Integrating the AC-AT concept into an Electronic Negotiation Support System: Implementation and Challenges

Alexander Dannenmann[1], Marc Fernandes[1], Michael Filzmoser[2], Johannes Gettinger[2], Sabine T. Köszegi[2], Ronald Mitterhofer[2], Andreas Reiser[1], Mareike Schoop[1], Rudolf Vetschera[3]

[1]Institute for Interorganisational Management and Performance, University of Hohenheim, 70593 Germany
[2] Institute of Management Science, Vienna University of Technology, Austria
[3] Department of Business Administration, University of Vienna, Austria

alexander.dannenmann@wi1.uni-hohenheim.de, marc.fernandes@wi1.uni-hohenheim.de, filzmoser@imw.tuwien.ac.at, gettinger@imw.tuwien.ac.at. sabine.koeszegi@tuwien.ac.at, ronald.mitterhofer@tuwien.ac.at, andreas.reiser@wi1.uni-hohenheim.de, m.schoop@uni-hohenheim.de, rudolf.vetschera@univie.ac.at

Abstract: The AC-AT concept (Analytical Concession-Advising Technology) has the potential to help negotiators in creating integrative proposals for offers during an electronic negotiation. Whilst integrating the AC-AT into the web-based electronic negotiation support system Negoisst, several technical challenges had to be faced which will be highlighted in this paper. Furthermore, a first experiment with the AC-AT component will be discussed.

Keywords: Online dispute resolution, electronic negotiation support systems, electronic negotiations, linear programming

Introduction

The AC-AT concept (Analytical Concession-Advising Technology) aims at supporting negotiators to find suitable offers according to their preferences (Vetschera et al., 2010). The motivation is to enhance the negotiators' performance as quite often, the negotiation skills and decision power are not used to their full potential (Sebenius, 1992). The idea of the AC-AT is to provide an active support (Kersten, 2004) of the negotiators during the negotiation process through a complete offer suggestion system.

Decision support in Negoisst

As a prerequisite to understand how the AC-AT model is implemented, the basic concept of the decision support in Negoisst has to be presented first (Schoop et al., 2004, Schoop, 2010).

In Negoisst, a linear additive utility function is used as a preference model. The main elicitation process is a direct self-explicated approach. The negotiators have to rate all attributes included in the negotiation agenda. Based on this preference model, each message of the negotiation process is evaluated.

In Negoisst, there are two types of negotiation attributes. The first one, i.e. the numerical attribute, is for representing numerical values, e.g. the price for a car. During the elicitation process, the negotiator has to specify a worst case and a best case. The second attribute type is called categorical attribute. This attribute type is used for attributes with discrete values, such as the colour of the car (red, blue, black, …). Each value has a fixed utility value and no function is used for calculation since the utility value of an offer can directly be read from the preferences. During the exchange of offers and counteroffers, the system calculates the total utility of each offer according to the preferences of the recipient. The preferences of the counterpart are kept secret and separate within the system.

AC-AT in Negoisst

The AC-AT component in Negoisst uses additional information to calculate offers as suggestions for the negotiators. Therefore, the AC-AT needs information about the concession behaviour and the preferences of both parties (c.f. figure 1, bargaining process in utility space). Using this information AC-AT in Negoisst calculates an offer cone which is restricted by the Pareto Efficiency Frontier and generates possible offers for the negotiator (c.f. figure 1, offers in issue space).

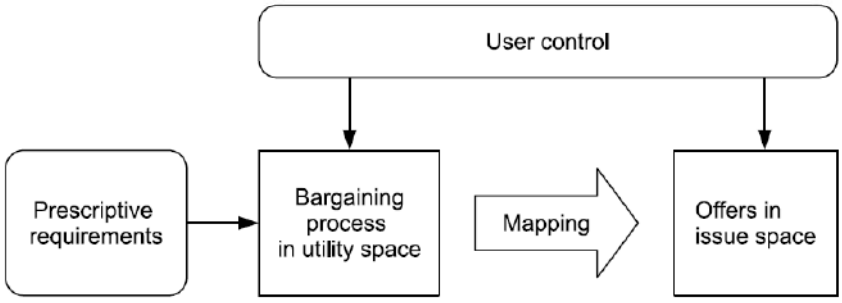

Fig. 1. Overall AC-AT framework (Vetschera et al., 2010)

Nevertheless, the final control rests with the negotiator as shown in figure 1. The negotiator decides on his/her preferences and also decides whether to adopt a generated proposal of the AC-AT or not. The negotiator should be able to influence the offer generation process. In Negoisst, this is done via an additional parameter for the fairness of an offer (c.f. figure 3, cooperative parameter), which can be configured by the negotiator and is also used during the calculation of offer suggestions. Furthermore the negotiator has the possibility to lock single attributes in order to exclude them from the solving process. This feature is useful in the context of electronic negotiations as negotiators could already have agreed on an attributes value whilst still being in the process of negotiation about the values of the remaining attributes.

According to the AC-AT model of Vetschera et al. (2010), the calculation of offers is restricted by some preconditions (c.f. figure 2): At least one offer of each party has to be present and the last offer of the negotiation partner has to contain a concession, i.e. in each negotiation step, a concession must be made (reciprocity condition). In addition, a higher joint utility is desired in each negotiation step in order to reach an integrative negotiation result (value creation condition).

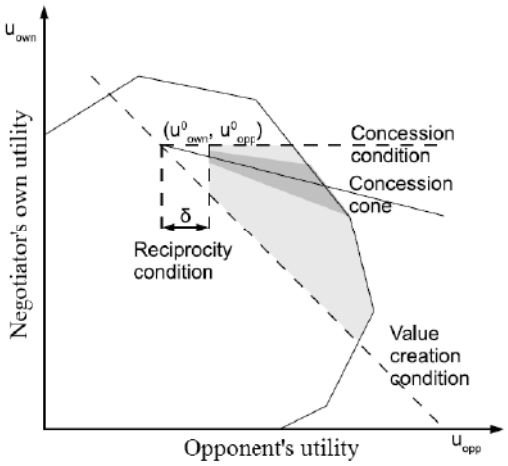

Fig. 2. AC-AT conditions (Vetschera et al., 2010)

The generation of offers with the use of preference information is based on mathematical optimisation models. These calculations are complex and need high-performance algorithms because the generation of offers must be done during the negotiation process on the fly with fast reply times. Therefore, we decided to use a so-called linear optimisation solver from IBM which is shipped within the "IBM ILOG CPLEX Optimization Studio"[9]. This CPLEX Studio additionally offers an environment for the development of optimization models. Access to the solver is via an API and thus directly integrates into the Negoisst system, i.e. data required for calculations are passed via the API to the solver and results are fetched again via the CPLEX API and can be processed and displayed inside Negoisst.

Usability considerations

Another challenge besides the ability of the system to calculate offers with the help of preference information on the fly was the graphical representation of the AC-AT component in Negoisst. Apart from a detailed briefing of the component, negotiators should also be in a position to grasp intuitively the functionality of the component, without being confronted with its mathematical complexity. For this, the component was divided into three different areas (c.f. figure 3):

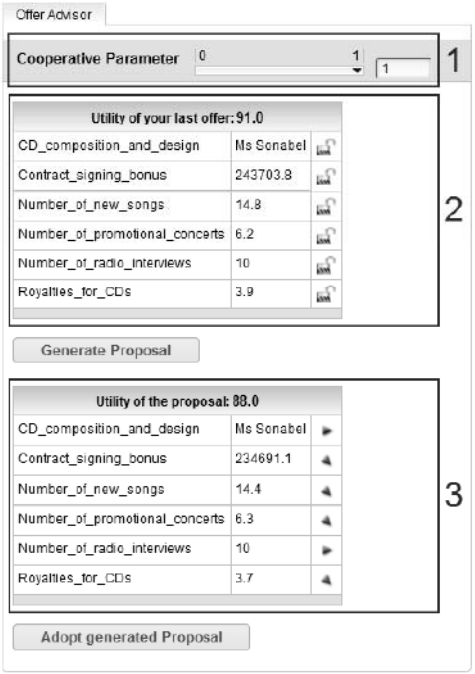

Fig. 3. Screenshot of the graphical AC-AT interface in Negoisst.

The first area offers the possibility to select the "fairness" of a possible new proposal by means of the cooperative parameter. Negotiators can choose between a cooperative parameter of 0 (=lowest possible cooperation; a very tough new proposal with almost no concessions) and 1 (=highest possible cooperation; a very fair new proposal with as much concessions as possible). Area 2 shows the last proposal, which the negotiator sent to the counterpart. If the negotiator wants to exclude one or more items from the generation, the lock symbol allows fixing an attribute value. In case of clicking on "Generate proposal", area 3 occurs and shows the new suggested proposal to the negotiator. The arrows at the end of each row illustrate the changes within an attribute compared to the last offer sent to the counterpart. This process of (1) choosing a cooperation parameter, (2) optional locking of attributes, and (3) generating a new proposal can be done as often as one likes. If the negotiator is satisfied with one of

[9] http://www-142.ibm.com/software/products/de/de/ibmilogcpleoptistud/

the suggested new proposals, it can be adopted to become the new offer and can then be sent to the counterpart.

Experiments

A first experiment with the AC-AT support in Negoisst with a fictional B2B case has already been conducted in November 2011. 164 Students from the universities of Vienna and Hohenheim negotiated as experiment participants. The 82 negotiations were separated into three treatment groups, see table 1 below.

The 30 negotiations in the control group were conducted without the help of the AC-AT component. In the group "AC-AT optional", the 18 negotiations were conducted with the possibility of using the AC-AT while in the last group ("AC-AT enforced"), the negotiators were forced to use the AC-AT to generate a proposal at least once for each offer. It is important to mention that they were not forced to adopt the generated proposal. The data of the AC-AT usage was collected within experimental logs.

Table 1: Descriptive statistics of AC-AT experiment

Treatment	1	2	3	Total
Treatment Description	AC-AT Enforced	AC-AT optional	Control	
Dyads	34	18	30	82
Final Accepts	25	15	19	59
Final Rejects	7	3	11	21
Timeouts	2	0	0	2
Agreement Rate (%)	73,5	83,3	63,3	
Requests	2	1	1	4
Offers	39	27	36	102
Counteroffers	364	209	325	898
Formal Messages (per dyad)	12,85	14,17	13,07	13,22
Clarifications	14	10	8	32
Questions	16	14	9	39
Informal Messages (p.d.)	0,88	1,33	0,57	0,87
Utility Receiver	0,534	0,553	0,563	
Utility Sender	0,545	0,505	0,513	
Joint Utility	1,078	1,057	1,075	
Contract imbalance	0,104	0,069	0,174	
Number of Concessions per dyad	6,12	7,28	6,83	
Sum of concessions per dyad (%)	60,76	70,22	61,87	
Decrease of own utility per concession (%)	9,93	9,65	9,05	

Data for descriptive statistics was collected as shown in table 1. We will refrain from tests for statistic significance as, unfortunately and against the rules of the experiment, some private information about the case was made accessible to the students via an internet platform. As we can not ascertain ex-post how many student read the information and how much the results were influenced by it, we will use the data mainly to describe the potential of the AC-AT component in Negoisst. For example, the highest number of acceptances and thus the highest agreement rate is in the "AC-AT Optional". There are interesting results that need further analysis with a new case. Experiments are planned for 2012.

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