Attitude-Based Negotiation Methodology for the Management of Construction Disputes

Saied Yousefi¹; Keith W. Hipel²; and Tarek Hegazy, M.ASCE³

Abstract: A systematic negotiation methodology for construction disputes is presented to take into consideration the attitudes of negotiators at two complementary levels of decision making: strategic and tactical. At the strategic level, the proposed methodology employs the graph model for conflict resolution and helps negotiators find the most beneficial subset of solutions to the conflict. At the tactical level, the proposed methodology examines the most beneficial strategic decisions using utility functions to provide agreed-upon tradeoffs with respect to any conflicting issues. A construction case study is used to illustrate the proposed methodology and demonstrate the importance of incorporating decision makers’ attitudes into negotiation to better identify the most feasible decisions. The proposed methodology may assist negotiators with the challenges of conventional negotiation through the incorporation of decision makers’ attitudes into a range of analytical tools that will clarify interests, determine equilibrium outcomes, identify tradeoffs, recognize negotiators’ satisfaction, and generate optimum solutions.

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Introduction

Construction projects have become increasingly complex and involve many parties who often have conflicting objectives. The owner, for example, would like a project to be inexpensive and speedy, while the contractor wants fewer restrictions. According to the Litigation Trends Survey Findings (Fulbright and Jaworski 2006), construction firms around the world spend close to $31 million annually on litigation fees, second only to the insurance industry.

In the highly competitive multiparty environment of the construction industry, many disputes can arise for a host of reasons, such as the complexity and magnitude of the work, lack of coordination among parties, poorly prepared and/or executed contract documents, inadequate planning, financial issues, and disagreements about on-the-spot site-related problems. Any one of these factors can derail a project and lead to complicated litigation or arbitration, increased costs, and breakdown in the relationships among the parties (Harmon 2003). Resolving construction disputes, therefore, is an essential component of construction administration. Many studies have been carried out regarding construction dispute resolution methods (Doug 2006; Cheung et al. 2002; Rameezdeen and Gunaratna 2003).

The traditional method of resolving construction disputes, particularly for large and complex projects, is litigation (Pinnell 1999). Since litigation involves enormous amounts of time and cost for all the parties involved, other dispute resolution methods, called alternative dispute resolution (ADR) tactics, have emerged (Harmon 2003). There are two groups of ADR techniques for construction: formal (binding) methods and informal (nonbinding) methods. Binding ADR is predominantly arbitration, while nonbinding ADR methods include minitrials, mediation, third-party neutrals, dispute resolution boards, and negotiation (Trantina 2001).

Negotiation is the least hostile approach and is also fast and least costly. This has been proven by various studies of negotiation, particularly in the domain of family counseling (e.g., Bellucci and Zeleznikow 1998) which involves complex situations where the attitudes of individuals have a major impact on the outcome. Negotiation is also a part of daily routine in construction activities among participants who may have different positions, goals, and attitudes. Negotiations among construction participants can be, and usually is, the most efficient form of dispute resolution in terms of managing time and costs, confidentiality, and preserving relationships.

The few negotiation models which have been prepared for the construction industry (e.g., Cheung et al. 2004 and Omoto et al. 2002) do not consider the psychological mindsets (i.e., attitudes) of the decision makers (DMs) when describing situations. In psychology, attitude is defined as a hypothetical construct that represents an individual’s likes or dislikes for an item. An individual’s attitude can be positive, negative, or neutral toward an object, behavior, or event. Unlike personality, attitudes are expected to change as a function of experience. Breckler and Wiggins (1992) defined attitudes as “mental and neural representations, organized through experience, exerting a directive or dynamic influence on behavior.”

The attitudes of participants play an unavoidable role in the outcome of negotiation. Negotiators with aggressive attitudes...
Proposed Negotiation Methodology

The primary objective of this research is to investigate how the attitudes of participants can influence the outcome of construction negotiations and how the incorporation of attitudes can help negotiators make more reliable decisions. To achieve this objective, a construction negotiation methodology is proposed, based on the graph model for conflict resolution (GMCR) and taking into account the attitudes of negotiators. A construction case study is also used to illustrate the proposed model and show how negotiators’ attitudes toward one another can change the outcome of the negotiation. The proposed methodology provides decision support at two complementary levels of negotiation (Fig. 1): strategic (i.e., the general terms of agreement) and tactical (i.e., the detailed settlement of any conflicting issues). The developments related to these two negotiation levels are discussed in the following sections.

Strategic Negotiation: A Graph Model Approach

To support negotiation at the strategic level, the GMCR (Fang et al. 1993) is used. GMCR is a methodology for modeling and analyzing DMs’ interactions in a conflict in order to find the stable decision states for each DM, as well as the decision states that represent potential resolutions (or equilibria) of the conflict. GMCR has been reported as an appropriate method for providing an understanding and insight into strategic decisions (Kilgour 2007).

GMCR, which originated from conflict analysis (Fraser and Hipel 1984) that in turn is based on the metagame theory (Howard 1971), utilizes concepts and definitions from the graph theory, the set theory, and the game theory. Each DM’s possible moves from one decision state to another are captured within a directed graph, in which nodes represent states and arcs indicate state transitions controlled by the DM. A decision state is a potential outcome of the conflict. The systematic procedure for applying the graph model follows two main stages: modeling and analysis. At the modeling stage, the problem is structured by determining the DMs, the possible decision states, the DMs’ preferences among the decision states, and the possible moves and countermoves that a DM can make among the decision states. Next is to analyze the stability of each decision state from the viewpoint of each DM individually. Such stability analysis is conducted with respect to a set of solution concepts (stability concepts), as listed in Table 1. The objective is to find which decision state(s) is/are stable for all the DMs with respect to each solution concept. At the end of the analysis, the decision state that exhibits the highest stability level represents a potential resolution of the conflict. The use of the graph model technique in the construction industry has been explained by Kassab et al. (2006).

Table 1. Solution Concepts for Conflict Resolution (Kassab et al. 2006)

<table>
<thead>
<tr>
<th>Solution concepts</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nash stability (R)</td>
<td>Moving to a different state brings no benefit to the DM.</td>
</tr>
<tr>
<td>General metarationality (GMR)</td>
<td>Moving to a more preferred state may trigger the opponent’s countermove with less benefit to the focal DM, even if the countermove is less preferred for the opponent.</td>
</tr>
<tr>
<td>Symmetric metarationality (SMR)</td>
<td>Moving to a more preferred state may trigger the opponent’s countermove to harm the DM, even if the countermove is self-harmful to the opponent. The focal DM has the chance to counter-respond.</td>
</tr>
<tr>
<td>Sequential stability (SEQ)</td>
<td>Moving to a more preferred state may trigger the opponent’s countermove to improve the opponent’s positions where self-harmful countermoves are not considered.</td>
</tr>
<tr>
<td>Limited move stability ($L_h$)</td>
<td>The DM acts optimally within a defined number of action/countermove cycles ($h$ state transitions).</td>
</tr>
<tr>
<td>Nonmyopic stability (NM)</td>
<td>Same as limited move stability but for infinite state transitions.</td>
</tr>
</tbody>
</table>
Attitude Representation in Strategic Negotiation

This research represents a major expansion of GMCR: combining attitudes within the paradigm of GMCR furnishes a flexible analytical tool which reflects how the DMs’ attitudes may change the strategic outcomes of a negotiation. Attitudes are formally defined by Inohara et al. (2007) and can be represented in a matrix format. Table 2 represents the attitudes between two DMs, where each cell entry in the table can take on a value of “+,” “0,” or “−” to represent a positive, neutral, or negative attitude, respectively. As shown in Table 2, the DMs have positive attitudes toward themselves since \( e_{ii} = + \) and \( e_{jj} = + \) and have neutral attitudes toward one another (\( e_{ij} = 0 \) and \( e_{ji} = 0 \)).

Brownfield Case Study

The brownfield case study in this research represents a common conflict situation in which the land of a privately owned property is found to be contaminated, and according to municipal laws, the property is considered to be a brownfield. Due to the enormous remediation costs, responsibilities, risks, and uncertainties involved with brownfield problems, conflicts have often risen between the property owner and the municipality, thus starting a negotiation process between the owner and the local government in order to find the most beneficial solution. More information about brownfield projects can be found in De Sousa (2000).

In this brownfield case study, it is assumed that both DMs have defined the different options available to them as follows:

1. Owner’s options:
   - Accept liability; and
   - Sell the property.

2. Government’s options:
   - Share costs; and
   - Lawsuit.

The two DMs and their options are shown in part a of Fig. 2. Each option can be either accepted or rejected by each DM, and since there are four choices in total, the number of decision states is \( 2^4 = 16 \), however, the total number of feasible states is 12, as shown and listed on the right in part a of Fig. 2, where each column represents a state in which \( Y \) means “Yes” and \( N \) indicates “No.” For convenience, the states are numbered from 0 to 11. Infeasible states (e.g., the situation where all four options in part a of Fig. 2 are “\( Y \)”) and the process of deleting them are explained in Fraser and Hipel (1984).

Once feasible decision states are identified, DMs’ preferences and the possible transitions among them are defined as shown in Fig. 2. For example, one of the owner’s possible moves is among States 0, 1, 2, and 3 in which the options of the government are similar (i.e., “N” and “N” for its two options). Similarly, all transitions are defined for the DMs as shown in Figs. 2(b and c).

As an important step in the graph model process, the prefer-

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**Table 2. Representation of Attitudes (Inohara et al. 2007)**

<table>
<thead>
<tr>
<th>DM</th>
<th>( e_{ii} )</th>
<th>( e_{ej} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( i )</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>( j )</td>
<td>0</td>
<td>+</td>
</tr>
</tbody>
</table>
ence of each DM among the decision states are defined, as shown in part d of Fig. 2, which started from the most preferred states on the left to the least preferred states on the right. As shown, the owner prefers most that the government only shares the costs of redevelopment and prefers least to accept liability and have the case filed in court. The most preferred state for the government is State 1, in which the current owner accepts liability and no other actions are taken, and the least preferred state is State 4, in which the government shares the costs of the brownfield redevelopment.

**Stability Analysis Considering DMs’ Attitudes**

A stability analysis is the systematic evaluation of potential moves and countermoves by the DMs as they negotiate for more preferred positions (Hipel et al. 2007). The solution concepts defined in Table 1 are used to carry out stability analysis that takes into account the DMs’ attitudes using three attitude scenarios as described in the following subsections.

**Case 1: DMs’ Neutral Attitudes toward Each Other**

The first situation considers the DMs to have positive attitudes with respect to themselves and neutral attitudes toward each other. The tableau in Fig. 3 shows the analysis process. The tableau has three parts: the top part for the analysis of DM1 (owner) stability, the middle part for the analysis of DM2 (government) stability, and the bottom part for equilibrium analysis. The rows in each DM section show its list of preferences (state ranking), possible moves from each state to any other state, and stability types. Such a tableau helps in the systematic analysis of the moves and countermoves by the DMs. The arrows moving down from the state ranking indicate the moves that can put a DM in a more preferred decision state. For example, the arrow from State 5 (circled in Fig. 3) indicates that the owner can move to State 4 which is more preferred to State 5 (according to the owner’s ranking). While it is possible for the owner to move from State 5 to States 4, 6, or 7 (as shown in the middle figure in part b of Fig. 2), only State 4 is more beneficial than State 5 while States 6 and 7 have less ranking. Accordingly, only State 4 appears under State 5 in Fig. 3, which is consistent with the owner’s positive attitude toward itself. Similarly, all the moves from the various decision states in state ranking to other states that are consistent with the DMs attitudes in Case 1 are shown in Fig. 3.

Using Fig. 3, the procedure for determining the type of stability for each state is quite straightforward. For example, to check for Nash stability (first type in Table 1), the analysis starts from the state ranking (first row, for the owner) and looks at the states that have no arrows (i.e., cannot be improved). As such, States 4, 2, and 10 for the owner and States 1, 7, 2, and 8 for the government are Nash stable states, which are marked with “Nash” in Fig. 3. Similarly, other stability types are indicated as shown in Fig. 3. Let us consider, for example, the stability of State 5 for the owner. Once the owner moves from State 5 to State 4, the examination of the government’s moves reveals that the government can respond by moving from 4 to 8 or to 0. However, in the owner’s state ranking, both 8 and 0 are less preferred than 5, and thus, the owner is deterred from improving from 5 because it can lead to states 8 or 0. Consequently, State 5 is sequentially stable as indicated in Table 1 and, as such, a “SEQ” is written below 5 in the owner’s stability analysis. It should be noted that the states that do not have any type of stability are unstable states and, as such, the DMs can move from these states to more preferred states. Unstable states are indicated by “U” in Fig. 3.

Once all stability types are examined for each state with respect to each DM, equilibrium is investigated as shown at the bottom part of Fig. 3. As indicated by “E,” States 2, 5, and 7 are stable for both DMs because they have some type of stability for both DMs. If a state possesses some type of stability for all DMs, it is called an equilibrium state, and this state constitutes a possible resolution to the conflict (Fraser and Hipel 1984). All other states are unstable for at least one of the DMs and, therefore, are not considered possible resolutions. The end result of the analysis

<table>
<thead>
<tr>
<th>DM1 Stability</th>
<th>Owner</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
<td>+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Owner’s State Ranking</th>
<th>4 5 6 7 2 0 3 1 10 8 11 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner’s Moves</td>
<td>4 ▼ 4 ▼ 2 ▼ 0 ▼ 10 ▼ 10 ▼</td>
</tr>
<tr>
<td></td>
<td>5 ▼ 5 ▼ 2 ▼ 0 ▼ 8 ▼ 8 ▼</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Owner’s Stability</th>
<th>Nash SEQ SEQ SEQ Nash</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DM2 Stability</th>
<th>Government’s State Ranking</th>
<th>Nash SEQ Nash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government’s Moves</td>
<td>1 ▼ 7 ▼ 2 ▼ 1 ▼ 8 ▼ 8 ▼</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 ▼ 5 ▼ 0 ▼</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Government’s Stability</th>
<th>Nash SEQ SEQ Nash</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Equilibrium</th>
<th>States</th>
<th>0 1 2 3 4 5 6 7 8 9 10 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equilibria (Final Result)</td>
<td>E</td>
<td>E</td>
</tr>
</tbody>
</table>

**Fig. 3.** Stability analysis tableau for two DMs with rational attitudes
is that Decision States 2, 5, and 7 are equilibria, or possible strategic solutions for this case study, based on the DMs’ neutral attitudes toward each other.

**Case 2: DMs’ Negative Attitudes toward Each Other**

To examine the influence of DMs’ attitudes toward each other, a situation is considered in which the DMs change their attitudes from neutral to negative attitudes toward each other. The stability process is explained as shown in Fig. 4.

In Fig. 4, all beneficial moves are initially indicated underneath the state rankings, however, some of these moves are crossed out by an “X” (Fig. 4) to unbeneficial moves according to the DMs’ attitudes in Case 2. State 6 (encircled) is considered as an example. Since the owner has a negative attitude toward the government, the owner desires to move only to the states that will not benefit the opponent. From the ordering of the states for the government in Fig. 4, it can be seen that State 5 will put the government in a better position, and as such, State 4 is the only state that the owner moves to in order to improve its own position and lower the opponent’s position. State 5 is therefore crossed out in Fig. 4. The same procedure is then carried out for all other states to determine the moves for each DM.

Once the DMs’ moves are determined, the stability type of each state is determined according to the DMs’ attitudes. The stability of State 6, for example, is assessed. From the owner’s perspective, if he/she moves from 6 to 4, then the government can move from 4 to 8. Although 8 is less preferred to 6 for the government, State 8 is also less preferred to 6 for the owner and because the owner has a positive attitude toward itself, the owner is deterred to move from 6 to 4. Thus, State 6 becomes SEQ for the owner and a “SEQ” is written below State 6. Afterwards, the stability of State 6 is assessed from the government’s perspective. It can be seen from Fig. 4 that by moving to State 2, the government will not only benefit itself (positive attitude) but also State 2 is less preferred to the owner (negative attitude). As such, the government has an incentive to move from State 6 to State 2, thus rendering State 6 as unstable indicated by “U” below State 6 in government stability in Fig. 4. Similarly, stability analysis is performed for all other states to define the type of stability and consequently to obtain equilibrium states. As a final result of this attitude scenario, States 2, 5, 7, 8, and 10 (indicated by “E” at the bottom of Fig. 4) are equilibria. It is noted that in Case 1, different equilibria (2, 5, and 7) were obtained. Thus, the change in the DMs’ attitudes causes a corresponding change in the resulting equilibria.

As a third attitude case, the stability analysis is carried out for a scenario in which both the owner and the government have positive attitudes not only toward themselves but also toward each other. A summary of the resulting equilibria in the three cases is shown in Fig. 5.

**Discussion of Attitude-Based Strategic Negotiation**

In the brownfield case study, the results of the three attitude scenarios in Fig. 5 indicate the following:

1. When the DMs change their attitudes from neutral to nega-

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**Fig. 4.** Stability analysis tableau for two DMs with negative attitudes

**Fig. 5.** Equilibria for the three attitude cases
tive, the set of equilibria changes toward more hostile solutions (e.g., States 8 and 10).

2. On the contrary, better possible solutions (e.g., States 1 and 4) in the set of equilibria are obtained in case the DMs have positive attitudes toward each other.

3. The increase in the number of resolutions in a conflict may help the involved DMs choose a better possible solution from the resulting equilibria.

4. The positive attitudes of the DMs toward themselves and each other not only mitigate the degree of hostility involved in Outcomes 8 and 10 but also shift the range of equilibria in the DMs’ state ranking from right (less preferred states) to the left (more preferred states). As such, the positive attitudes of the DMs help shift the set of equilibria in the state ranking to the more preferred options for both DMs.

5. One important observation is that outcomes 2 and 5 are the only common equilibria obtained from the stability analysis based on three different DM attitudes. Outcomes 2 and 5 are considered as the most stable outcomes of the negotiation for both DMs because no matter what type of attitudes (neutral, negative, or positive) the DMs have toward each other, these outcomes provide equilibrium solutions.

Based on the case study results, the owner and the government examine all equilibrium states and select one as their strategic solution. It is assumed in this case study that both DMs agree on State 2 which involves the owner selling the property. This strategic solution, however, does not involve determining an agreeable sale price which is an important detail issue that requires the DMs to continue their negotiation. Therefore, a tactical-level negotiation support is proposed in the next section to complement strategic negotiation and help in the settlement of any conflicting/pending issues involved in the selected strategic solution.

Tactical Negotiation: Utility Analysis

To support detailed tactical negotiation for any specific issue, utility analysis is proposed in this section as a suitable approach to maximize the benefits to all DMs. A utility function represents and describes, for each DM, his/her level of satisfaction (0 to 1) of a certain criterion (Keeney and Raiffa 1976). For example, an owner may assign utility values of 1.0, 0.9, 0.5, and 0.0 if the contractor’s bid price (criterion) is $2.6, $2.7, $2.8, and $3.0 million, respectively. In this case, the utility function that represents the “bid price” criterion can be as shown in Fig. 6. In cases of decisions that involve multiple criteria, then the alternative that maximizes the expected utility, considering the criteria weights, is selected (Kilgour 2007). In the case of multiple DMs, such as negotiations, it is logical that the best decision is the one that maximizes the joint expected utility value of all DMs which represents a cooperative environment.

One key step in utility analysis is to determine a suitable utility function. The form of a utility function depends on the characteristics of the DMs who have a specific attitude with respect to their preferences for consequences (Kirkwood 1997; Eliashberg and Winkler 1978). Utility function has been used in many research efforts (e.g., Du and Chen 2007, Peña-Mora and Wang 1998, Mumpower 1991, Zeleznikow et al. 2007, and Darling and Mumpower 1990) to develop negotiation supports. However, these research efforts have not considered the psychological aspects of negotiations such as the DMs’ attitudes. The proposed tactical negotiation approach in this section considers the attitudes of DMs when using utility function. Moreover, the proposed tactical negotiation approach complements the strategic negotiation developed in the previous section, thus forming a comprehensive negotiation strategy.

Among suggested utility functions (e.g., Zuhair et al. 1992, Peña-Mora and Wang 1998, and Hanoch and Levy 1970), reformatted polynomial utility functions are used in this research be-

![Fig. 6. Utility function for bid price](image)

![Fig. 7. DMs’ utility functions for the “price” issue](image)
cause they are more flexible for assigning risk attitudes to DMs (Zuhair et al. 1992). The reformatted polynomial utility function form is \( f(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x + a_0 \), where \( x \) = input variable; \( n \) = power of function; and \( a \) = real number coefficient. Using this utility form, the tactical negotiation for the case study follows the steps discussed in the following subsections.

**Step 1: DMs’ Utility Functions**

In this case study, the DMs’ negotiating issue at the detailed level is the offered initial price of the owner’s property. According to the negotiating issue, the DMs start their tactical negotiation by selecting a proper utility function. The general form of utility function for the owner (seller) and the buyer (government) is shown in Fig. 7(a). These shapes reflect the seller’s highest preference to get the highest price and, at the same time, the buyer’s highest preference to pay the lowest price. Generalizing these functions, various function forms can be generated for the owner and the government, as shown in Figs. 7(b and c), respectively. Because the government’s position on the price of the property is in contrast to the owner’s position, the government’s utility function is a mirror image of the owner’s utility function (Peña-Mora and Wang 1998).

**Step 2: An Integrated Utility Function for Each Issue**

In this case study, it is assumed that the owner prefers to have a cooperative attitude and a desire to sell the property and avoid all risks involved with the brownfield property. As such, a utility function with \( n = 7 \) is a good representation of the owner who is willing to compromise more than the government. On the other hand, the government prefers to be cooperative but has no great interest in buying the property. As such, a utility function form with \( n = 2 \) is a good representation of the government who is willing to concede less than the owner. Accordingly, the interactive negotiation between the DMs can be modeled. By integrating the utility function of all DMs an integrated utility function for the negotiating issue is obtained, as shown in Fig. 8. The integrated utility function is simply the summation of the utility values associated with the two individual functions. Point H, for example, on the total utility function is obtained by algebraically calculating the length of line DH=DE+DF. The same approach is applied to other points on the integrated utility function.

**Step 3: Selecting the Best Decision Value**

The maximum point on the integrated utility function represents the maximum utility value and as such, the maximum level of satisfaction for DMs (Kilgour 2006; Darling and Mumpower 1990). Accordingly, the maximum point on the integrated utility function is Point B with the maximum combined utility value. As shown in Fig. 8, Point B represents the settlement point (SP) or the point of agreement because both DMs have reached the highest degree of satisfaction for their cooperative effort (Kilgour 2006). The SP is used to obtain the percentage of price (indicated on the horizontal axis) that each DM should pay. In Fig. 8, Point N indicates 30% of the price is paid by the government and 70% (100–30%) of the price is reduced by the owner. If the initial price of the property is $200,000, for example, the government should pay $60,000 (0.3 \times $200,000) and the owner should reduce the initial price to $140,000 (0.7 \times $200,000). As it can be seen, the proposed negotiation methodology at the tactical level helps the DMs determine the exact amount of concession that each DM should make to reach mutual agreement on each issue.

**Considering Attitudes in Tactical Negotiation**

It is important to assess what DMs think about each other during negotiation at the tactical level. A DM’s attitude toward risk taking determines the shape of his or her utility function. Knowing that a DM is risk averse can substantially restrict the shape of a utility function (Kirkwood 1997).

In the proposed tactical negotiation, the attitudes of DMs are reflected by \( n \), the power of the reformatted polynomial utility function. As shown in Fig. 7, the shape of utility function changes with the value of \( n \). When \( 0 < n < 1 \), then the polynomial function has a negative convex shape for the government and positive convex shape for the owner. When \( 1 < n \leq 10 \), then the polyno-

<table>
<thead>
<tr>
<th>Table 3. Results of the Sensitivity of the DMs’ Attitudes</th>
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<tbody>
<tr>
<td>DM 1 (owner)</td>
</tr>
<tr>
<td>( n )</td>
</tr>
<tr>
<td>( 0 &lt; n &lt; 1 )</td>
</tr>
<tr>
<td>( 0 &lt; n &lt; 1 )</td>
</tr>
<tr>
<td>( 0 &lt; n &lt; 1 )</td>
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<tr>
<td>( 1 &lt; n \leq 10 )</td>
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<tr>
<td>( 1 &lt; n \leq 10 )</td>
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<td>1</td>
</tr>
</tbody>
</table>
mial function has a negative concave shape for the government and positive concave shape for the owner. The function shape is linear when \( n = 1 \). Concavity in utility functions (i.e., \( 1 < n \leq 10 \)) reflects the risk-taking (more cooperative) attitude of DMs, while convexity (\( 0 < n < 1 \)) reflects a risk-avoiding attitude (Keeney and Raiffa 1976). When the DMs cooperatively negotiate at the tactical level, they know that they may take the risk of conceding to come up with a mutual agreement. In the present case study, both the owner and the government have \( 1 < n \leq 10 \) for their utility function and as such, both utility functions have concave shape. Therefore, once the range of \( n \) values is appropriately selected, the exact \( n \) values are determined based on clear understanding/observation of the DMs’ behavior. As such, a value of \( n = 7 \) is a good representation of the owner who is willing to compromise more than the government. On the other hand, the government prefers to be cooperative but has no great interest in buying the property. As such, a value of \( n = 2 \) is a good representation of the government. Such mutual positive attitudes can help the DMs reach a “win-win” solution for their joint effort using the proposed attitude-incorporated utility function. It should be noted that once a proper \( n \) range is selected, the different in the shape of the utility function between \( n = 2 \) and \( n = 7 \) is not large (Fig. 7). In future research, a sensitivity analysis will be incorporated to assess the impact of changes in \( n \) on final resolution.

Table 3 summarizes the results of various scenarios in this case study, under three different \( n \) ranges for the DMs’ utility functions: \( 0 < n < 1, 1 < n \leq 10, \) and \( n = 1 \). If low \( n \) value (e.g., \( 0 < n < 1 \)) is used in the utility function, it means that the shape of utility function is convex and the DMs have negative attitudes toward each other and as such, the range of the utility is low (Table 3). On the other hand, if high \( n \) value (e.g., \( 1 < n \leq 10 \)) is used in the utility function, it means that the shape of utility function is concave and the DMs have positive attitudes toward each other and as such, the range of utility is increased as shown in Table 3.

Conclusions

This research contributes significantly to the provision of managerial tools that have the potential benefit of supporting construction negotiations by integrating the strategic and tactical perspectives as well as the decision makers’ attitudes as an important psychological aspect of negotiation. The proposed attitude-based negotiation introduces a new systems engineering methodology to help managers tackle various real-world controversies, particularly in the construction industry. The research is expected to help improve negotiation methodologies for construction disputes and save enormous time and cost due to the following benefits:

1. The proposed negotiation methodology can be conveniently implemented as a negotiation decision support system. Such a computer-based system has great advantages with respect to speed, practicality, and flexibility.

2. Attitude-based negotiation systems can be highly useful for practitioners who must deal with the costly and complex disputes in construction projects.

3. Practical negotiation support systems can help minimize emotional costs of the parties involved in construction disputes, and maximize work performance in construction.

4. The research helps to foster a positive environment in which construction professionals can negotiate.

References


