

Negotiation Life cycle and AI-based negotiation modeling for Interactive marketing system

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Abstract:

Negotiation is a process of cooperative decision-making between parties concerning the resolution of a common dispute. The goal of negotiation is to develop a settlement that is acceptable to both parties.[1] In e-commerce application, the interaction between producer and consumer is common and is known as interactive (on-line) marketing system.[2].In this paper we focus on modeling the negotiation life cycle[1] of the interactive marketing system. We further propose an AI-based negotiation technique in interactive marketing system.

Keywords: AI, Negotiation support system, e-commerce application, Information system

1. Introduction:

In negotiation, participants bring their goals to a bargaining table, strategically share information, and search for alternatives that are mutually beneficial. Negotiation is complex in that a global understanding of all goals, solutions, and their interactions can be extremely complex. Participants may not know or want to reveal their goals and solutions for some goals may have complex interactions with the solutions for other goals. The interactions can lead to participant conflicts or coalitions. Without negotiation techniques, participants often focus on persuading others to accept a ready solution, rather than seeking new solutions that may be acceptable to all. Expert human negotiators address these problems through a combination of social and analytical techniques [6]. Experts provide strategic advice on when to generate new solutions and when to persuade others. Moreover, they use a specific set of techniques for coordinating interactions, generating resolutions, and deriving agreements. Recently, a growing number of computer programs are employing these techniques to support human, as well as software agent collaboration.

As the opportunities for humans and software agents to interact increase, the mediating role of negotiation systems is becoming more important. Recent improvements in function and generality have led to a growth of embedding negotiation systems within group meeting systems, concurrent engineering and design tools, software agents, and electronic commerce systems. Where a group must agree on a description that has complex implications, negotiation systems succeed by bringing interaction analysis and consensus building techniques to bear. Future systems will use these techniques to provide quick and expert negotiation techniques to achieve user goals within the growing networked community.

In this paper, we illustrate an interactive marketing system (as an example of e-commerce system) where we highlight the implementation technique of negotiation procedure. We also suggest negotiation life cycle(NLC) [1] pattern in terms of the proposed interactive marketing system to further analyze the negotiation model to facilitate a) learning negotiation support system [2] by information system (IS) experts and b) modeling NLC of widely used 'producer-customer interaction (PCI)' in e-commerce world..

This paper is organized as follows: In section 2, we illustrate a typical interactive marketing system – interaction between producer and online-buyer (consumer); in section 3, we present pitfall of the marketing system due to lack of automated negotiation; in section 4, we depict negotiation life cycle (NLC) in terms of proposed interactive marketing system; in section 5, we describe categorical entities of automated negotiation system to work with; in section 6, we show some related works; and lastly in section 7, we propose AI based negotiation technique in interactive marketing system.

2. Interactive Marketing:

A cooperative organization for producers of perishable goods has been formed to assist the producers to sell their products. Consumers must be informed about the availability of the product. To do this, the system would allow producers to record their available products and provide an enquiry system to look up these products. The information about products is stored in a file named MARKET-DATA. Then subsystems must be provided to allow product orders to be placed and deliveries of the products arranged. Finally an invoicing subsystem is needed to arrange payments. To ensure that deliveries are made promptly, the proposed system also allows consumers to place orders directly on the system and arranges deliveries of these orders. Later it is directed to add automatic billing to the system. The proposed system includes an ORDER-FILE to store all orders placed in the system, as well as a DELIVERY-FILE to keep a record of deliveries.

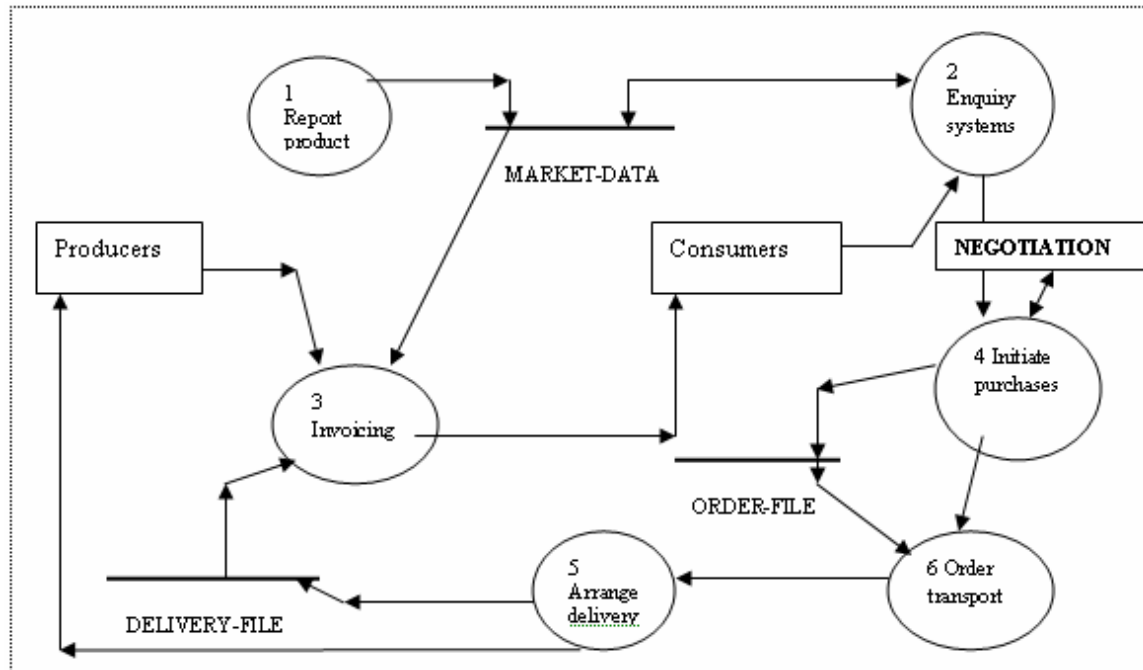


Figure 1: Presence of negotiation procedure in interactive marketing system

3. A Pitfall of the proposed interactive marketing system:

The above marketing system does not support direct contact between producers and consumers but only allows them to access data on the same database. Thus an important human element is removed, preventing activities such as negotiating a price or benefits. In the following sections we will define ‘negotiation procedure’, characteristics of negotiation life cycle [1]. We also propose an AI-based negotiation technique for ‘producer-consumer negotiation-problem’ after analyzing many of related works regarding automated negotiation techniques. Figure 1 shows the position of ‘negotiation system’ in interactive marketing system.

4. Negotiation life cycle:

According to [1], It addresses steps directly leading to, or following, the actual negotiation process. This includes the sub-processes of initial problem recognition, participant solicitation and communication, goal analysis, solution generation, solution selection, solution implementation, and solution maintenance. In this context, a computerized negotiation system is a composite of computer techniques that support the social or analytical aspects of the negotiation life cycle. The negotiation life cycle has many similarities with the software life cycle—partly because both are exercised in formalization. Like software development, negotiation moves through stages of requirement acquisition, specification, design, implementation, and

maintenance. Like software development, negotiation automation varies with the life cycle stage; generally, more automation is provided for the “downstream” stages of negotiation design and implementation. Finally, like software development, different negotiation problem contexts call for the use of different negotiation methodologies. However, the negotiation life cycle differs from the software life cycle in some significant ways. First, analysis elicits participant goals, which allow for a range of satisfaction, as opposed to software requirements. Second, interaction design explicitly addresses individual achievement among competitors. Finally, the negotiation artifact (contract) is produced through interactions with competitors, as opposed to the teamwork of software development. On the other hand, some have characterized requirements analysis as having these same negotiation qualities [8].

The negotiation life cycle framework categorizes the roles of negotiation participants into analyst (owner and analyst), designer (designer and technologist), and implementer (facilitator and negotiator) [1]. Each role may be identified with a unique agent, or conversely, a single agent may play multiple roles in the process. Finally, perspectives may be identified with individuals or groups. Each of the perspectives is described next. An owner is the main stakeholder of the negotiation outcome. Owners initiate negotiations by setting forth abstract unstructured goals prior to negotiation (e.g., reduce labor costs). An analyst works with an owner to refine, structure, and formalize an owner’s goals. Additionally, the analyst may conduct domain analysis to place the goals within the context of goal alternatives, thereby defining the search space and making possible compromises and substitutions. Hence, good analysts are formalists with some experience with the domain [1]. Once the owner goals are sufficiently understood, the designer contributes knowledge of the negotiation process; this is largely strategic meta-knowledge. The designer plans for a series of interactions with the other participants which will likely lead to the optimal satisfaction of the owner’s goals. Planning can entail developing a probabilistic contingency model based on strategic exchanges of information with the goal of persuading others to accept the owner’s preferred alternative [10].

The technologist and facilitator bridge the gap from the design to the actual negotiations; they design and provide the communication link between the participants. The technologist seeks to provide and maintain the best infrastructure for participant interactions. This can range from simply reserving a meeting room to configuring and running a virtual decision room. The technologist specifies and maintains the appropriate technology for the designer’s strategy, the size and duration of negotiation, and the mode of communication among the negotiators. In contrast, the facilitator conducts the actual negotiations. The facilitator seeks to implement the strategy provided by the designer while using the technology specified by the technologist. The facilitator contributes the tactical knowledge, people (or agent) skills, hands-on use of technology, and the knowledge of appropriate protocols. This may involve governing the interactions when an arbitration protocol is used, or it may simply involve guiding participants toward a mutually beneficial alternative through persuasion.

Finally, the negotiator represents the owner by proxy. The role of the negotiator is to “do” the negotiation within the specified framework on behalf of the owner. The negotiator may have specialized skills to strategically manipulate other negotiators, or even the negotiation framework. For human negotiators, this is the “charm” of a salesperson. For software negotiation agents, this may include specialized algorithms or knowledge aimed at inferring other agents’ models and gaining their support. While actually physically separating the owner agent from the negotiator has the advantages of specialization and parallelism, it does introduce the possibility of misrepresentation of the owner’s goals—especially for new or dynamic domains where the owner has yet to accept a consistent set of preferences. All these sequential activities produce negotiation life cycle (NLC) for an entity. We consider ‘interactive marketing system’ as the entity and propose an NLC for interactive marketing system which is described in figure 2.

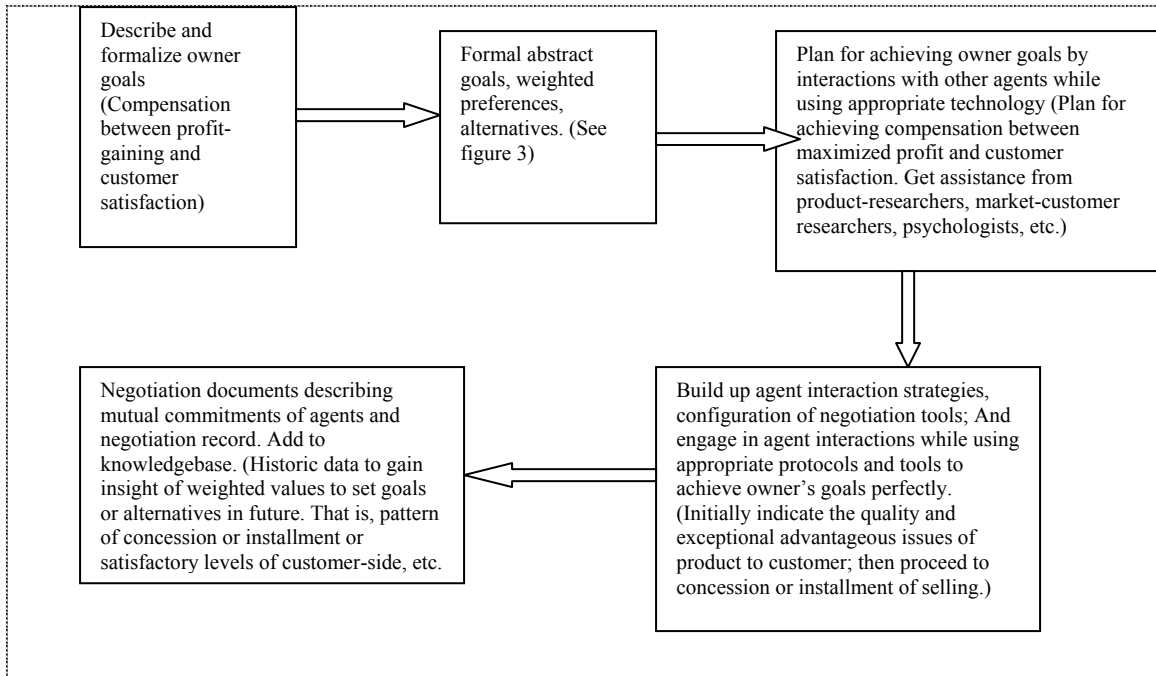


Figure 2: NLC of Producer-consumer interaction

5. General observations of Automated Negotiation Techniques:

From section 3 and 4 we see that the main theme behind negotiation is to fulfill 'goal' of parties. At first we have to start over with 'Goal analysis'[1]. This method overcomes differences in terminology and classify goal interactions (e.g., conflicting, cooperative). Further analysis may be applied to the decision alternatives themselves in order to distinguish between apparent goal conflicts and actual means conflicts [7][5]. Goal conflicts occur when two abstract contradictory goals are desired (e.g., x and $not\ x$). Some goal conflicts can be overcome by: (a) redefining the goals, or (b) defining the conditions surrounding their achievement (e.g., alternate between achieving x , then $not\ x$, then x , etc.). On the other hand, means conflicts occur when two specific contradictory goals are desired and there is no known method to achieve both. *Resolution generation* methods[1] create new decision alternatives. Two classes of methods include[3][5][6][7][9]:

- **Value-oriented Resolution.** These methods generate alternatives by altering values within domains defined by the conflict. They include: distributive compromise, which distributes some portion of a resource to different agents within the confinement of a given constraint space; and integrative "logrolling," which generalizes distributive compromise to consider multiple resources whose varied distributions can be traded among agents.

- **Structure-oriented Resolution,** which generates alternatives by restructuring alternatives or agent goals. Restructuring may simply involve an agent "backing off" and providing less contentious goals. However, restructuring can involve an analysis of the contextual conditions causing conflict, followed by the introduction of goals that alleviate the conflict. For example, conflicts over non-consumable resources can often be resolved by alternating usage, or even creating more resources.

We will elaborate some works (based mainly on these two resolutions) in the following sections (Related works).

6. Related works:

Sycara, K. suggests that in developing real world negotiation support systems, one must assume bounded rationality and the presence of incomplete information [15]. In [4], Several negotiation support systems (NSS) were built and compared on the assumption that the parties to the dispute have complete information about the problem at hand and the beliefs and goals of the opposite side. The NSS should not make decisions for parties, but merely make suggestions which are acceptable to both parties. Further, the suggestions need to be based on a model which takes into account the previous behavior of both disputants. [13] classifies techniques for designing negotiation strategies into 3 categories: game-theoretic, heuristic and argumentation-based. We propose game-theoretic approach, since it finds dominant strategies for each participant by applying simple rational assumptions and most of the time it leads to simple and optimal solution. Recent work has evolved around agent-based methodologies and game-theoretic techniques. Agent-based theory refers to entities which can act independently of other agents. Distributed problem solving [13] refers to systems made up of many agents which co-operate to solve a global problem. For our purposes, it does not work since here individual agents can resolve the global problem.

Rule-based work like NEGOPLAN[12], GENIE [16] offer decision support aimed at resolving international disputes. MEDIATOR [11] used case-based retrieval and adaptation to propose solutions to international disputes. PERSUADOR [14] integrated case-based reasoning and game theory to provide decision support. Family-negotiator [17] used a hybrid case-base and rule-base to make suggestions as to how best resolve issues.

The major AI techniques used to support negotiation have been rule-based and case-based reasoning. The drawback of using rule-based reasoning is in its lack of flexibility. Similarly case-based reasoning can be quite shallow in the information retrieved, as it is limited to whatever data is stored in the case-base. This was the major inadequacy of [3].

Game-theoretic techniques and decision theory were the basis for AdjustedWinner [4]. It implemented the procedure of [6]. It is point allocation procedure that distributes items or issues to people on the premise of whoever values the items or issue more. We present this principle in our work.

7. Our contribution:

Intelligent decision system have capability to support both quantitative and qualitative data at varying level of precision and use reasoning to transform data into opinions, judgments, evaluations and advice[15]. Intelligent decision system must be able to exploit a tolerance for imprecision, uncertainty and partial truth to achieve tractability, robustness, low solution cost and a better rapport with reality. Before describing the technique, we have already introduced the case study of an interactive marketing system in section 2. The case will be used to demonstrate how our algorithm operates.

Consumer bought items previously worth of 50,000 taka. He wants concession of 20%. The producer is making profits till the year round, which is ahead of expected profit. Consumer is depriving from suitable monetary position (reported from tax-issuing condition). Moreover, customer has not yet cleared previous two (2) dues.

We first analyze the user input; that is the issues and sub-issues and the degrees of significance of each of the issues in dispute. A decomposition hierarchy is used to enable easier specification of the problem (by listing sub-issues) in a more tangible form. The disputants must indicate the issues in dispute, decompose the issues into sub-issues until their positions are reflected in the sub-issues. Each issue is broken down so that allocation values are in binary form, that is the issue is allocated to either the producer or the customer.

The process supports the process of negotiation by introducing important values to indicate the degree to which each party desires to be awarded the issue being considered. We assume the important value of an issue is directly related to the desire that the disputant wants the issue to be awarded to her/him. The system used this information to form trade-off rules. The trade-off rules are used to allocate issues according to the

strategy similar to compensation, in which both consider differences in interests and priorities to reach a satisfactory agreement.

For every issue at the same level of decomposition, the disputants enter two values, a number whose sum over all issues is 100. This information consists:

1. Users choosing which of the following broad categories will be the negotiation concern: concession issues, monetary issues.
2. An indication of independent relationship exists between issues.

Table 1 represents the importance placed by each party when all issues are considered. Disputants have not indicated any issue independencies, and so it will be assumed all issues relate to each other in some way.

We assume that B is the union of the issues which have been raised by the disputants. For each $b_i \in B$, we define two sets X and Y to be numerical value that the producer and consumer respectively give to each other of the issues in B. Thus $X=\{x_1,x_2,\dots,x_{n-1},x_n\}$ and $Y=\{y_1,y_2,\dots,y_{n-1},y_n\}$. Note that $\text{summation}(x_i)=\text{summation}(y_i)=100$.

Let set $D=\{d_1,d_2,\dots,d_{n-1},d_n\}$ and $d_i=|x_i-y_i|$ where $i=\{1,2,\dots,n-1,n\}$

The issue b_i with the highest d_i value will be dealt with first, whether that be for decomposition into sub-issues or direct allocation. The sequential strategy of decision-making is negotiated one at a time.

The process first calculates the set D. For our example, the set {concession ,monetary-issues} corresponds to $I=\{1,2\}$ respectively . Therefore, $D=\{15,5\}$. The issue with the largest difference between important values is dealt with first. The larger the difference, the more likely parties will be happy with allocation or the issue to the party who values it the most. The system then allocates an issue from the set of sub-issues generated previously.

Since ‘concession’ related issues have the highest value in the set D, namely 15, the computer will suggest to disputants that they consider the issue ‘concession’ first. Now, the parties put forward sub-issues which reflect their positions on the issue. Producer wants to sell at least 50% without concession of the desired amount at first hand. Both want to take control of concession (that is, consumer wants 20% concession, producer wants to cut-down the concession oppositely). Moreover, consumer want installments and assured concession upon further buying (upon defined values). Each party must allocate values to every sub-issue generated, including issues raised by the opposing party. Table 2 shows the incidence.

People	Concession	Monetary issues
Producer	60	40
Consumer	55	45

Table1: values which form the best compromise or trade-offs for each party.

People	I want to sell at least 50% (without concession) of the desired amount at first hand	I want to take full control of concession (that is I will decide whether there will be concession or not)	I want them to provide me a concession upon more buying products	I want installment
Producer	30	50	0	0
Consumer	0	30	30	50

Table 2: Each party allocates sub-issue into issues with values

The set D is calculated again. The set {50%_sell, control_consetion, more_buying, installment} corresponds to {30,20,30,50}. Since 'installment' acquires more points and it was values more important by Consumer than by Producer, Consumer is allocated installment advantage. This bidding continues in the next round too until all issues have been dealt with, at which point the initial top-level issues is modified to reflect the allocation of concession -related issues. Disputants are then referred to decomposing the issue of 'monetary-issues' and so forth until all issues are resolved. Our process relies on numerical values given to the negotiation issues by the parties involved. Then those values are used to determine the order of decomposition and allocation of the content of dispute.

8. Conclusion:

In this paper we propose AI method to support negotiation decision making for interaction between producer and online customer. We also propose NLC for that interaction. Once it has been further refined we shall subject it to rigorous evaluation by e-commerce implementers. The availability of such negotiation support system will provide unbiased support for solving conflict between producer and online-buyer. The savings in both financial and emotional expenditure will be significant.

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