the communicative action paradigm (Section 4). Descriptive cognitive models tend to be critical of the rationality assumption made in prescriptive economic models (Bazerman 1983) and stress the importance of errors and failures caused by framing effects and irrational biases.

### 3.2. *A communication perspective on negotiation*

Negotiation can be analyzed from different perspectives. In economics, the main focus has been the decision process. In that perspective, a negotiation support system (NSS) is a special kind of a decision support system (DSS). A perspective that in our opinion so far has been neglected too much in negotiation support systems is the communication perspective. Any negotiation process is realized in some kind of communication. There are three key characteristics of a communications perspective on negotiation: micro elements, dynamics, and systems of meaning (Putnam and Roloff 1992). First, communication processes consist of many micro elements that occur in a specific context, for instance, messages are related to previous and subsequent messages in the context of a particular goal. Second, the dynamics of communication need to be studied. One example is how offers are formulated and changed. Third, systems of meaning from individual, interpersonal, situational, and cultural perspectives need to be uncovered to properly guide the negotiation process. Especially in computer-mediated business negotiation, sufficient attention needs to be paid to the development of an appropriate communication model. Patterns, such as needed to construct offers or information requests, must be defined. Defining who can change what, and how the various information products are changed in the negotiation subprocesses is very important. Different sets of meaning adopted by, for example, business partners from different countries, need to be carefully defined.

The communication perspective has been used extensively in non-electronic (face-to-face) negotiation settings (see e.g., Ulijn and Strother 1995). In the area of Negotiation Support Systems, most research so far has focused on analysing relatively simple context-free and artificial negotiation situations, while little is known about the determinants of, for instance, intercultural negotiations (Kersten and Noronha 1999). Besides the MeMo system described earlier, an example of a simple communication model-based negotiation support system is the Fair Internet Trader ([www.semper.org](http://www.semper.org)). In this system, one can act

either as a buyer or a seller. An offer can be negotiated, using some simple parameters like product, quantity, price, and VAT. An order is then produced, and a payment can be made. For this reason, the system pays a lot of attention to security.

In this paper, the perspective is communicative (Chang and Woo 1994; Habermas 1981; Schoop and Quix 2001a). Negotiation moves are analysed as communicative actions (speech acts) that have a certain effect in the social world (the world of norms and commitments), the subject world (the world of values and beliefs) and, at the end of the day, also in the object world (the world of accomplishments). We will not go into decision problems as such. The social and cognitive perspectives are only taken into account as far as they are relevant to the communication process. A communication perspective on negotiation considers utterances in the negotiation processes (either spoken or written), in some language and format, and relates these to the underlying communicative actions. As far as it is descriptive, it tries to explain the form of the utterances (illocutions, lexical choices etc.) from its functions, and tries to explain the coherence in the negotiation by calling upon the logic of the communicative actions. As far as it is prescriptive, it provides protocols or suggestions that incorporate quality norms for communication (Weigand and De Moor 2001). These protocols and suggestions are not meant to support decision making, but they aim at improving the quality of the communication in terms of clarity, efficiency, trust enabling, error reduction etc.

### 3.3. *Negotiation stages and protocols*

Most approaches agree or recommend that a negotiation process consists of a number of stages. Depending on the negotiation model used, the number and contents of these stages differ considerably. We first present some possible subdivisions of the negotiation process by looking at the negotiation *life cycle*.

Most process models agree that there is at least some form of (1) negotiation preparation, (2) the actual conduct of the negotiations, and (3) the implementation of the results, sometimes including their re-negotiation (e.g., Gulliver 1979; Kersten and Noronha 1999; Lim 1999). Others only take into account the planning and conduct of the negotiation itself, while not paying attention to what happens with the results. Robinson and Volkov (1998), inspired by the software life cycle, talk about the negotiation analysis, design, and implementation stages. The first two stages together form the preparatory stage, whereas the actual conduct of the negotiation takes place in their implementation stage (note that to them, implementation refers to the negotiation process, whereas above it concerned what happened to the end results once this process is finished).

If negotiation is to be adequately supported, it is not enough to merely describe the various characteristics of this process. Instead, prescriptive guidance in the form of negotiation *protocols* is also required. These can be defined as protocols that define how agents (usually human) communicate through an ordered interchange of structured messages. Using this definition, Robinson and Volkov (1998) claim that negotiation protocols regulate four types of behaviour: revealing agent models, identifying conflicts, searching for alternatives/conflict resolution, and selecting an alternative. Using such a protocol, *negotiation*

*strategies* can be employed which consist of the plans by which agents interact with each other to achieve a desired goal. Of course, such agents can be human, machine, or a combination of both, although it is still theoretically unclear when to use what kind of agent.

In B2B e-commerce, negotiation protocols are useful for a few additional reasons:

1. If the negotiation is to be automated using intelligent agents, this is only possible when these agents can use a fixed protocol;
2. If business negotiations cannot be automated, it may be possible to support them by Internet, for example, with e-mail. But e-mail itself does not provide any process structure. A staging of the negotiation process increases the efficiency and effectiveness, but one should not reinvent the wheel. Protocols can be considered as accumulated wisdom about negotiation process structure.
3. Structuring the negotiation process is always useful, but even more so in intercultural settings. The Internet has a global reach. It is to be expected that when a company makes more use of Internet for its business, it will more often meet partners from a different cultural and linguistic background (Schuster and Copeland 1996). To reduce the uncertainty in these situations, a clearly specified protocol may help and may avoid many mistakes or ambiguities.

#### **4. A Communicative View on Negotiation**

##### *4.1. The model of communicative action*

The communication process model that we adopt makes a distinction between three levels of abstraction in the communication process: the media level, the information level, and the communication level. The *media* level of communication describes the physical characteristics of the communication process. The question is: how? How are messages put across? Quality attributes at this level include media richness, interactivity, reliability, security and efficiency. The *information* level of the communication has to do with the data contents. It is not about *how* messages are transported, but *which* messages are transported. Traditional information quality attributes are for instance integrity, completeness, preciseness and timeliness. Integrity constraints in the communication system can be used to enforce some of these qualities. The *communication* level is about what people do with messages. The communication level can be specified using the Language/Action Perspective and Habermas' theory of communicative action (Habermas 1981; Winograd 1988). For Habermas, the essence of communicative action is that the parties are oriented at mutual understanding (Verständigung) of a situation for the purpose coordinating actions. The situation definition includes what is the case, but also what should be done and what is desirable. Communication proceeds by parties making claims. For example, an assertion is not just to convey some information, but claims that the situation is such and such. As the orientation is towards mutual understanding, the other party can accept the claim, but can also challenge it, which means that a rational discussion is started in which arguments on validity claims pro and con can be exchanged.



Sometimes, Habermas' framework has been dismissed as being too idealistic. People are not always acting rationally. They have biases and their own (hidden) agenda. However, the framework does not ignore that people are fallible and opportunistic. They are not always rational, but nevertheless they enter rational discussions. They use arguments to support their claims and they try to attack the arguments of the counterparty if they do not agree. As long as they do that, rationality apparently plays a normative role. A similar remark can be made about opportunism. Habermas's framework does not assume that people are altruistic. They do pursue their own goals, but when they have to cooperate with others, they can only achieve their goals by coordinating. That is why they use communicative action. They may choose other instruments, or start with communicative action but not play according to the rules of the game. Normal business (and the results of the MeMo project did confirm this) is heavily based on trust and sustaining long-term relationships, which strongly urges for the use of communicative action (Weigand and van den Heuvel 2001).

In this paper, the focus is on negotiation. A first observation with regards to Habermas' framework is that negotiation is considered to be at the very heart of communication. Communicative action is negotiating a situation definition. It includes making assertions, requests, promises, apologies etc., but these actions are only effective when the other party accepts them as such. Communication is a type of joint action (Clark 1996). Of course, it is not always necessary to go into an argument. It is possible that the other party accepts the claim immediately, perhaps even without stating this fact explicitly. In such a case, one might say that there is no real negotiation, but the essence of negotiation is there.

It is not only true that communication is a kind of negotiation, the reverse can also be maintained. The second observation is that to the extent that negotiation is a communication process, it should also have this orientation towards a shared situation definition. This includes exchanging proposals and finally agreeing on one, but asking questions can be much more effective, and also argumentation.

The communicative action theory leads to a three-layer model of communication (Reijswoud 1996) as represented in Figure 1. The top layer is the "success layer", the phasing of the process where progress is defined in terms of claims being made and being accepted (cf. the developmental model of Gulliver). When a claim is not accepted, the addressee challenges the claim. In terms of the Language/Action Perspective, a *break-down* occurs. A break-down means that a discussion starts and only after having finished this discussion, the phase can be closed. The discussion level corresponds to the cyclical model of Gulliver. At this point, it is worthwhile to consider the four different validity claims that Habermas distinguishes, namely comprehensibility, truth, truthfulness, and appropriateness. *Comprehensibility* has to do with meanings. Before we can agree or disagree on a certain issue, we have to talk the same language. A discussion on comprehensibility is typically a conversation for clarification. In intercultural and multilingual cases, comprehensibility needs special attention. *Truth* has to do with the situation in the objective world. In business, discussions about the truth are typically supportive of other claims. For example, in dispute resolution, the claim can be that the other party has to compensate damage, but to support this claim, a discussion can start about what has actually happened or not happened. Also oriented towards the objective world is a conversation for possibilities, which

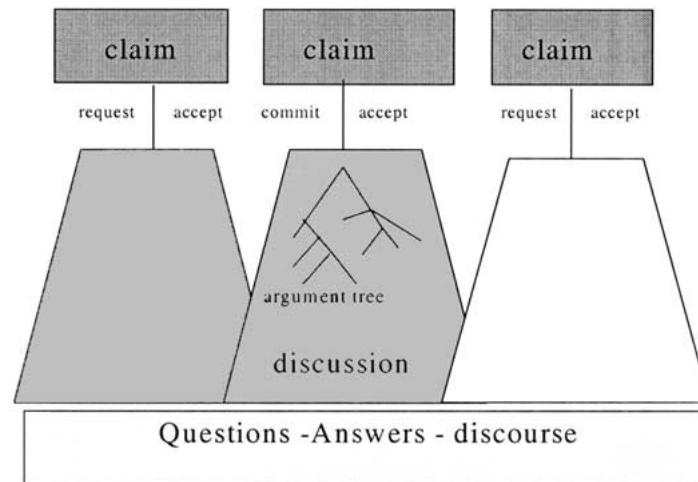


Figure 1. The layered model of communicative action.

is what is usually considered the heart of integrative negotiating. *Appropriateness* is related to the social world or normative context. A legal dispute about what is right according to the contract or the law in place, is an example of such a negotiation and typically takes the form of an exchange of arguments (cf. e.g., Prakken 2000), but there are other examples as well. For example, during business negotiations the parties may refer to business ethics, or to cultural values. The fourth main validity claim is *truthfulness* or sincerity which relates to the subject world in Habermas' view. A communicative action presupposes that the speaker believes what (s)he asserts and intends what (s)he commits to. In this paper, we would like to limit the subject world to the world of goals and values. We omit beliefs because a discussion about beliefs cannot be separated from a discussion about truth, and therefore is already covered, so to speak. However, what cannot be found in the objective world nor in the social world, are goals and desires (including what economists call "preferences"). They are invisible as such, but in many ways actors reveal their preferences, by acts but also by means of communication. Hence it is possible to discuss preferences, and to discuss the appropriateness of a certain communicative action with regards to these revealed preferences.

The bottom line of Figure 1 represents the discourse level. When a discussion does not lead to a result, two options remain. Either the communication is ended, or the participants can enter into a dialogue (discourse) in which they critically examine the presuppositions they both started from. In a discourse, communicative action is put into brackets. It aims at finding a common ground, which makes new communicative action possible, in terms of norms, values, language, situation definitions etc. Questions/answers play an important role in discourse.

If we compare Habermas' model to the traditional model of decision-making, we can conclude that Habermas' approach introduces a radically different perspective. In the first place it views decision-making as a process of coordination of action, based upon nego-

tiations about validity claims. In the second place it distinguishes between four dimensions of such negotiations: the dimension of comprehensibility, the dimension of truth, the dimension of appropriateness (justice), and the dimension of truthfulness. Related to this distinction is the philosophical assumption that rationality is being improved when these dimensions are properly distinguished. In the third place, the model contains a way out of a possible conflict: the levels of discussion and discourse.

#### 4.2. A classification of communicative negotiation models

If negotiation is about arriving at an agreement, the question is what drives the process. This question is directly related to the question which validity claims are made and how the claims are defended or challenged. *What argument does one party use to convince the other?* One argument can be that the other is obliged, on the basis of social commitments made earlier in the process. To the extent that appropriateness arguments are used, we talk about norm-oriented negotiation. The classical quotation/ordering process is norm-oriented, as we will show in the next section. But another argument is that the deal is in line with the expressed goals and desires. In other words, the party is supposed to be motivated by goals (at least partly). This leads to a type of negotiation that we call goal-oriented. In this type of negotiation, the parties try to fix common or mutually accepted goals. We do not claim that norm-oriented and goal-oriented negotiation are mutually exclusive, but we do claim that giving priority to one type over the other leads to quite different protocols. It is important that designers of negotiation support systems are aware of that, so that it is clear what the underlying assumptions of a particular system are.

In addition to the distinction between norm-oriented and goal-oriented negotiation, there is a distinction between message-based and document-based negotiation (Figure 2).

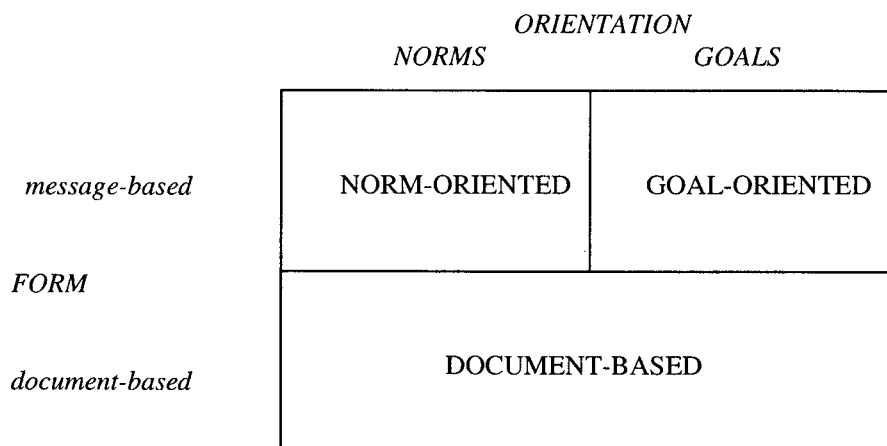


Figure 2. Two dimensions of negotiations.

Document-based negotiation involves the collaborative writing of a contract, namely the business contract specifying the result of various interactions between the business partners and of the various agreements reached during the negotiation process. Thus, not the discussion in terms of message exchange but the discussion in terms of collaborative document management is the main characteristic of such form of electronic negotiation. In principle, the distinction between message-based and document-based negotiation is orthogonal to the distinction between norm-oriented and goal-oriented. When in document-based negotiation, the document in question is a legal contract, as it typically is in international sales, the negotiation is norm-oriented. Nevertheless, we prefer to talk about document-based negotiation in this case, rather than norm-oriented, as it is the structure of the contract which heavily determines the structure of the negotiation process.

In Section 5, we will discuss norm-oriented negotiation, which is the most common type in the application domain of the MeMo system. Section 6 and 7 present the other negotiation models.

## 5. Norm-Oriented Negotiation

Let us consider an order message. Usually, an order is analyzed logically as a request (illocution) for the delivery of a product (propositional content). A request contains an implicit validity claim: why should the other party honour the request? In (Weigand *et al.* 1997) three possible validity motivations have been distinguished: charity, authorization and power. Power is not applicable normally in a market environment (except perhaps in star networks such as common in the automotive industry). Charity means that the other party is not obliged in any way to honour the request, but may decide to do so himself/herself, and then, only after the commitment, an obligation is created. This is a real possibility, but there are certain disadvantages. If the buyer mentions a price, (s)he runs the risk that the price is too high or too low. If it is too high, the seller will accept the order, but the buyer could have made a better deal. If it is too low, the seller will not accept the order and the negotiation may terminate immediately. Another disadvantage of a charity-based order from the perspective of the buyer is that (s)he cannot compare different sellers, since the discussion is about the order, and so when the two parties arrive at an agreement, the order is placed and the buyer cannot withdraw anymore. And finally, since the order is charity-based, (s)he does not know whether the seller will respond, or will respond timely. This uncertainty is often unacceptable in a business environment. We conclude that an *authorized* request is to be preferred over a charity-based one.

If the order is authorized, the question is where this authorization stems from. In B2C relationships, shops are identified as such and prices are listed. These *listed prices* authorize the consumer to order (or request) a product for that price. In B2B relationships, it is less common to use listed prices. This implies that the authorization must be granted first. Of course, this is exactly what a *quotation* message does. In speech-act theory this is analysed as an authorization message, a message that creates an authorization (namely, to order). The quotation itself is an action from the seller that must be triggered somehow and possibly also authorized. For that reason, there is usually a message before the quotation,

the *request for quotation (RFQ)*, by which the buyer explicitly request a quotation message. This request is usually based on charity; the other party commits to this request voluntarily. The RFQ authorizes the seller to send a quotation. It might be remarked that the uncertainty that we tried to reduce in the ordering process now is still present in the RFQ process. Indeed, there might be situations where the buyer would like to be authorized rather than rely on charity. However, the RFQ process is often performed in parallel to multiple potential sellers, which makes the results of one party less critical.

### 5.1. *The main phases of norm-oriented negotiation*

This logical reconstruction of the pre-ordering communication leads to a distinction in at least two phases: the RFQ phase and the QUO (quotation) phase. In the simple case, these messages (and their uptake by the other party) are sufficient. But if something is unclear or not satisfactory to one of the parties, a discussion can start.

If there is a discussion in the RFQ phase, it usually centers around the identification of the parameters of the transaction. This includes the identification of the participants themselves (“who are you?”) as well as the precise identification of the product (“what do you want?”). In terms of Winograd (1988), the discussion is a *conversation for clarification* and the typical speech acts in this phase are questions and answers. The discussion ends when both parties have sufficient confidence that the intended transaction is properly identified (to both) and the seller commits himself to make a quotation.

In the QUO phase, the seller fulfils his obligation to send a quotation. This quotation contains an authorization for the buyer to order the product. It may contain alternatives (different products, or different prices for different product quantities). A discussion can start on this proposal that in terms of Winograd takes the form of a *conversation for possibilities* and the typical speech acts are proposals and counter-proposals. The discussion ends when both parties accept one or more proposals and the buyer accepts the (modified) quotation.

It should be noted that often the quotation message *also* contains a (conditional) request to the buyer to pay the quoted price. Accepting a quotation implies accepting this request. Again, a discussion may arise in the case of a break-down (we talk about “break-down” even in situations where this break-down is designed, or has become customary). This discussion typically takes the form of a *bidding process* and the typical speech acts are bids and counter-bids. The discussion ends when both parties agree on a certain price. The bidding process can be structured by using a monotonic concession protocol (Zlotkin and Rosenschein 1994) which means that a next bid is always stronger than a previous one (in plain words, the buyer only goes up with the bid and the seller only goes down). Note that this bidding process can run in parallel to the conversation for possibilities, although the parties can also decide to finish this conversation first. The advantage of doing the bidding at the end, is that price gets less attention during the exploration of the possibilities, which will probably result in more alternatives to be considered and worked out. In contrast, if the goods or services are not very asset-specific and easy to describe, the price may be the most important decision factor, and hence is better taken into account immedi-

ately. Our research in the Dutch construction industry showed the following picture: first, a quotation process is performed in which price is the most important attribute. Then one or two suppliers are selected and negotiations start with them in which all kinds of possibilities are explored. In terms of the formal model used here, this means that within the QUO phase, there is a bidding process first, followed by a conversation for possibilities.

After the quotation has been accepted by the buyer, there is no contract yet. The buyer can negotiate several quotations from different suppliers and then choose the one that fits best. At this point, different patterns can be followed. One is that the buyer fills in a purchase order or some other formal contract. After having been signed by both parties, this contract is binding and contains not just authorizations, but obligations of both parties to perform their part. It is also possible that a frame contract is set up and afterwards a delivery order is sent in accordance with the frame contract. The simplest case is that the buyer sends an order to the seller and the seller accepts this (note that normally, the seller is obliged to accept the order since it is authorized by the quotation).

Even in the ordering phase, a discussion can arise. From the MeMo perspective, we are only interested in discussions about the contract, so we ignore discussion about a delivery order after a contract has been signed. However, if there is already a contract or purchase order document, the discussions will tend to become document-based (cf. Section 7).

### 5.2. Logical semantics of the quotation phases

For all negotiation types that we have distinguished, we would like to have clear logical semantics. In this way, the protocols that are used in the negotiation support system are more transparent. However, we only describe here the semantics for norm-oriented negotiation, as the other cases are much harder to deal with. Moreover, norm-oriented negotiation is the most important requirement in MeMo. The semantics of the other types is left as a challenging topic for future research.

In Verharen (1998) and Weigand *et al.* (1997), a formal logic has been described for modelling communication. It is based on Dynamic Deontic Logic (DDL) and extended to include speech acts. Instead of repeating all the formal definitions here, we limit ourselves to a vocabulary and some examples of its application in business negotiation. Our aim here is not to discuss deontic logic as such – for example, how to axiomatize obligations exactly – but to use this logic as it is in order to give formal underpinnings of the negotiation processes that we have identified.

- O( $\alpha$ ) action  $\alpha$  is obliged (possibly with indices  $i$  and  $j$  to indicate the agent and principal)
- [ $\alpha$ ] $\phi$  (Dynamic Logic) formula  $\phi$  holds after the performance of action  $\alpha$ ,
- Auth( $\alpha$ ) action  $\alpha$  is authorized (where the action is a speech act)
- DIR directive (based on charity (c) or authorization (a) – the latter meaning that the request claims to be authorized by a previous agreement or norm and hence leads immediately to an obligation)

*Examples:*

$$[\text{DIR}_c(i,j,\text{give-quotation}(j,i,g,p))] \text{O}_{ji}(\text{give-quotation}(j,i,g,p) \text{ OR } \text{refuse}(j))$$

After a request for a quotation (i.e., a directive based on charity) the company is obliged to give the quotation or send a refusal. This follows from the generic business rule that a request for a service offered is always answered.

$$[\text{give-quotation}(j,i,g,p)] \text{auth}(i, \text{DIR}_a(i,j,\text{deliver}(j,i,g,p)))$$

If a company gives a quotation for a certain price (p) the client is authorized to order the product (g) for that price. (i.e., a meaning definition for give-quotation).

$$\text{auth}(i, \text{DIR}_a(i,j,\text{deliver}(j,i,g,p))) \Rightarrow [\text{DIR}_a(i,j,\text{deliver}(j,i,g,p))] (\text{O}_{ji}(\text{deliver}(j,i,g,p)) \text{ AND } [\text{deliver}(j,i,g,p)] \text{auth}(j, \text{DIR}_a(j,i,\text{pay}(i,j,p))))$$

If a customer is authorized to order a product for a certain price (i.e., a quotation has been given for that price) then the company is obliged to deliver the product after the customer has ordered it. After delivery of the product, the company is authorized to order the customer to pay for it.

Besides O and auth, we include one more primitive operator in the deontic specification language. This is acc, for accomplishment. acc( $\alpha$ ) means that action  $\alpha$  has been executed.

When talking about O, auth, or acc, it takes typically two messages, one of both parties, to establish a fact (Weigand and van den Heuvel 1998), as is predicted by the theory of communicative action. Hence it is more accurate to use transactions as basic logical units rather than individual speech acts. A transaction is defined as the minimal sequence of speech acts that has a deontic effect. The typical case is a REQUEST followed by an ACCEPT. Although it can be agreed upon by the parties that a simple REQUEST already creates an obligation, we prefer to assign deontic effects to transactions only, even if in some case the transaction consists of only one speech act. When a discussion arises, the transaction becomes much longer, of course.

The DDL model contains the basic deontic modalities, but can be extended in many ways. For example, to account for the subject world, it should contain a Belief modality, Goal and Desire modalities, as well as for instance an identity predicate that makes a link between a communicative role and some social identity. See for example (Dignum *et al.* 2000).

Drawing on the DDL model, we now describe the various phases of norm-oriented negotiation in a semi-formal way. In the following, we repeat the phases (formally: transactions) and the deontic effects (postconditions) of each phase:

$$\begin{array}{ll} [\text{identification}/\text{RFQ}] & \text{social world: } \text{O}(y,\text{quote}(y,x,g)). \\ & \text{subject world: } \text{ident}(x,i), \text{ident}(y,j), \text{G}(x,\text{get}(g)) \end{array}$$

In words: the parties mutually know the identity of buyer x, the identity of seller y, and that x wants goods g (G stands for “goal”) . These are changes in the subject world. The change in the social world is that y has an obligation to send a quote.

[proposal/QUO]	<i>social world:</i>	auth(x,order(x,y,g))
	<i>object+ social world:</i>	acc(quote(y,x,g))

In words: x is authorized to order product g from y, and the obligation of y to send a quote has been fulfilled (both objectively, and in the social world, when x has accepted it). Note that the price still needs to be determined.

[bidding]	<i>social world:</i>	auth(y,invoice(y,x,p))
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In words, y is authorized to invoice x for the amount p - where invoice means: request to pay. The quotation phase is the composition of a proposal and bidding phase.

[quotation] = [proposal] + [bidding]

When the authorization for ordering established in the quotation phase is actually used, obligations to deliver are created. This is called the contracting phase.

[contracting]	<i>social world:</i>	O(y,deliver(y,x,g)), O(x,pay(x,y,p)).
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In words: y has an obligation to deliver and x has an obligation to pay. There may be additional clauses, for example, requiring the seller to deliver *before* sending the invoice. In the case of a frame order, both obligations are conditional (the condition can be the delivery order message, or a stock status change).

All of these phases are essential in the sense that they have a specific effect on the social world, but each phase may be passed in one step, or may contain an extensive discussion. The second and third phase (proposal/ bidding) are often done in the same message exchange. The advantage of having four phases is that the discussions in each phase can focus on one issue at a time. As is clear from the formalization, the effects are mainly in the social world, which supports our claim that the process is primarily norm-oriented.

The semantics developed in this section are based on logical analysis. An interesting topic for future research is how this analysis relates to national or international trade law. Obligations are most effective when they can be legally enforced, but especially in international business trade, partners have a lot of freedom in what they specify as a (legally binding) obligation. One important legal principle is that a contract is a reciprocal commitment that requires explicit consent from both sides. This principle is incorporated in our notion of transaction. In a negotiation support system for international trade, the system should ideally warn for each phase which obligations and authorizations are legally enforceable (and under which law) and which are not.



### 5.3. Tender-based negotiation

In the above, we assumed one seller and one buyer. However, it is also possible to negotiate with several parties at the same time. Instead of a request-for-quotation, the buyer can send a call for tenders to a set of sellers. After receiving the bids, the buyer typically selects the cheapest one (or best one, given multiple criteria), and puts the order. The phases are the same as in quotation-based negotiation; the bidders are typically *obliged* to perform the transaction when they are selected, thus it is a type of norm-oriented negotiation.

Roughly, two subtypes of tender-based negotiation can be distinguished. In one type, the tender procedure is pre-defined, and all parties involved are informed about the rules of the game. The buyer is usually *obliged* to select the cheapest (or best) bid. There is no room for discussion. The bids may or may not be revealed to the other bidders. In the other type, the tender-based negotiation is nothing but the performance of a number of quotation-based negotiations in parallel. The buyer can use information that (s)he receives in one negotiation to press the party in another negotiation. There are no rules defined for all parties, and in each negotiation there is the possibility of discussion.

The advantages of a formally defined tender protocol are the efficiency of the process, and built-in guarantees for a fair competition. A disadvantage is that, since discussion is excluded, the subject of the tender must be clearly defined in advance. Also the evaluation criteria are determined in advance (most often, this is the price), which leaves little room for suppliers to distinguish themselves with special services. A tender procedure can be quite costly (Holmes 1995).

The MeMo system does not only support quotation-based negotiation, but also tender-based ones. The shared workspace can be used to publish the details of the tender and the tender procedure.

## 6. Goal-Oriented Negotiation

*Goal-oriented negotiation* does not aim at achieving obligations via authorizations, but assumes that the parties (whether human or software agents) are motivated by goals. Hence, if a deal can be defined that meets the goal of the other party, this will motivate him or her to agree. In the following we will work out one way of performing such a goal-oriented negotiation which is closely related to what Raiffa (1982) calls negotiation on the basis of interests. Negotiation on the basis of interests is opposed to negotiation on the basis of positions. The difference is that when a party takes a position, this position is not open for discussion. This kind of negotiation is not based on communicative action. If the party does allow a position to be challenged (e.g., do you really prefer X over Y?), the negotiation becomes a negotiation on the basis of interests.

The novelist Antoine de Saint-Exupéry once wrote: “If you want to build a ship, you should not request the workers to collect wood, you should not distribute the work nor give any order. Instead, you should teach them to long for the vast endless sea”. Although one may doubt whether this is the best way to build a ship nowadays, the idea is clear.

A goal-oriented negotiation protocol may consist of four main phases: (1) the introduction, in which the parties greet the other and introduce themselves, (2) goal identification – in which the parties express some of their goals, typically only after being asked, and trying to find a mutual goal (3) exploration – in which the parties suggest opportunities, alternative ways of achieving the mutual goal, and (4) agreement in which one of the alternatives is agreed upon by both partners, perhaps with some small modifications. The exploration phase may be diverging first and converging in the end when agreements are made.

### 6.1. *The main phases of goal-oriented negotiation*

The speech acts in the first introductory phase are greetings and self-introductions. This phase is not unlike the first phase of the norm-oriented negotiation. In all types of negotiation this phase is used to exchange information about identities, products specification etc. However, the norm-oriented negotiation starts with a request for a quotation in order to get a quote, which is a kind of conditional obligation. The goal-oriented negotiation starts with an expression of *interest* to pursue some goal or the question whether the counter-party is interested to pursue some goal. The reply does not need to be more than an agreement on finding out whether the parties might find a *mutual* interest (or goal). So, here there are two differences to norm-oriented negotiation. First, the parties do not yet create obligations. Secondly, the answering party does not have to reveal all its own intentions yet. Usually it is advantageous for a party to know as much as possible about the goals of the other party before revealing one's own goals.

The speech acts in the second goal identification phase are mainly questions and answers (i.e., assertives). The assertives partly indicate the commitments of the parties to goals they have. Although this phase is not as well ordered as that of the norm-oriented negotiation, we can make the following observations.

Both parties start off with a goal that usually is quite concrete. For example, one party might want a specific type of windows from a known brand to be delivered next week for a house that is being renovated. The other party might be willing to deliver windows, but does not have the particular brand in stock (and thus cannot deliver the next week).

Basically, the parties will now relax the constraints on their goal (making it more general) until they get to a point where the goals overlap enough to get a mutual goal. In the example, this might be that both parties want windows to be delivered next week. In the extreme case it might even get to a goal that windows will be delivered. The latter can only arise if it is most important for the customer to have the windows delivered by this particular supplier. This preference is stronger than any other preference, including timeliness. If this is not the case, the customer will quit the negotiation and try another supplier.

The essence of goal-oriented negotiation lies in the way that the constraints are being relaxed by both parties. This can be done in many ways. For example, one party can persuade the other party that a constraint is not important or should be seen differently. In the example, the constraint that the windows have to be of a particular brand might no longer be important if the customer can be convinced that a different brand has the same quality and fulfils all specifications and is available in time. Although no formal models are avail-

able to describe the process in this phase, it is clear that the exchanges consist of arguments that should convince the counter-party of a certain point of view. The way to do this in a peer-to-peer relation is usually by providing extra information and indicating the way it might relate to the goals of the other party, in the hope that the counter-party might change its beliefs and goals on the basis of this information. However, it might also be that one party dictates a certain aspect to the other party. For example, the customer might state bluntly that (s)he will quit the negotiation if the supplier will not deliver next week.

This second phase might be seen as diverging, because often different opportunities are suggested in order to find goals that are abstract enough so that both parties can agree upon them as a mutual goal.

In the third phase, the (usually abstract) mutual goal has to be converted again into a concrete joint plan (cf. Clark 1996). Many of the arguments that came up in the goal identification phase can now be used as suggestions of how to fill in parts of the mutual goal. For instance, the parties in the example can agree to use windows of the alternative brand. But now they might also want to discuss the price that should be paid for this brand of windows. The speech acts in the third phase are suggestions and expressions of agreement/disagreement. They do not yet create obligations, but try to establish whether certain alternatives would be acceptable. It is important to make this distinction, because only after the final agreement phase are the parties legally committed to each other and the mutual goal and do actual obligations exist.

So one important difference between having a commitment expressed in this (plan-formation) phase and an obligation as expressed in the last (agreement) phase is that here commitments can more easily be changed when more information becomes available, e.g., when new alternatives are considered. A commitment of a party to an action indicates that a party considers that action as the best alternative to pursue given the knowledge it has about the situation. When a party gets more knowledge it might realise that another action is preferable given the updated knowledge. It might then change its commitment to the new action if the benefits of choosing the new action over the old action are big enough. So, changing a commitment is mainly an internal process of the party. Changing an obligation, however, cannot be done by one party. It should be done by mutual consent between the parties involved. The last phase of the goal-oriented negotiation is therefore meant to explicitly change the commitments into obligations. This transformation (or actually addition) objectifies the commitments and makes them "enforcable".

The agreement phase consists mainly of proposals. Only in this fourth phase do the parties actually form obligations towards each other. The type of messages in this phase resembles the messages exchanged in the norm-oriented negotiation. The main difference is that here all information is (usually) available already and the messages are mainly meant to form the obligations. Questions are very important, not only in the second phase, but in all phases, for the parties to express their goals and their proposals. This is in sharp contrast with the typical norm-oriented negotiation, where requests are predominant.

Negotiation styles are influenced by cultural backgrounds (Ulijn and Strother 1995), and it may be the case that the goal-oriented negotiation is closer to the Oriental cyclic style. It is important to note that whereas norm-oriented negotiation is grounded in what Habermas calls the social world, the goal-oriented negotiation is grounded in what Habermas

calls the subject world. As a consequence, we can expect for this kind of negotiation to work that either the parties already share a background before or need a lot of time to establish a common background in the form of an intersubjective domain of shared goals and values. Whereas in the norm-oriented negotiation, there usually must be a given set of social and legal norms to draw upon. Another consequence is that the trust in the partners is much more important. This contrasts again to the norm-oriented case, where the emphasis is on trust in the legal context. For that reason, we conjecture that norm-oriented negotiation is more applicable in open electronic commerce, whereas goal-oriented negotiation is more applicable within closed communities or virtual organizations.

## **7. Document-Based Negotiation**

As discussed before, negotiation can be seen as one particular kind of communication. The negotiation partners exchange speech acts such as enquiries, offers, requests, orders, quotes, questions, statements, counterproposals etc. Electronic negotiations involve the exchange of written forms of communication, rather than talking face-to-face. Therefore, it is easy to see that (different types of) documents are involved in electronic negotiations (Schoop and Quix 2001). However, the mere fact that the spoken messages are now in document form is not essential.

Document-based negotiation is more; it emphasises the significance of a document (or different versions of a document) during the negotiation process. Thus, document-based negotiation is defined in the present paper as a negotiation process in which a document – typically the contract – plays a pivotal role. A document is a persistent object that can be manipulated, for example, by adding a clause or making a new version. Here, it differs from a message.

We will first present the negotiation pattern of this type of negotiation (Section 7.1). In Section 7.2 it will be discussed how document-based negotiations can be integrated with message-based negotiations into one coherent framework.

### *7.1. The main phases of document-based negotiation*

Document-based negotiation involves the collaborative writing of a contract, namely the business contract specifying the result of various interactions between the business partners and of the various agreements reached during the negotiation process. Thus, not the discussion in terms of message exchange but the discussion in terms of cooperative document management is the main characteristic of such form of electronic negotiation.

Document-based negotiation usually requires a pre-structured established document template such as the contract templates issued by the International Chamber of Commerce. The negotiation process proceeds in steps determined by the contents of the contract. The clauses of the contract are structured under different headings representing meaningful and coherent parts of the whole contract. Each negotiation step concerns a particular document part. The negotiation pattern is a sequential set of cooperative authoring activities,

i.e., each part of the contract template is dealt with separately and an agreement on a part is reached before the next part is the subject of the negotiation (if some parts can be handled in parallel, it is better to merge them into one part). In practical terms it means that the relevant part of the template is filled in by one negotiator and brought to the attention of the other negotiator. That second party then checks the proposal and either agrees on the terms or changes certain parts. If an agreement concerning the relevant part of the template is reached between the two parties, they move on to the next part. Finally, when a preliminary agreement (soft commitment) is reached on all parts, the parties discuss the whole contract. The outcome of a successful document-based negotiation is a business contract that represents a firm commitment on both sides and specifies the particular obligations for each party.

Document-based negotiation is especially interesting in complicated situations, e.g., international sales. In such cases, it is better to check first if an agreement is possible at all before negotiations of particular elements such as bargaining about the price or other one-dimensional parameters such as delivery time make any sense. A standard document template can help the parties to focus on relevant issues and not to forget important ones.

The grouping of contract clauses needs to be done carefully. Standard contract templates such as those provided by the International Chamber of Commerce contain clauses that are summarised under one heading. Nevertheless, there might be contextual exceptions that require other or more detailed groupings. Certain contract clauses depend on other contractual agreements. For example, a partner might agree to use a certain court of jurisdiction in international negotiations but only if his or her general terms of business hold and the agreement is about a frame contract. Another example is that the method of payment can depend on the types of securities provided. Thus, flexible methods to structure existing contract templates are required.

A negotiation does usually not follow a *strictly* sequential pattern. Even if one section of the contract is agreed upon, this agreement represents only a soft commitment. Therefore, it must be possible to jump back to this section and to re-negotiate if disagreement occur in later sections or if dependencies with other sections exist that change the context of the contractual elements that were negotiated before. Only when all relevant sections are agreed upon, does a firm commitment arise that covers the obligations of all these sections. The agreement can either cover the complete contract or it can be the precondition for negotiations about particular parameters such as price or delivery date.

The latter case shows that a combination of different negotiation models can be useful. For example, document-based negotiation can be used to establish the general terms such as court of jurisdiction, length of a frame contract, contractual penalties, details on marketplace used for negotiations, details on product quality etc. Once these terms are fixed, norm-oriented negotiations can start to discuss particular contractual elements such as price, method of payment, delivery mode etc. Another possibility is to use document-based negotiations for negotiating about frame contracts and to use other models for the individual negotiations that are based on the frame contract but that contain a number of negotiable elements.

Document-based negotiation is currently supported in the MeMo prototype in the form of a contract base with a number of template documents and a negotiation protocol around this contract. The contract templates are stored in XML format which allows flexible (re-)

structuring of the sections in the contract. A shared workspace is provided as the medium for the negotiators to engage in document-based negotiations.

### 7.2. Integrating document-based and message-based negotiation

So far, we have introduced document-based negotiations that are strictly document-based but that can be combined with other models. In this section, we will discuss a framework that integrates structured message exchange and document management, thus combining elements of message-based and document-based negotiation models into one coherent framework.

Figure 3 presents the DOC.COM framework combining communication management and document management. Each negotiation consists of messages and documents. Communication management is enabled by means of structured messages. Searle (1969) argues that each speech act consists of an illocutionary force and a propositional content. Likewise, messages in DOC.COM are composed of a message type and the message content. In face-to-face interactions, the meaning of an utterance can be figured out by observing the speaker's tone, his or her body language, gestures etc. In electronic (i.e., written) forms of communication, there must be a new way of establishing the speaker's intended meaning. Therefore, each message has a message type which reflects the illocutionary point ("intention") of each message and thereby identifies the role of the message in the negotiation process.

Messages can be classified into five classes (Searle 1969), namely assertive, commis-

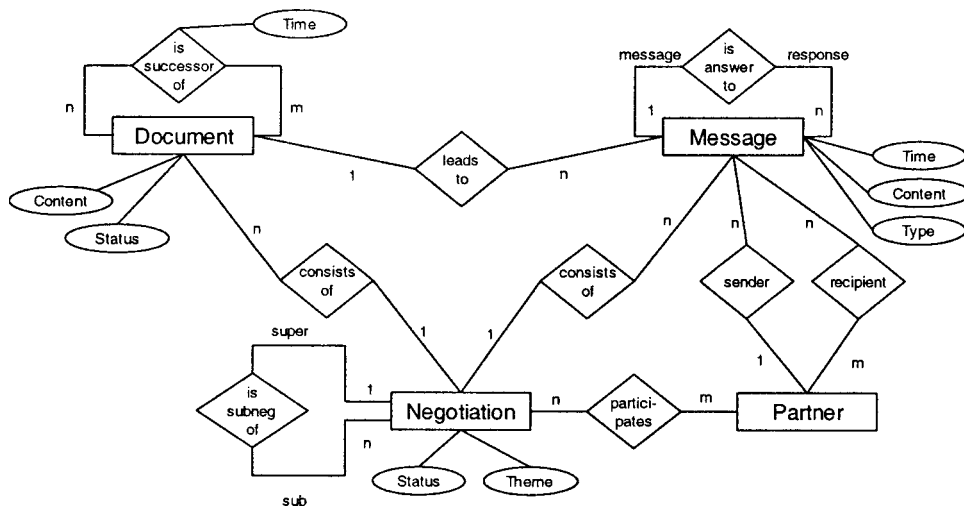


Figure 3. DOC.COM Model (Schoop and Quix 2001b).

sive, directive, expressive, and declarative utterances. A trade-oriented set of subcategories of these five classes has been developed in order to be able to make statements about illocutionary points specific to that application area (Schoop 1999). Directive and commissive messages (e.g., requests and promises respectively) issue commitments for the recipient and the sender respectively. For example, a request made by a buyer and accepted by a seller implies that the seller is obliged to perform the action indicated in the message. To ensure that all business partners know their duties, the obligations resulting from the exchanges need to be made explicit. In our approach, it is specified what kind of obligations the companies have already accepted during a negotiation.

A negotiation protocol is implemented that specifies the pattern of such a negotiation. The negotiation protocol is influenced by Searle's categories of speech acts and by Habermas' remarks on rational communication flows. The illocutionary points (represented explicitly by the message type) help to control the negotiation workflow. For example, a negotiation can only start with an offer or a request; an offer can only be answered by an acceptance, a counter-offer, or a rejection etc. (Schoop and Quix 2001a).

In Habermas' theory, four validity claims are introduced, namely comprehensibility, truth, truthfulness, and appropriateness (see section 4). They have informally influenced the system design. There is a message type "information" that aims to integrate the claims into the system while leaving the discussion of the exact problem to the users themselves. If one of the negotiators has a comprehensibility problem, (s)he might compose a message with the type "information" to ask for further clarification which is related to the claims of comprehensibility and truth. Appropriateness of the illocutionary force is ensured by only allowing pre-defined forces that are deemed appropriate in the context. For each message, the possible replies are defined and, therefore, inappropriate message types are excluded. The appropriateness of the propositional content must be ensured by the users themselves.

Apart from messages, the second vital element of a negotiation is the class of documents. Messages and documents are linked as follows. Each message leads to a new document which is a new version of a contract in the present context. For example, a request of company A asking company B for the delivery of 100 window frames until 23/01/2002 for the price of 180• per window leads to a preliminary contract with the following elements: buyer is company A, supplier is company B, product is window frame of a certain specification (e.g., represented by a product code), number is 100, unit price is 180•, complete price is 18000•, delivery date is 23/01/2002. The contract elements are automatically derived from the message structure, i.e. the negotiator does not need to enter information in the document. There will be information in the messages that is irrelevant for the contract. For example, the phase of identification, polite phrases, explanation etc. will be discarded and only the relevant contractual information is filtered out. Changes to the previous version are marked to show the negotiators at one glance which modifications have been made. Thus, document management and communication management are combined.

The history behind each negotiation step can be assessed by means of messages and documents. Both a message-oriented view of a negotiation and a document view on the process are provided. Figure 4 shows the message view which has links to the related documents. The logging of messages and documents can serve as the basis for efficient traceability and monitoring functionalities (Schoop and List 2001).

The document-based negotiation presented in this section by means of the DOC.COM framework has been implemented into a prototype. In general, such form of negotiation emphasising document management is useful if the reasons and the thread of argumentation behind agreements is of interest. In this case, the messages will provide such reasons while the document thread shows the evolving contract versions. On the other hand, if cooperative authoring of documents is sufficient without the additional explanation facilities of messages, then the document-based protocol presented in the previous section will be the most appropriate one. It is important to state again that the different protocols can be combined for negotiations, depending on the user requirements in particular contexts.

## 8. Conclusion

B2B negotiation support systems are still in a preliminary stage. Most of these systems take a decision support perspective and do not pay much attention to the communication aspects. However, negotiating is communicating, so the decision perspective considers only one aspect at best. In contrast, most communication studies so far concentrate on face-to-face situations that are quite different from electronically mediated settings. The aim of this paper has been to lay a foundation for a formal analysis of negotiation support systems from a communication perspective.

We have taken the MeMo system and the negotiation support it currently offers as a mo-

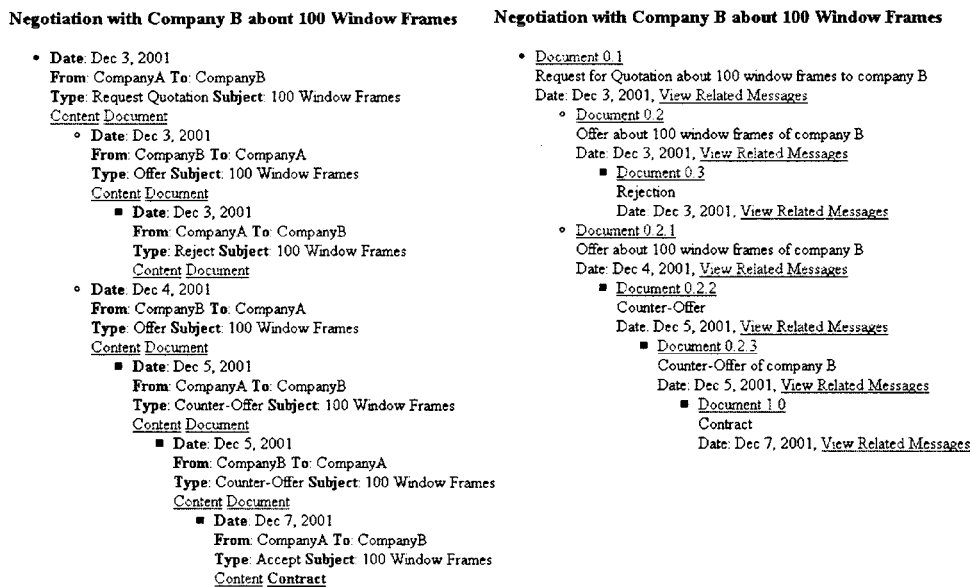


Figure 4. Message-based view and document-based view of a negotiation.



tivating case. The MeMo system aims at flexible negotiation support; instead of imposing one protocol on each negotiation session, the parties can choose a preferred protocol themselves. For example, in the case of a sales contract, the quotation-based (norm-oriented) protocol can be used, while for the negotiation about an agency contract, a document-based protocol is more appropriate. Combinations of protocols are possible as well. According to the users in the MeMo project, an important contribution of a B2B NSS is its potential to improve the quality of the communication. This shows again that a decision support focus is too limited and a broader communication perspective is needed.

A formal analysis of negotiation as communication is only possible when communication is viewed as action, with certain formalizable effects. We have argued for a distinction between norm-oriented negotiation and goal-oriented negotiation. The difference is based on type of claims made, or, alternatively, on what moves the main process from one step to another. Currently, it seems that norm-oriented negotiation is the dominant form in business, especially when the negotiation is performed via written media (such as fax) or Internet. Goal-oriented negotiation is found more in face-to-face settings. It is not included in the current MeMo system yet, and it can be argued that since it draws heavily on the subject world of the negotiators, it can only be applied in computer-mediated situations when the parties already know each other and have an established relationship and trust level. The medium (in particular, the availability of audio and video support) can also play a role. One of the interesting issues for further research is to get a better understanding of the relationships between media choice and negotiation type (cf. Poole *et al.* 1992).

We have sketched logical semantics for norm-based negotiations. Unfortunately, this semantic framework cannot be applied directly to other types of negotiation. To formalize goal-oriented negotiation, more research is needed in the logic of goals and values. Document-based negotiation is quite different. Although there are logics for describing the contents of contracts (e.g., Tan and Thoen 2000) the process of drafting, editing and signing contracts, followed by fulfilment or breaching, is not covered by these logics. Here are challenges for future research.

The goal of this paper is to contribute to a formal theory of negotiation from a communication perspective. Evidently, the formal/logical aspects are not the only aspects of communication. Aspects such as medium choice, data quality, language and culture are as important. The advantage of a communication perspective is that it provides an integrated framework in which these different aspects can be considered, with a higher or lower level of formalization.

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