Pre Negotiations Over Services – A Framework for Evaluation

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Abstract. A framework for evaluation and selection of service offers during the pre-negotiation phase in automated negotiations over services is proposed. The pre-negotiation problem for a buyer of services is regarded as essentially a decision making problem, related to a set of possible scenarios, involving a number of pre-negotiation choices – identifying suitable service offers, establishing a common criteria scheme, evaluating the offers and choosing the best alternatives to proceed negotiations on. The concept of Alternative Focused Thinking (AFT) during pre-negotiations is introduced. Since the comparison of service packages involves multiple criteria, it is argued that it may be beneficial to use an integrated approach for evaluation, involving different weighting methods. The use of multiple criteria decision aid software in supporting the pre-negotiation interactions is illustrated through a HIPRE model, involving three weighting techniques – the Analytic Hierarchy Process (AHP), the Multi-Attribute Rating Technique (SMART) and a simple weighting function. The application of hybrid multi-criteria decision making (MCDM) methods in pre-negotiations is proposed as a direction for future research.

1 Introduction

The electronic commerce of services is a vastly expanding area and especially suitable for automation. Numerous negotiating agents of varying complexity are already in place. Advanced models of negotiation reasoning engines have been developed. Very few studies, however, have addressed the reasoning and actions that may take place during the pre-interaction phase of an automated negotiation, the pre-negotiation [1]. Although the computational complexities of automating negotiations over multidimensional goods like services have been identified, the concept of preempting some of the decision-making problems and shifting part of the reasoning and deliberations to the pre-negotiation phase has not yet been clearly formulated.

The reasoning during pre-negotiations may be regarded as largely a MCDM evaluation problem. Such problems involve uncertainties related both to the values of the criterion variables and to the weights of the criteria. There exists no
'best' method for evaluation. Different methods allow different problem formulation options and possibilities. Each method can give some additional 'flavor' to an evaluation scheme.

The reasoning process during pre-negotiations has also a behavioral aspect. The currently overwhelming way of thinking among buyers of services is the Value Focused Thinking (VFT).

The purpose of this paper is to set a framework for pre-negotiations over services and to focus on possible evaluation methodologies facilitating the selection of optimal service offers.

On the first place, an Alternative Focused Thinking (AFT) approach is proposed to complement the VFT one since the consideration of alternatives may help identify and define criteria, while criteria are shown to help identify and define alternatives.

Secondly, the paper discusses and demonstrates an integrated evaluation approach with the simultaneous use of three MCDM weighting methods in support of a pre-interaction selection of service providers. The main aim in applying different methods in combination is to use their advantages in a compatible manner. The AHP is applied in order to bring qualitative analysis capacity into an evaluation scheme, SMART in cases where the AHP method causes rank reversal, etc. Such an integrated evaluation approach is possible with the current availability of suitable decision analysis software.

2 Negotiation Over Services

During negotiations over services the bargaining parties are engaged in multi-criteria decision making, where the decision variables may be both discrete and continuous in value, quantitative and qualitative in nature. Since the trading in services is unique in a number of ways due to their intangible character, complex properties and spatio-temporal constraints, the need for decision support enhancing the processes of search and transactions raises a number of problems, among them the evaluation of the set of issues to be resolved and the assessment and selection of the best service offers.

Service properties and their representation are of major importance in building evaluation models and designing automated negotiation mechanisms [2]. Among the major properties are price, method of payment, service quality, availability, security and trust. Building a utility function as a measure of the goodness of a service package is far from being a straightforward task due to a number of reasons:

Price and pricing: The intangible nature of services offer opportunities for flexibility and customization. Since demand for services may fluctuate, demand fluctuating pricing may be employed. Bundling together services is another marketing approach with great potential in services. Thus evaluating the perceived cost is rather difficult in contrast with the trade in goods.

Charging techniques: They may vary, depending on the type of delivery of the service, the granularity of the service, etc.
Settlement methods: They may be transactional, rental, escrow agreements, swap agreements.

Service quality: Largely domain specific, measured often along five dimensions - reliability, responsiveness, assurance, empathy and tangibles.

These criteria being of different importance, their evaluation is further complicated by the subjective character of some.

This substantial diversity and complexity in service properties means that a decision maker, potential buyer of a service, has to use a complex assessment scheme in selecting a particular offer. With service providers trying to differentiate their product from those of their competitors, the eventual mapping of service properties of diverse nature and different providers with the buyer's requirements is a challenging problem.

3 Pre-Negotiations

Durfee [3] contends that "In many domains, a substantial part of the negotiation effort is involved in figuring out what needs to be settled. As our computational agents are increasingly applied in dynamically evolving worlds (like on the Internet), capabilities for identifying who needs to negotiate and over what, rather than having these predefined by the system developers or users, will come to the fore."

Authors agree [4],[1],[5] that the local problem of agents is defined in the pre-negotiation phase{1} where decision variables describing the deal offer and the preferred satisfaction constraints are enumerated. The possibility of assisting decision makers at that preliminary stage of negotiations is a challenging design problem. With a large number of decision variables that interact in a non-linear way, the decision space can become exponentially large. Some preference elicitation and representation problems arise as well. Most existing negotiation models only partially address the problem of how to reason and communicate during the pre-negotiation phase. The possibilities to set an optimal framework and implement an intelligent pre-assessment of possible scenarios for the negotiation itself are either underestimated or simply not addressed.

Faratin et al. [6] think that it is impossible to pre-compute an optimal strategy at design time. Rather the agents need to adopt an heuristic and satisfying approach in choosing their strategy 'on the fly'.

4 Framework for Evaluation and Selection

The assessment of the initial multidimensional service property packages as early as the pre-negotiation phase require at least two stages:

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{1} The pre-negotiation phase is sometimes referred to as a meta-negotiation phase, i.e. negotiating over negotiations. For example, a buyer or seller of services may negotiate which negotiation rules to accept before the start of the actual negotiation
Property discovery and comparison of the services. The process of property discovery presumes pre-negotiation deliberations between the buyer and sellers of services. Services today are typically described by a large range of properties, thus their accurate representation and description is of major importance both for the service provider and service requestor. Due to the difficulty of describing complex services, some service providers may not always outline specific details. The current study proposes a new approach in this early pre-negotiation phase involving the application of an Alternative Focused Thinking concept, where the buyer should be able to build and refine the preliminary request for service. The interactions between the service requestor and service providers may lead to updating some service representations and the iteration process may result in an evolution in the service offer at this early stage of negotiations.

Using appropriate evaluation methods. There are many techniques to elicit attribute weights. Using appropriate evaluation methods in the case of multi-dimensional goods like services requires the application of techniques that address several unsolved problems, the major one being how to build a common evaluation scheme for qualitative and quantitative criteria (attributes). Another major issue to be addressed is the difficulty in modeling relationships that may exist among service properties. Existing evaluation methods used in isolation may solve one type of problems, while leave another unresolved.

The Multi-attribute Value Theory (MAVT) [7] uses an additive value function to aggregate the component values. The weights indicate the relative importance of an improvement of one attribute from its worst level to its best level compared with changes in other attributes. While the MAVT provides a way of ranking service provision offers, it requires preferential and utility independence among the attributes, conditions that are often not met in service package offers.

The Analytic Hierarchy Process (AHP) [8] uses a simpler and theoretically sound multiple-criteria methodology for evaluation that can complement the MAVT. The strengths of the AHP, namely its ability to structure complex, multi-attribute problems hierarchically and then model the decision-maker's preferences by pairwise comparisons, are ideally suited to the above requirements.

Several other MCDM weighting methods have been applied to problems of various complexity, each one with its advantages and shortcomings. The simultaneous application of different methods seems suitable in refining the evaluation process during the pre-negotiation stage. It has become possible lately with the proliferation of suitable, multi-facet software.

4.1 Alternative Focused Thinking
Multi-criteria decision-making is based on conceptualization in terms of criteria and alternatives. The problem of first identifying the alternatives and then applying value information (issue weightings, etc.) in order to make a decision is commonly referred to as Alternative-Focussed Thinking (AFT). With Value-Focused Thinking (VFT) the explicit consideration of values is the starting point
to the structuring process [9].
March [10] argues that values and criteria are formed out of experience with alternatives. Further Corner et al. [11] suggest that consideration of alternatives helps identify and define criteria, while criteria are shown to help identify and define alternatives. Such interaction seems to improve the decision-making process and as the authors note that 'thinking about alternatives helps generate criteria and vice versa'. Thus during the pre-negotiation phase a buyer may notice, analyzing the offers of a number of sellers of services, that there are service providers that address not only the core criteria, but provide new features as well, thus introducing new criteria. The buyer might be tempted to rethink his requirements at this stage and restructure her preference scheme. The buyer might send further queries to the vendors requiring more information regarding new issues. Such a dynamic iteration (Fig.1) between criteria and alternatives illustrates the notion that buyers cannot decide what they want until they can see what they can get. In the case of multi-issue multi-vendor negotiations that means that the buyer will benefit by using a multi-stage pre-negotiation protocol, where an initial query is sent to all potential sellers of services, and only after receiving the various initial offers a comprehensive and extended evaluation scheme should be designed. We have already suggested such an approach during the pre-negotiation phase [13].

Fig. 1. AFT and VFT in pre-negotiations

Further iterations may also be possible based on further queries to the sellers regarding additional attributes of the proposed service. Thus the alternative focused approach may complement the value focused one during the pre-negotiation phase.

4.2 Using an Integrated Evaluation Approach

In a recently published book Belton et al. [14] stress the need for an integrated approach to multiple criteria decision aid, including the use of multiple methods. The same conclusion can be drawn from other studies as well [15],[16].
The evaluation and weighting of the attributes of service offers in this study have been done using three weighting methods - the AHP, SMART and simple value functions, in various combinations and at different levels and nodes of the decision hierarchy. This integrated approach has been chosen because the AHP and SMART are better suited for quality evaluation, while the application of simple value functions seems the best suited method at the lowest value of a hierarchy (determining the scores of the alternatives).

The Analytic Hierarchy Process [8] allows users to assess the relative weight of multiple criteria (or multiple alternatives against a given criterion) in an intuitive manner. It involves the use of pairwise comparisons, thus solving a problem in cases when quantitative ratings are unavailable. In such cases research has shown that humans are still adept at recognizing whether one criteria is more important than another. The AHP provides a consistent way of converting such pairwise comparisons into a set of numbers representing the relative priority of each criteria. Each criterion can be broken down into individual parameters whose values are either estimated or determined by measurement or experimentation. Once the hierarchy has been structured, local priorities must be established on a given level with respect to each factor on the level immediately above it. This is done by making pairwise comparisons between the criteria to develop the relative weights. Since the approach is basically qualitative, it is arguably easier to implement from both a data requirement and validation point of view than using the multiattribute value theory approach. Not all MAVT independence conditions need to be verified, nor functions derived.

A potential drawback of the AHP method, however, is the so called Rank Reversal phenomenon [17]. Since judgments using the AHP are relative by nature, changing the set of alternatives may change the decision scores of all the alternatives. It has been shown that even if a new, very poor alternative is added to a completed model, those alternatives with top scores sometimes reverse their relative ranking. In such cases, however, the The Simple Multi-Attribute Rating Technique (SMART) can be applied. When using SMART, ratings of alternatives are assigned directly, in the natural scales of the criteria (where available). In order to keep the weighting of criteria and rating of alternatives as separate as possible, the different scales of criteria need to be converted to a common internal scale. In AHP this is taken care of by the relative nature of the rating technique. In SMART, it is done mathematically by the decision maker by means of a value function. The simplest choice of a value function is a linear function, and in most cases this is sufficient. However, to better allow for human psychology in decision making, it is often advantageous to use non-linear functions. The advantage in using the SMART method is that the decision model is independent of the alternatives. While the introduction of value functions makes the decision modeling process much more difficult to implement, using the SMART method ensures that the ratings of alternatives are not relative, so that changing the number of alternatives considered will not in itself change the decision scores of the original alternatives.
5 Results

The model presented illustrates the application of the AHP method and SMART in combination with a simple multi-attribute weighting technique using WebHIPRE (HIPRE, software for decision analytic problem structuring, multi-criteria evaluation and prioritization, has been created at the System Analysis Laboratory, Helsinki University of Technology by R. Hamalainen and H. Lauri, http://www.hipre.hut.fi). The software supports several weighting methods including AHP, SMART, SWING, SMARTER and simple value functions that map the ratings of alternatives directly to their values. The advantage of this approach is that different methods may be applied at different levels and nodes of the decision hierarchy.

The model demonstrates an evaluation scheme for pre-negotiation service offers involving four major criteria and their respective sub-criteria – pricing (cost based, demand fluctuating, price bundling), settlement (transactional, rental, facilitated), delivery time (immediate or negotiable) and service quality (reliability, responsiveness, tangibles). Five service providers (alternatives) were to be evaluated (ranked). An example of the three level hierarchy for deciding on a suitable service provider is shown on Fig.2.

As can easily be seen, some of the criteria are qualitative and related, thus the application of a simple multi-attribute value approach alone was not sufficient. We used a combination of weighting methods – PC on the Figure stands for Pairwise Comparison (AHP), SR – for SMART and at the last level – VF – for simple value functions. The evaluation methods at the different levels of the hierarchy and at different nodes were also selectively applied according to the type of criteria. For example the preferred method at Level 1 on the Figure is AHP since some of the criteria are interdependent (Pricing and Service Quality). A ratio scale was applied to quantify the decision maker’s ranking on any two alternatives with respect to a given criterion. The derived weights were interpreted as the degree to which one alternative is preferred to another. The AHP comparison engine of HIPRE is shown on Fig.3.

With four factors to be compared, the matrix has \( n(n - 1)/2 = 6 \) elements (answers). The total weights of the alternatives (named ‘composite priorities’) are shown in Fig.4 by a bar graph. The bars, divided into segments, indicate the contribution of each criterion.

One of the aims of the experiments was to observe the effects of using various evaluation methods at different levels of the hierarchy and at different nodes. We tested three different configurations:

1. Using SMART at Level 1 (the highest level), AHP (pairwise comparisons) at Level 2 and simple value functions at the lowest Level 3.

2 Using the SWING technique you are asked first to give 100 points to the most important attribute change from the worst criterion level to the best level.

3 In the SMARTER-technique you are asked to rank the attributes in the order of importance for the attribute changes from their worst level to the best level.
Fig. 2. An AHP three level hierarchy for choosing a service provider

2. Using AHP at both Level 1 and Level 2, and simple value functions at the lowest level.
3. Using AHP at Level 1, SMART and AHP at selected nodes of Level 2, and simple value functions at the lowest level.

While using SMART, the weights were elicited in two steps – first, ranking the importance of the changes in the attributes from the worst attribute levels to the best levels, and second – making ratio estimates of the relative importance of each attribute relative to the one ranked lowest in importance. We started with assigning 10 points to the least important attribute. The relative importance of the other attribute(s) were then evaluated by giving them points from 10 upwards.

We observed different composite priorities in all three configurations, although no rank reversal among the alternatives (service providers) was established for the set of data (preferences) used. The difference in values in the composite priorities for the same set of initial preference data, however, was substantial in some cases.

Our results show that using various evaluation methods at different levels of the hierarchy and at different nodes does influence the overall weightings and further research should be conducted in that direction. While some authors [18] have seen different methods yielding different results to be a major disadvantage of the MCDM approach, we think that the integration of various methods may be
the way to a more comprehensive multi-attribute analysis. Hybrid applications, similar to HIPRE, may provide practitioners in various areas with the possibility of tailoring and fine tuning suitable tools for decision support.

6 Conclusions

Integrative evaluation schemes using a combination of weighting methods and suitable hybrid software packages may provide flexibility in decision making during pre-negotiations. While methodological extensions in existing MCDM methods may enable more sophisticated analysis, research around differences among methods becomes increasingly important as the currently available software allows the combination of different weighting methods easily. Developing hybrid methods that make use not only of MCDM methods, but combine also other decision support approaches like the outranking method (PROMETHEE II and ELECTRE III), seems a promising avenue for future research.

References

Fig. 4. Composite priorities in HIPRE