Chapter 20
Logrolling "Win–Win" Settlement in Construction Dispute Mediation

Yingying Qu and Sai On Cheung

Abstract Reaching "win–win" settlement is the desired outcome of mediation. Logrolling is a strategy for achieving "win–win" trade-off. In this study, a logrolling strategy in mediation is proposed through which parties can improve the joint value by bargaining exchange and get convergence along the efficient frontier. A multi-objective decision making (MODM) model is employed to propose the efficient frontier and assist parties to engender "win–win" settlement. To operationalise the logrolling strategy, a web-based logrolling system is developed to assist parties to achieve "win–win" settlement in a user-friendly environment. The system includes 3 processes: reality test, preference identification and logrolling. Reality test is proposed to test parties' concession rate. Preference identification assists parties to identify their utility value of the bargaining alternatives. Logrolling is to provide user-friendly strategies for parties to make efficient trade-off that involves (1) when to concede (2) on which issue (3) for which party and (4) how much should be conceded. Finally a mock mediation experiment was conducted to examine whether the logrolling system can assist parties to achieve "win–win" settlement, where the system simulates a *Mediator* in action. The results are evaluated by comparing the difference between the mediator's expected logrolling outcomes and the subjects' actual logrolling outcomes. The logrolling-difference degree (L-DD) is used to measure this difference. It is found that the average of L-DD in bargaining range and reaching agreement are 11.43 % and 8.46 % respectively, which indicates that the logrolling system is having good potential in assisting parties to achieve "win–win" settlement.

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20.1 Introduction

Conflict and dispute regularly feature in construction projects. Mediation has been identified as an effective means to resolve dispute due to its flexibility, cost-effectiveness and non-threatening process. From the information of the Hong Kong International Arbitration Center (HKIAC), out of the arbitrations handled by the HKIAC, the construction industry provided 24 % of the disputes in 2012. Chau (2007) reported that 82 % of all disputes got settled either by mediation or through negotiation at the mediation stage. The Chief Executive of the Government of the Hong Kong Special Administrative Region, in his 2007–2008 policy address announced the vision of developing Hong Kong as a regional centre for mediation service.

Reaching "win–win" settlement is the desired outcome of mediation. A "win–win" settlement can be seen as one that encourages parties to uphold their contracts when one party achieve its profits and the other party would still be better off (White 2009). However parties negotiating face to face often have difficulty in identifying and realising "win–win" settlement (Neale and Bazerman 1991; Pruitt 1981; Sebenius 1992).

In the last two decades, negotiation support system (NSS) and e-negotiation system (ENS) have been widely applied in conflict resolution. Negotiation support system (NSS) is developed on stand-alone computers or local network to implement decision making models (Lim and Benbasat 1993). They can help users to understand and formalise the objectives and preferences, and can help users to understand the problem structure and search for solution. Examples of such systems include MEDIATOR (Jarke and Jelassi 1987), RAINS (Bronisz et al. 1988), HIPRE (Hämäläinen and Pöyhönen 1996), RAMONA (Teich et al. 1995). E-negotiation systems (ENS) refer to those web-based systems that are equipped with decision making analysis, communication and coordination functions (Bichle et al. 2003; Insua et al. 2003). They can provide the reactions of the counterparts and the construction of arguments and counter-arguments. They can help to set up virtual laboratories and collect data from people around the world by user-friendly interfaces. They can facilitate the parties to communicate, store and access bargaining information. They also help the parties in achieving an agreement, by offering potential compromises and proposing concessions which may lead to a settlement. The role of these systems is thus similar to that of a mediator who communicates the parties' true interests and preferences. There are some examples of ENS application: Inspire (Kersten and Noronha 1999), Web-HIPRE systems (Hämäläinen et al. 2001), Kasbah (Maes et al. 1999), WebNS (Yuan et al. 2003), Negoisst (Schoop and Quix 2001), MeMo (Weigand et al. 2003), Negotiator Assistant (Druckman et al. 2004).

Logrolling is a strategy for achieving integrative trade-off, by which each party concedes on low priority issues in exchange for concessions on issues of higher priority to them (Neale and Bazerman 1991; Pruitt and Rubin 1986; Lax and Sebenius 1986). However there is no literature either on application of logrolling strategy in mediation or on computer-simulated mediator in facilitating "win–win" settlement. This study fills this gap by developing a web-based logrolling system to assist parties to achieve "win–win" settlement in mediation. In this study, a logrolling strategy is proposed through which parties can improve the joint value by bargaining exchange and get convergence along the efficient frontier. Based on that, a web-based logrolling system is developed to assist parties to achieve "win–win" settlement in a user-friendly environment. The logrolling system can help parties to make efficient trade-off, by suggesting (1) when to concede (2) on which issue (3) for which party and (4) how much should be conceded.

The remainder of the chapter is organised as follows. Review of literature on logrolling is firstly outlined. The conceptual model of logrolling strategy in mediation is then presented. To operationalise the logrolling strategy, a web-based logrolling system is developed. A mock mediation experiment was reported to examine whether the logrolling system can assist parties to achieve the "win–win" settlement. In the experiment, the logrolling system simulates a *Mediator* in action.

20.2 Logrolling in Negotiation

The strategy of logrolling is closely related to the concept of efficient frontier. In economics, "frontier" is where alternative is worse than what they could achieve (Mas-Colell et al. 1995). The logrolling process is described as procedures that generate jointly improving outcomes from non-Pareto optimal alternative towards a Pareto optimal one.

Kersten (2001) compared several logrolling models on negotiation. The logrolling solution paths in Fig. 20.1a, c, d, e, f are similar that each subsequent offer gives higher utility than the previous one. Fig. 20.1a can be viewed as an example of a single negotiated text (SNT) process. The SNT is one of the earliest logrolling models (Raiffa 1982). SNT is a tentative negotiation proposal that is to be examined and improved by all parties. The method produced a series of SNTs, which are jointly improving and ends when all parties accept one SNT as their final agreement. In Fig. 20.1a, an initial offer *a* is made that yields very low utility by both parties. Each party then proposed a better offer *b*, *c*, *d*, until the efficient offer *e*. Figure 20.1c refers to a negotiation in which the parties know the sets of offers. Knowledge of the sets of offers allows the parties to verify the efficiency of each offer. The difference between two processes in Fig. 20.1a and d is whether the parties expand the utility set. In Fig. 20.1a the parties do not modify the utility set *U*. In Fig. 20.1d, the parties propose new offers that are outside of the utility set they considered earlier. In Fig. 20.1e both integrative and distributive offers are

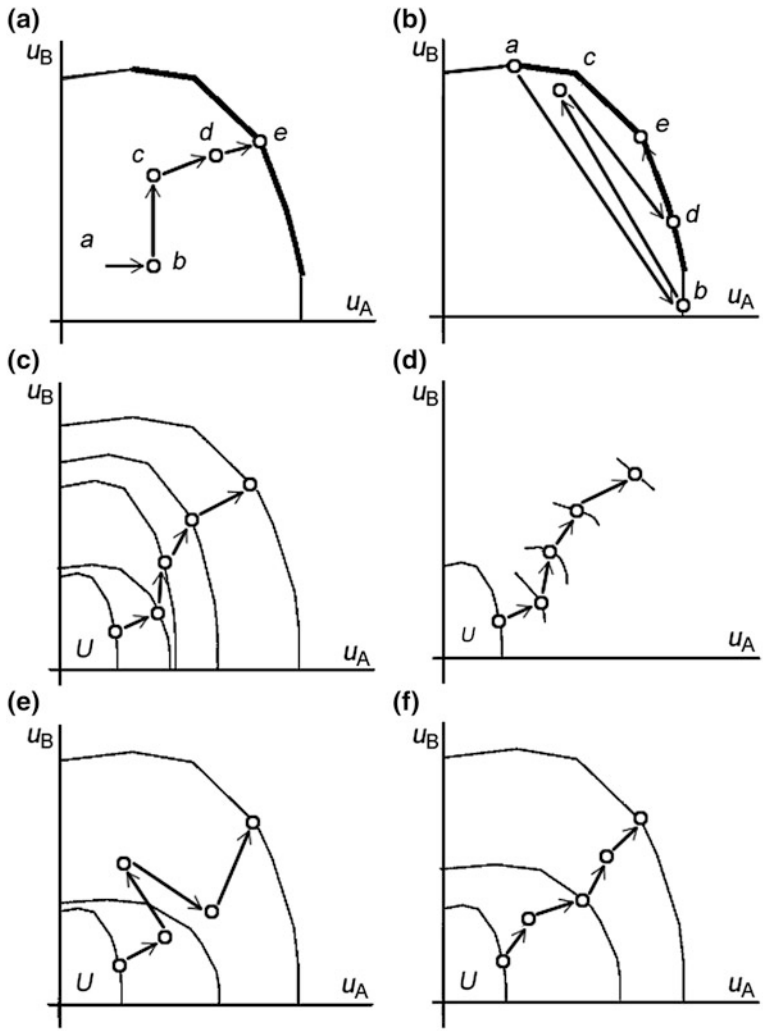

Fig. 20.1 Logrolling solution path comparison (adopted from Kersten 2001)

made, while in Fig. 20.1f there are only integrative offers. The process in Fig. 20.1b is a simple example of positional bargaining. The parties begin to make offers at the worst position which yields high utility value for their opponents. In Fig. 20.1b party A makes offer *a* to which party B replies with counteroffer *b*. Then party A proposes *c* and party B replies with offer *d*. In response to the counteroffers, each party makes a small concession and the process continues till both parties achieve a compromise *e*.

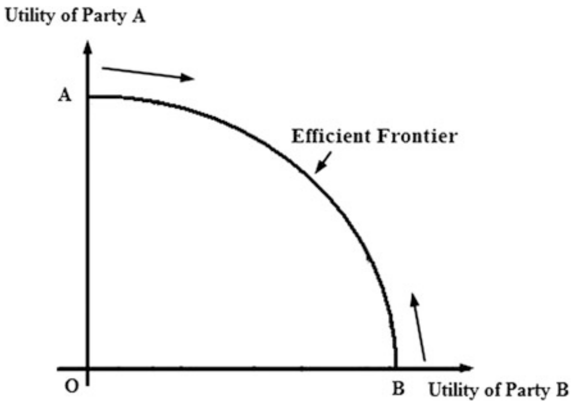

Fig. 20.2 Logrolling strategy

20.3 Application of Logrolling Strategy in Mediation

A logrolling process is proposed through which parties could improve joint value by bargaining exchange and get convergence along the efficient frontier. The related conceptual model of logrolling in mediation is shown in Fig. 20.2, which specifies an optimal logrolling solution path for negotiators. The parties are to begin with their most preferred position. Party A begins with point A and Party B begins with point B. Both parties move along the efficient frontier towards pareto-optimal solution.

To achieve it, a multi-objective decision making model is proposed to approximate efficient frontier and assist parties to engender "win–win" mediation settlement. Multi-objective decision making (MODM) approach accompanied with multi-attribute utility theory (MAUT) and applied in a multi-criteria decision making (MCDM) setting has been widely applied to generate options and identify potential agreements in dispute resolution.

There are several decision making criteria for judging the pareto-optimal outcome: maxi-min equity solution, Nash solution and utilitarian solution. Maxi-min equity solution is an approach that seeks to balance the difference between two parties. It has been suggested that one party is not only motivated by self-interest but also "a strong aversion to disadvantage themselves" (Nowak et al. 2000). It seems that the aversion to disadvantage (or "envy principle") affected the animal species as well. Brosnan and de Waal (2003) reported that high percentages of capuchin monkeys rejected the opportunity to trade rocks for cucumber slices when they saw other monkeys receiving grapes, either in exchange for their rocks or without being required to exchange anything. Nash solution is the famous principle for solving "efficiency" in non zero-sum two-person bargaining game. Raiffa (1985) and Lax and Sebenius (1986) pointed out that a lot of disputes are settled with "the value left on the table", since disputants focus on the pie to be shared, but fail to realise "this small pie" can be enlarged. Nash solution is measured as maximisation of the product of the two parties' utilities when the status quo point is normalised to zero (Raiffa et al. 2002). Utilitarian solution is to maximise the sum of the two parties' utilities (Thompson 1990).

The proposed MODM model:

With i as disputing party, j is defined as issue $j = 1,\ldots, J;$ U_{ijn} is defined as the preferred utility of party i on issue j's each bargaining alternative n; w_{ij} is defined as the weighting value on issue j preferred by party i where $\sum_{j=1}^{J} w_{ij} = 1$; define M_{ijn} as utility value considering the weight of current issue j of party i. Therefore, M_{ijn} can be calculated as follows:

$$M_{ijn} = U_{ijn} \times w_{ij} \tag{20.1}$$

The gain/loss rate is taken to be one party's gain in terms of the other party's loss. For example, the utility gain of *Contractor* in terms of utility loss of *Client* between alternative $n + 1$ and n, on issue j can be calculated as follows:

$$Rate_{Contractor} = \frac{\left|M_{Contractor,\,j,\,(n+1)} - M_{Contractor,\,j,\,n}\right|}{\left|M_{Client,\,j,\,(n+1)} - M_{Client,\,j,\,n}\right|} \tag{20.2}$$

Both parties are proposed to concede on minimum loss in exchange for maximum gain from the other party for every bargaining round. Therefore, the *Benefit* is defined as evaluation of joint value on each issue. Following the above example, the related formula is as follows:

$$Benefit = M_{Client,\,j,\,n} + Rate_{Contractor} \times M_{Contractor,\,j,\,n} \tag{20.3}$$

The *benefit* can be used to measure and improve the efficiency of the logrolling process. And we can get the efficient logrolling proposals as the maximum *benefit*. In other words, when *Max.Benefit* is satisfied, the efficient points on the frontier can be calculated, with a vector $[M_{Client,\,j,\,n},\ M_{Contractor,\,j,\,n}]$, $j = 1,\ldots, J,$ thus the efficient frontier is simulated and the utility value of efficient point on the frontier is $[\sum_j M_{Client,\,j,\,n}, \sum_j M_{Contractor,\,j,\,n}]$.

The optimal agreement is generated based on the following three criteria:

Utilitarian solution: $Max.\sum_i \sum_j M_{ij}$

Nash solution: $Max.\prod_i \sum_j M_{ij}$

Maxi-min equity solution: $Max.\left\{\min \frac{\sum_i M_{ij}}{\sum_i \sum_j M_{ij}}\right\}$

To simulate the conceptual model, data from the case reported by Cheung et al. (2004) is used. This is a two-party, three-issue case. "This construction dispute begins with the date of completion, which was 1 Jan 2001 in the contract. But due to the delay of sub-contractor and late Architect Instruction, the completion date shifted from 1 Jan 2001 to 1 Mar 2001. The issues are *Extension of Time (EOT)*, which Main Contractor argued for 60 days but Architect only granted 40 days, *Acceleration Cost (AccCost)* which was estimated as $30,000 by Project Manager, as well as *Lost and Expenses (L/E)*." From their work, the issues, bargaining alternatives and two parties' input data are listed in Table 20.1.

The points that satisfy the condition $M_{Client,j,n} + Rate_{Contractor} \times M_{Contractor,j,n}$ are listed in Table 20.2. The points constitute the efficient frontier as shown in Fig. 20.3. In Table 20.2 the optimal solutions can be generated according to the 3 criteria as aforestated. From utilitarian solution and Nash solution, the points F and G are the optimal choices, which are highlighted in Fig. 20.3. To achieve Maximin equity solution, the point G is selected finally.

The multi-objective decision making model is not only a generator of optimal solution, but also specifies a logrolling solution path for negotiators to achieve "win–win" settlement. In consideration of self-interest motivation, the proposed mediation begins with the parties' most preferred positions. In this case, *client* begins with point A and *contractor* with point L respectively. In each of the next scenario, parties are suggested to move in a direction that makes efficient trade-off. For example from A to B, *client* is suggested to increase the budget for L/E from 6000 to 6100, with no change on the other two issues. Meanwhile, the *contractor* is persuaded to cut down EOT arguments from L to K in Table 20.2. In this way moving along the efficient frontier, both parties are suggested to make concessions till convergence.

20.4 Logrolling System for Construction Dispute Mediation

To operationalise the logrolling strategy, a web-based system is developed. The system includes 3 processes: reality test, preference identification and logrolling. Reality test and preference identification are designed for logrolling information collection. Logrolling process is to provide user-friendly strategies for parties to make efficient trade-off addressing (1) when to concede, (2) on which issue, (3) for which party and (4) how much should be conceded.

20.4.1 Reality Test

Reality test is proposed to test parties' concession rate and assist disputing parties to get ready for achieving "win–win" settlement. Some negotiation support systems (Korhonen et al. 1986; Rangaswamy and Shell 1997) follow the assumption advocated by Keeney and Raiffa (1991) that "all inventing and creating of issues and potential settlements have occurred," and the parties are ready to negotiate over the identified options. However this assumption has significant limitation in practice. When engaged in negotiation, parties may hesitate to make concessions,

Table 20.1 Input data for *Contractor*/*Client* M_{ijz}

Issue	EOT	EOT	EOT	EOT	EOT	EOT	L/E	L/E	L/E	L/E	L/E	L/E
Bargaining alternative	35	36	37	38	39	40	6000	6100	6200	6300	6400	6500
Contractor	0	25	40	50	58	60	0	10	18	24	28	30
Client	30	28	24	18	10	0	40	38	33	25	15	0
Issue	AccCost	AccCost	AccCost	AccCost								
Bargaining alternative	10000	11000	12000	13000								
Contractor	0	5	8	10								
Client	30	25	15	0								

(Adopted from Cheung et al. 2004)

Table 20.2 Set of points on the efficient frontier

	EOT	L/E	AccCost	Contractor utility	Client utility	Utilitarian solution	Nash solution	Maxi-min equity solution	
								Contractor (%)	Client (%)
A	36	6000	10000	20	98.4	118.4	1968	16.89	83.11
B	36	6100	10000	35	96	131	3360	26.72	73.28
C	37	6100	10000	50	92	142	4600	35.21	64.79
D	38	6100	10000	60	86	146	5160	41.09	58.91
E	38	6200	10000	68	81	149	5508	45.64	54.36
F	38	6200	11000	73	76	149	5548	48.99	51.01
G	39	6200	10000	76	73	149	5548	51	49
H	39	6200	11000	81	68	149	5508	54.36	45.64
I	39	6300	11000	87	60	147	5220	59.18	40.82
J	39	6400	11000	91	50	141	4550	64.54	35.46
K	39	6400	12000	94	40	134	3760	70.15	29.85
L	40	6400	12000	96	30	126	2880	76.19	23.81

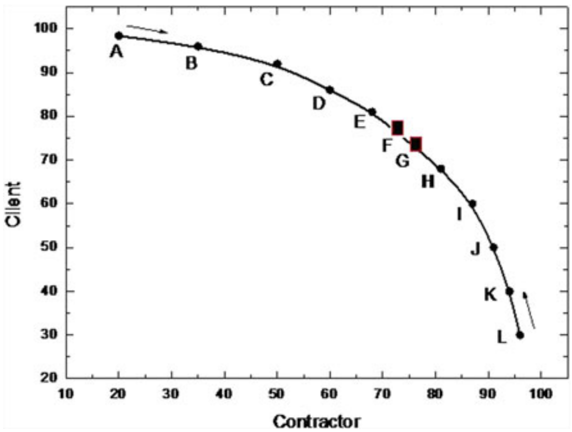

Fig. 20.3 Efficient frontier

because they are not sure whether the other party will make the concession or not. It is also quite common for parties to over-value their own cases while under-value the opponent's assertions (Neale and Bazerman 1991). As a result, the disputants always walk away at very early stage. According to Boulle and Nesic (2001), mediators are 'agents of reality' in so far as their function of encouraging the parties to consider the realities of the dispute.

If two parties reach agreement, they definitely have options that are mutually acceptable. Otherwise parties still need to adjust their concession rate to close the gap.

Table 20.3 Symbol definition

Symbol	Definition
$CR_{Contractor}$	Concession rate of *contractor*
CR_{Client}	Concession rate of *client*
$V_{Contractor}$	*Contractor*'s optimistic proposal
V_{Client}	*Client*'s optimistic proposal
$BL_{Contractor}$	*Contractor*'s bottom line
BL_{Client}	*Client*'s bottom line
Min.Rate	Parties' mutual concession rate in mediation
n	Bargaining alternatives on one issue
N	Total number of bargaining alternatives
VPre	Parties' offer after ($N - 1$)th *concession*
VExp	Parties' final offer after *N*th concession
POW	Exponentiation

Principle 1: Party A and Party B reach agreement *if and only if* Party A's final offer is better than Party B's bottom line *AND* Party B's final offer is better than Party A's bottom line.

In this respect, $CR_{Contractor}$ and CR_{Client} are defined as the concession rate of *Contractor* and *Client* respectively; define $V_{Contractor}$ and V_{Client} as parties' optimistic proposal; define $BL_{Contractor}$ and BL_{Client} as Party's bottom line. The definitions of the symbols used are summarised in Table 20.3.

Take an example, if Client argued money for remedy and Contractor tried to reduce the payment. The bottom line for party i can be calculated as follows:

$$BL_{Contractor} = V_{Contractor} \times (1 + CR_{Contractor}) \tag{20.4}$$

$$BL_{Client} = V_{Client} \times (1 - CR_{Client}) \tag{20.5}$$

Minimum concession rate Min.Rate is defined as the parties' mutual concession rate in mediation. Therefore, Min.Rate = Minimum (CR_i). Define n ($n \geq 1$) as bargaining alternatives on one issue and the total number of alternatives is N. Each bargaining alternative represents one bargaining round. Suppose parties concede at the same rate on each round, in this example, the Principle 1 can be formalised as follows:

$$\begin{aligned} BL_{Contractor} \times (1 + MinRate)^N \geq BL_{Client} AND \\ BL_{Contractor} \times (1 - MinRate)^N \leq BL_{Contractor} \end{aligned} \tag{20.6}$$

Based on Principle 1, concession rate can be evaluated with given bargaining alternatives n. The algorithm for reality test is presented as Algorithm 1.

Algorithm 1: Reality Test

1. **Input** $CR_{Contractor}$, which is *Contractor's* concession rate;
2. **Input** CR_{Client}, which is *Client's* concession rate;
3. **Input** V_{Client}, which is *Client's* optimistic proposal
4. **Input** $V_{Contractor}$, which is *Contractor's* $V_{Contractor}$ optimistic proposal
5. $Min.Rate$ = Minimum ($CR_{Contractor}$, CR_{Client})
6. Calculate $BL_{Contractor} = V_{Contractor} \times (1 + CR_{Contractor})$
7. Calculate $BL_{Client} = V_{Client} \times (1 - CR_{Client})$
8. Define $VPre$ as parties' offer after $(N-1)^{th}$ concession
Define $VExp$ as parties' final offer after N^{th} concession
9. $V\,\mathrm{Pr}e_{Contractor} = BL_{Contractor} \times POW((1 + Min.Rate), N-1)$
10. $V\,\mathrm{Pr}e_{Client} = BL_{Client} * POW((1 - Min.Rate), N-1)$
11. $VExp_{Contractor} = BL_{Contractor} \times POW((1 + Min.Rate), N)$
12. $VExp_{Client} = BL_{Client} \times POW((1 - Min.Rate), N)$
13. **If** $((VPre_{Contractor} \geq BL_{Client}) AND\ (VPre_{Client} \leq BL_{Contractor}))$ **Then**
14. *Suggestion* = The advice of decreasing concession rate to both *contractor* and *client*;
15. **Else If** $((VExp_{Contractor} \geq BL_{Client}) AND\ (VExp_{Client} \leq BL_{Contractor}))$ **Then**
16. *Suggestion* = The successful of bargaining in reality test to both *contractor* and *client*;
17. **Else**
18. *Suggestion* = The advice of increasing concession rate to both *contractor* and *client*;
19. **End If**
20. **Output** *Suggestion*;

The related flow chart of reality test is shown in Fig. 20.4. The contractor and client are interacting via a message center with mediator. The test of concession rate in each round will return to both contractor and client. If the expected final offer doesn't reach the other party's bottom line, the mediator (system) will suggest another round until success.

To further illustrate the operation of reality test and the user interface, a series of screenshots from the system are provided in Fig. 20.5. Firstly, the *contractor* and *client* input the concession rate via different computers. Usually the concession rate begins with 3–5 % in mediation. After *contractor* and *client* submitted their concession rates, *mediator* can automatically receive a message, which contains the parties' concession rates. After that, system will provide a suggestion for *mediator* automatically whether the *contractor* and *client* cannot reach any agreement in this round. Then the 'Message Center' will send suggestion messages from the *mediator* to both the *contractor* and *client*. The parties receive the suggestion and work on the next round. If the *contractor* and *client*'s expected final offer reaches each other's bottom line, *mediator* will send a success message to them.

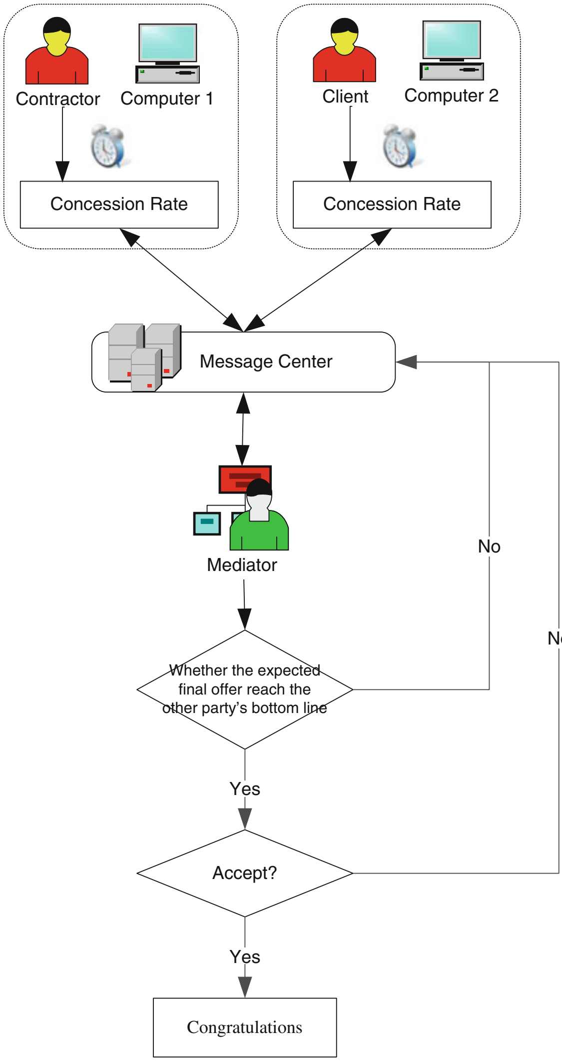

Fig. 20.4 Flow chart of reality test

20.4.2 Preference Identification

Preference identification is used to assist parties to identify the preference of each bargaining alternative. Non-linear utility distribution is applied widely. One notable example is the "law of diminishing marginal utility", which states that an individual consumes or acquires more of a good, the marginal utility of additional amounts of those good decreases (Northcraft et al. 1998). Some negotiation researches also outlined how non-linear preference functions dramatically alter the dynamics of negotiation exchanges (Northcraft et al. 1995, 1998; Pennings and Smidts 2003). However, there is no negotiation support system with non-linear

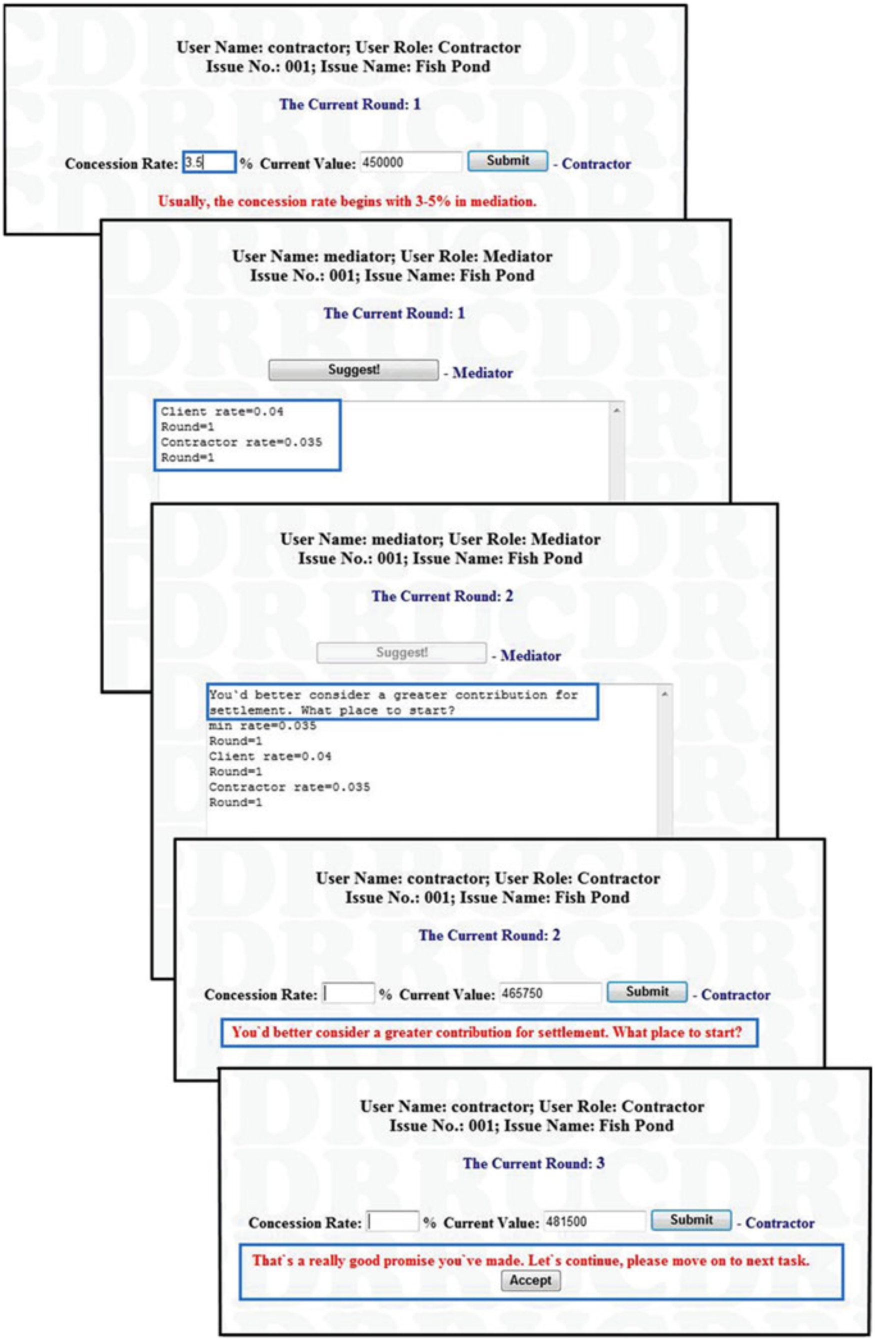

Fig. 20.5 User interface of reality test

utility distribution in practice and most experimental negotiation researchers imposed on subjects' explicitly linear utility identification (De Dreu et al. 1994; Thompson and Hastie 1990). The system is proposed to bridge the gap.

Negotiators' preference is an essential part in negotiation decision making process. The parties' preference identification includes (1) relative weightings on each issue and (2) relative preference on each bargaining alternative which involves utility range on each bargaining alternative and utility distribution.

In prospect theory, the shape of a decision maker's preference function is assumed to differ between the domain of gains and the domain of losses. "…convex regions in the value function for gains and concave regions in the value function for losses" (Kahneman 1979; Northcraft et al. 1998; Pennings and Smidts 2003). The convex curve reflects decreasing marginal utility and the concave curve reflects increasing marginal utility. The slope of the value function is steeper for losses than for gains, reflecting the fact that decisions involving prospective losses or prospective gains are distinguished by how much is at stake.

Principle 2: The loss-framed utility distribution should be taken as increasing marginal utility.

t_n is defined as the utility value on bargaining alternative. n; X_n is defined as utility range on bargaining alternative n, with successive utility value, thus $X_n = [t_n, t_n + R], X_{n+1} = t_{n+1,} t_{n+1} + R]$ in which, t_n is the minimum value on alternative n; t_{n+1} is the minimum value on alternative $n + 1$; t_n + R is the maximum value on alternative n t_{n+1} + R is the maximum value on alternative $n + 1$.

Accordingly, the range of utility difference between two bargaining alternative $[n, n + 1]$ *and* $[n - 1, n]$ can be calculated as follows:

$$\begin{aligned} X_{n,\,n+1} &= [|t_n - (t_{n+1} + R)|, |(t_n + R) - t_{n+1}|] \\ X_{n-1,\,n} &= [|t_{n-1} - (t_n + R)|, |(t_{n-1} + R) - t_n|] \end{aligned} \tag{20.7}$$

Based on Principle 2, the utility range X_n is appropriate *if and only if* the maximum value of $X_{n-1,\,\mathrm{n}}$ is smaller than or equal to the minimum value of $X_{n,\,n+1}$.

Algorithm 2: Preference Identification

```
Input the start and end number as start and end, respectively.
Define t_n as the candidate utility value on the alternative n;
For each ((X_{n-1}) in [start, end - R])
For each ((X_n) in [start, end - R])
Set Min.difference(n-1, n) =Minimum (|t_{n-1} - (t_n + R)|, |(t_{n-1} + R) - t_n|);
For each ((X_{n+1}) in [start, end - R] )
Set Max.difference (n, n+1) =Maximum (|t_n - (t_{n+1} + R)|, |(t_n + R) - t_{n+1}|);
If (Min.difference(n-1, n) >=Max.difference(n, n+1)) Then
Record (X_{n-1}), (X_n), (X_{n+1}) as appropriate utility range and add into list L;
End If
End For
End For
End For
Output L;
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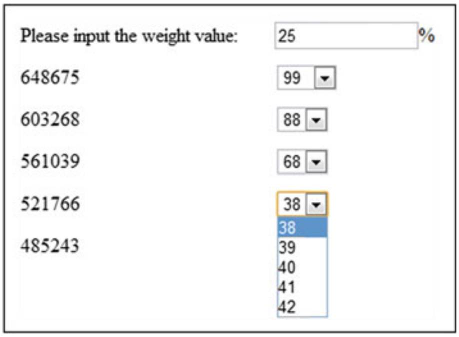


Fig. 20.6 User interface of preference identification

In this research, *start* = 1, *end* = 100, *R* = 5. The utility ranges are calculated by Algorithm 2, which should satisfy Principle 2. It is found that there are many complying results. In this implementation, the ranges of [96–100], [85–89], [66–70], [38–42], and [1–5] were selected for its large coverage over the scale [1–100].

An example of user interface of utility range [38–42] on bargaining alternative "521766" is shown in Fig. 20.6. The utility ranges are arranged in descending order. Here the users are required to identify most preferred utility value from the range on the corresponding bargaining alternative.

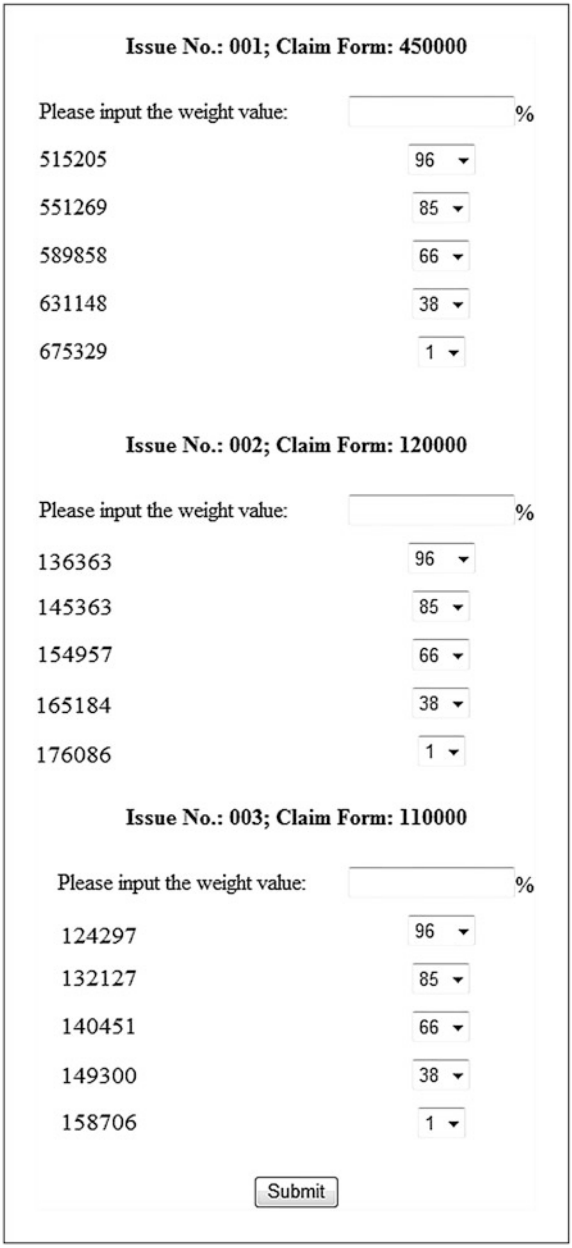
Contractor and *Client* come to "Preference Identification". In this part, they are required to submit survey regarding (1) the relative preferences among the issues, which are the weightings among all the issues; (2) the relative preferences among the bargaining alternatives. The complete user interface for *Contractor* is shown in Fig. 20.7.

20.4.3 Logrolling

The flow chart of Logrolling is shown in Fig. 20.8. After *contractor* and *client's* submission of preference information, *Mediator* analyses the data and calculates the optimal proposals, which are then returned to *contractor* and *client* as *Mediator's* suggestion round by round. *Contractor* and *client* need to confirm whether accept or reject.

In logrolling process, the mediation system will provide user-friendly strategies for parties to make efficient trade-off, which involves (1) when to concede; (2) on which issue; (3) for which party; and (4) how much should be conceded. Parties need to confirm whether they accept or reject. Fig. 20.9 shows the suggestion for *Contractor* on the first round.

Fig. 20.7 Complete user interface of preference identification



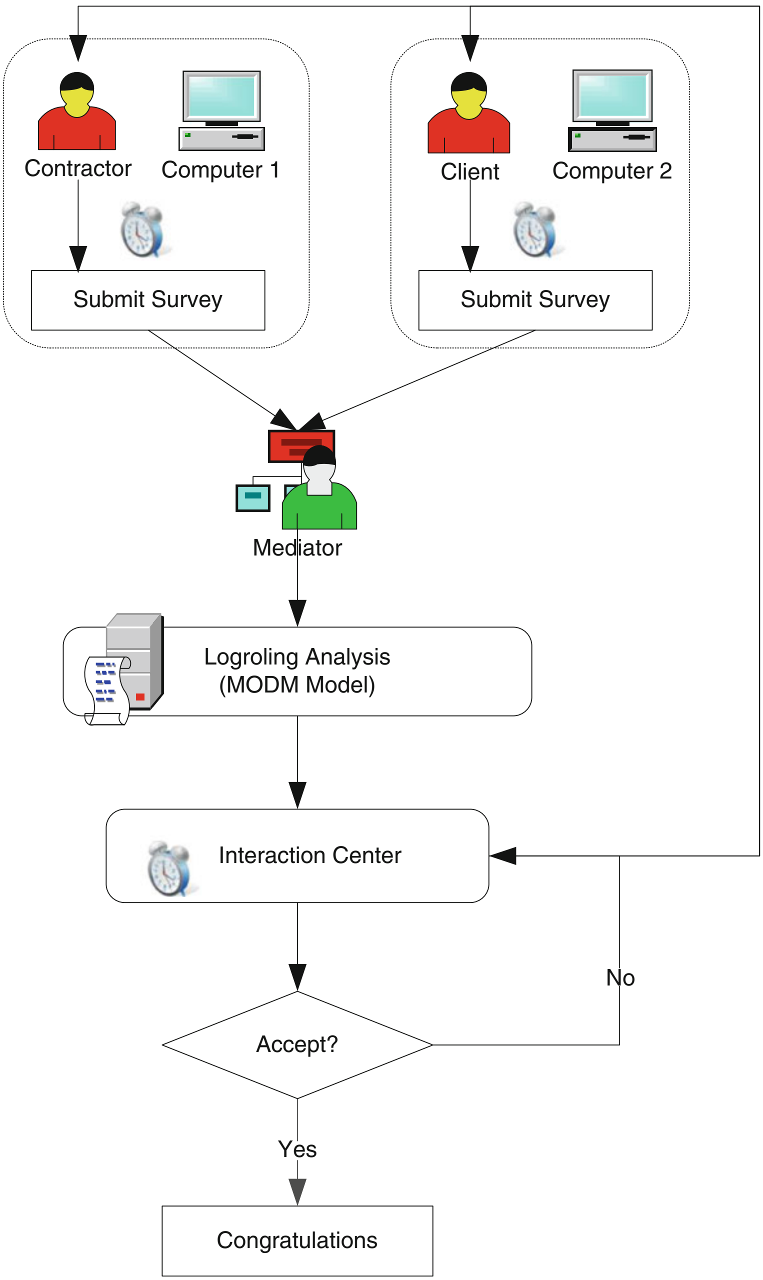


Fig. 20.8 Flow chart of logrolling

Fig. 20.9 Strategy for contractor on the first round

Table 20.4 Working experience

	Year of experience	No.	Percentage (%)
a.	Below 10 years	50	83.3
b.	10 years	4	6.7
c.	Above 20 years	6	10
	Total	60	100

Table 20.5 Nature of works

	Nature of Works	No.	Percentage (%)
a.	Building	50	83.3
b.	Civil	8	13.3
c.	A and A/Maintenance	2	50
			3.3
	Total	60	100

Table 20.6 Education level

	Education Level	No.	Percentage (%)
a.	Degree	44	73.3
b.	Associate degree	12	3.3
c.	Master	2	20
d.	High diploma	2	3.3
	Total	60	100

20.5 Use of the System

A mock mediation experiment was conducted to examine whether the logrolling system can assist parties to achieve “win–win” settlement, where the system is to serve as a *Mediator* in action. The participants are randomly selected and invited to participate in the experiment. Totally 60 construction practitioners (30 pairs) participated in the experiment. The detailed information in participants’ year of experience, nature of work and education level is shown in Tables 20.4, 20.5 and 20.6.

Before the experiment, the subjects were required to fill in the Personal Information Form and were given a hypothetical case *Peter and Brothers Gardening and Landscaping Ltd V ABC Property Management Ltd* and the experiment manual on the use of mediation system. The case is from openly available materials for Arbitration training of the CIArb and it had been adopted and modified to suit Hong Kong context.

The dispute occurred between the Client ABC property Management Limited and the Contractor Peter and Bothers Gardening and Landscaping Limited. Villa Rocha is a private luxury estate in Hong Kong, completed in June 2006. On 16th April 2008 Client engaged a Contractor. The contract price agreed was 2,500,000 Hong Kong dollars. The Client paid a deposit of 1,250,000 Hong Kong dollars and the Contractor started work. On 2nd June 2008, the Client contended the work of the contractor was of poor quality and workmanship. The Client therefore refused to pay the balance and claimed 1,130,000 dollars for remedy. On 7th July 2008, the Contractor issued a Mediation Notice. There are 3 dispute issues, fish pond, turf area and glass house.

20.5.1 Fish Pond

The defects of the fish pond are the location and the leakage. From the *Client*'s statement the *Contractor* transposed the diagram. The fish pond is marked on the right, but was constructed on the left. However from the *Contractor's* statement the wrong location is due to the ambiguous sketch. And they pointed out that the left side is a perfect location for fish since that side is shadier. As for the leakage, the *Client* emphasised the terrible situation that the pond was empty in the next morning even if it was fully filled with water the night before. But the *Contractor* argued that the leakage was really minor. They also failed to agree on the type of remedial work. The *Client* claimed HK$750,000 (claim form) for moving the pond to the correct position and replacing the lining. The *Contractor* responded HK$450,000 (response form) for the ‘extra’ work.

20.5.2 Turf Area

From the *Client's* statement, the turf was bared and had not been properly laid. A compensation of HK$200,000 was demanded by the *Client*. While the *Contractor* contends that the damage was caused by the *Client's* car, a request of HK$120,000 for re-doing the turfing was raised. The *Client* asked the *Contractor* to come around and see what had happened. But the *Contractor* refused to come unless the *Client* agreed to pay the bill in full.

Table 20.7 Case summaries

	Client		Contractor	
	Defects	Damages	Defences	Offer
Fish Pond	(1) Wrong location	HK$750,000	(1) Wrong location was because of the ambiguous sketch.	HK$450,000
	(2) Leakage		(2) Leakage was minor.	
Turf area	Bared	HK$200,000	Patches resulted from unplanned use of car parking	HK$120,000
Glass House	(1) Leakage	HK$180,000	(1) Leakage was because of the use of inappropriate adhesive chosen by the *Client*.	HK$110,000
	(2) Cloudy pane		(2) Cloudy pane was caused by the *Client*'s incorrect cleaning.	
			(3) Addition erection work cost 3 more man days.	
Total		HK$1,130,000		HK$680,000

20.5.3 Glass House

The *Client* claimed HK$180, 000 for the leakage and cloudy pane of the newly constructed glass house. The *Contractor* contended that the cloudy pane was caused by the *Client*'s incorrect cleaning, and the leakage was because of the poor quality of adhesive selected by the *Client*. Another *Contractor's* defense point is the additional installation work. From the *contractor's* statement the prices in the agreement of 16th April 2008 were estimates and subject to change if any of the work proved to be more or less difficult than anticipated. The complicated installation work cost more man days than anticipated. Based on these, the *Contractor* only offered HK$110,000 for *Client*'s damages (Table 20.7).

In the experiment, the dyad was randomly assigned to the roles of Client or Contractor, and each dyad was told not to speak with each other face to face in the experiment. The subjects are required to generate bargaining range and reach agreement using the logrolling system.

The logrolling system can assist subjects to achieve "win–win" settlement, which means that the difference between mediator's expected logrolling outcomes and the subjects' actual logrolling outcomes is not significant. The outcomes suggested by computer-simulated mediator are taken as the mediator's expected outcomes. The outcomes generated by subjects are taken to be the subjects' actual outcomes. The logrolling-difference degree (L-DD) is defined as difference between the two and to be used for the measure. The smaller the L-DD, the closer are the actual outcomes to the efficient frontier.

The four steps for calculating logrolling-difference degree (L-DD) are described as follows:

Step 1: Collect the data of expected logrolling outcomes and actual logrolling outcomes. The data are then used to plot curves on bargaining range and reaching agreement respectively (see Figs. 20.10 and 20.11).

Set x_1 as the value on the curve of expected logrolling outcomes

Set y_1 as the value on the curve of expected logrolling outcomes where $x = x_1$

Set as the value on the curve of actual logrolling outcomes

Set y_2 as the value on the curve of actual logrolling outcomes where $x = x_2$

Step 2: Calculate the corresponding mapping points on two curves respectively. Since the points on two curves may be both different in dimensions x and y, this mapping step is to unify the value in dimensions x, so that the data on two curves can be comparable for comparison in dimension y.

Set y_1's mapping value on the curve of actual logrolling outcomes where $x = x_1$

Set y_2's mapping value on the curve of expected logrolling outcomes where $x = x_2$

Step 3: Calculate L-DD based on points in two curves in dimension y. The L-DD on each pair of points is calculated as follows:

$$L - DD_{po\text{inti}} = \frac{|y_2 - y_1|}{Maximum(y_1, y_2)} \tag{20.8}$$

Step 4: Evaluate the average L-DD.

$$L - DD = \frac{1}{n} \times \sum_{i=1}^{n} L - DD_{po\text{inti}} \tag{20.9}$$

Taking group 1 as an example, the logrolling outcome on bargaining range and reaching agreement are shown in Figs. 20.10 and 20.11.

The L-DD between *Subjects*' actual logrolling outcomes and *Mediator*'s expected logrolling outcomes of group 1 in bargaining range task is 5.75 %, and 3.08 % in reaching agreement task. It is found that the *subjects*' actual logrolling curve is fitted with the *Mediator*'s expected curve (shown as Fig. 20.11). It reflects that the logrolling system can help user to make rational decision. Repeating the same procedures as for bargaining range, the L-DD of reaching agreement was obtained. It was found that this L-DD is smaller than task of bargaining range, since subjects can achieve more efficient trade-off in the logrolling process, assisted with the computer-simulated mediator.

The number of bargaining rounds and logrolling-difference degree (L-DD) between mediator's expected logrolling outcomes and subjects' actual logrolling outcomes for 30 groups are calculated in Table 20.8. It is found that the average of

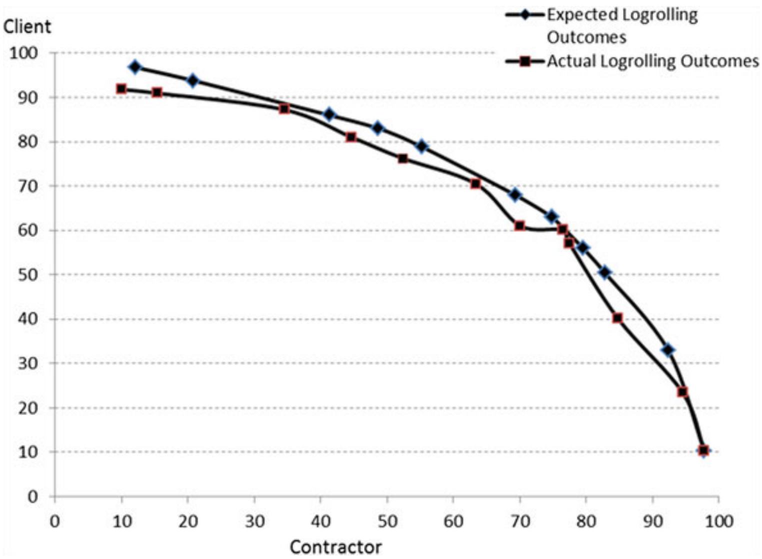


Fig. 20.10 Logrolling result in bargaining range

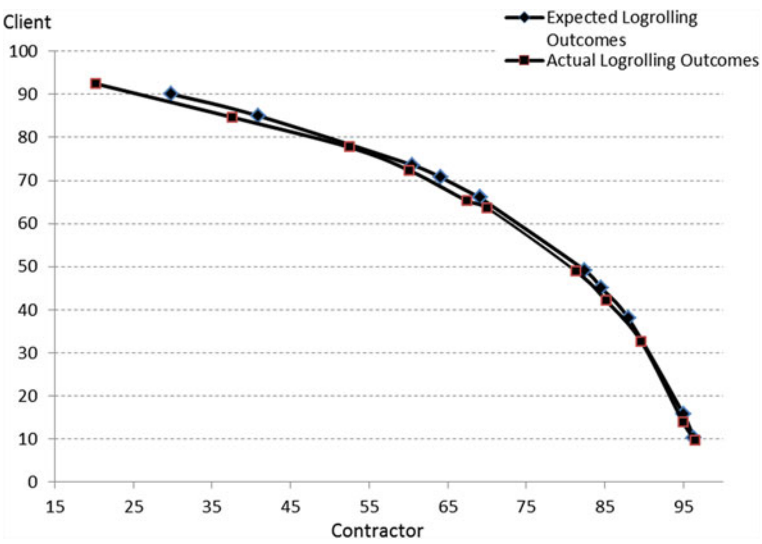


Fig. 20.11 Logrolling result in reaching agreement

Table 20.8 Experiment results

	Bargaining range task		Reaching agreement task	
Group No.	bargaining rounds	Logrolling-difference degree (%)	Bargaining rounds	Logrolling-difference degree (%)
1	7	5.75	7	3.08
2	7	5.79	7	11.03
3	6	10.97	6	11.94
4	6	12.49	6	11.19
5	7	9.31	6	15.41
6	6	20.95	6	10.87
7	7	20.93	6	14.68
8	7	9.45	7	2.76
9	6	12.86	7	5.86
10	6	11.43	6	4.86
11	6	8.05	7	5.69
12	6	16.59	7	7.88
13	7	4.29	6	1.70
14	7	30.23	7	16.32
15	7	8.52	7	13.09
16	7	10.87	7	9.85
17	7	19.79	7	7.60
18	6	10.35	6	7.21
19	6	8.90	6	9.82
20	6	2.01	6	5.57
21	6	12.56	6	3.67
22	6	2.71	6	10.48
23	7	16.49	7	9.70
24	7	5.00	7	18.34
25	6	3.32	6	10.31
26	6	17.83	6	1.31
27	6	21.54	6	8.77
28	6	5.12	7	3.36
29	6	3.69	6	5.86
30	7	15.15	6	5.65
Mean		**11.43**		**8.46**
SD		**6.80**		**4.44**

L-DD in bargaining range and reaching agreement are 11.43 % and 8.46 % respectively, which indicates that the logrolling system is having good potential in assisting parties to achieve "win–win" settlement. Figures. 20.12 and 20.13 show the fluctuation of the L-DD among the 30 groups in bargaining range and reaching agreement respectively. The fluctuation in bargaining range task is obviously greater. It is also found that 57 % subjects fulfilled the experiment within 6 bargaining rounds, while 43 % subjects needed 7 bargaining rounds to complete. The experiment test provides support for the hypothesis that the logrolling system is having good potential in assisting parties to achieve "win–win" settlement.

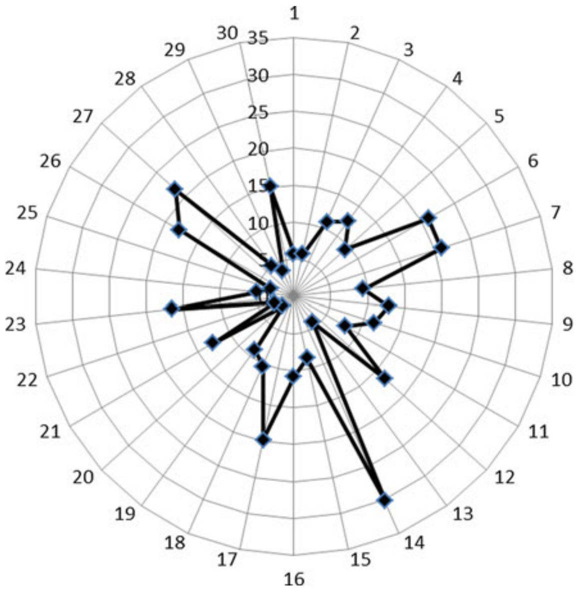


Fig. 20.12 Fluctuation of logrolling-difference degree in bargaining range

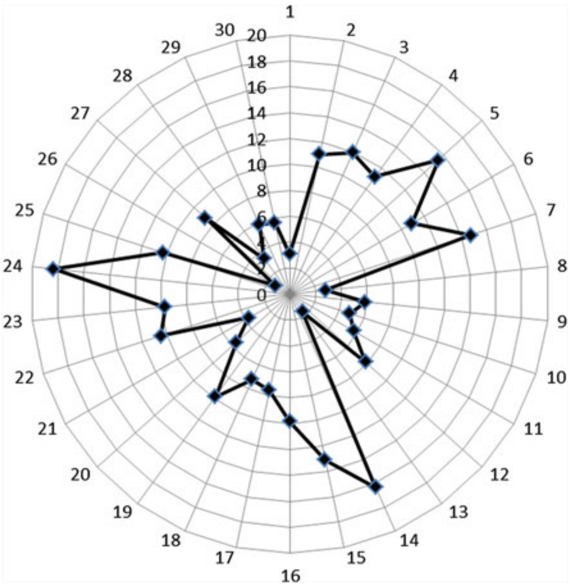


Fig. 20.13 Fluctuation of logrolling-difference degree in reaching agreement

20.6 Discussion

In the last two decades, negotiation support system (NSS) and e-negotiation system (ENS) have been widely applied in conflict resolution. For example, they can help users to understand and formalise the objectives and preferences (Bronisz et al. 1988; Hämäläinen and Pöyhönen 1996; Jarke and Jelassi 1987; Teich et al. 1995). They can facilitate the parties to communicate, store and access bargaining information (Hämäläinen et al. 2001; Kersten and Noronha 1999; Maes et al. 1999; Schoop and Quix 2001; Weigand et al. 2003; Yuan et al. 2003). The logrolling system also put a great deal of effort in its practical exploration in dispute resolution. Reaching "win–win" settlement is the desired outcome of mediation. A "win–win" settlement can be seen as one that encourages parties to uphold their contracts when one party achieve its profits and the other party would still be better off (White 2009). However parties negotiating face to face often have difficulty in identifying and realising "win–win" settlement (Neale and Bazerman 1991; Pruitt 1981; Sebenius 1992). Logrolling is a solution for achieving integrative trade-off, by which each party concedes on low priority issues in exchange for concessions on issues of higher priority to them (Lax and Sebenius 1986; Neale and Bazerman 1991; Pruitt and Rubin 1986). The model of logrolling in negotiation is closely related to the concept of efficient frontier. In economics, "frontier" is where alternative is worse than what they could achieve (Mas-Colell et al. 1995). Thus in this study, a logrolling strategy is proposed through which parties can improve the joint value by bargaining exchange and get convergence along the efficient frontier. A multi-objective decision making (MODM) model is employed to simulate the efficiency frontier and assist parties to engender "win–win" settlement. The model is test and applied in a two-party, three-issue case reported by Cheung et al. (2004) in a project management environment. It is found that the MODM model is not only a generator of optimal solution, but also specifies a logrolling solution path for negotiators to achieve "win–win" settlement. To operationalise the logrolling strategy, a web-based logrolling system has been developed to assist parties to achieve "win–win" settlement in a user-friendly environment. The logrolling system can help parties to make efficient trade-off, by suggesting (1) when to concede (2) on which issue (3) for which party and (4) how much should be conceded. Finally, a mock mediation experiment was conducted to examine the performance of the logrolling system, where the system is to serve as a Mediator in action. The experiment test provides support for the hypothesis that the logrolling system is having good potential in assisting parties to achieve "win–win" settlement. The mediator can also use the suggestion of the 'computer-simulated mediator' to help negotiators to facilitate the "win–win" settlement in the actual mediation process. Furthermore, the logrolling system can also be used for mediation training. By completion of the training, the trainee will be able to demonstrate: (a) they have acquired knowledge on the theoretical framework of logrolling process in mediation and two critical components, (b) they can analyse and explain logrolling model and logrolling strategy, and (c) they have the ability of putting the theories they learnt into practice on making use of the logrolling system to generate an optimal bargaining range and reach a "win–win" agreement.

There are several limitations in the use of the proposed logrolling system. In this study the logrolling system follows the logrolling assumption that high-priority issues of one party are of low-priority to the other party and vice versa. However bargaining situations can be more complex than this. Secondly, the proposed system did not consider the difference in users' risk preference, since the utility value of the MODM model largely depends on the people's risk preference which involving risk aversion (loss aversion), risk seeking, risk neutral, or combination of the above. Incorporating with risk attitude can strengthen and improve the performance of logrolling system in assisting parties to achieve "win–win" settlement. Furthermore the system in this chapter is in one-group and two-party mode. The number of parties in one group depends on the case situation, however in this mode, the experiment has to be done pair by pair, which definitely increased the time cost. As the future work, the system can be extended in n-group and n-party mode that groups of subjects can use the system simultaneously. To solve it, the database access technology which is based on table retrieval in MySQL connection currently, should be replaced by "view" technique, which is a virtual relation of data tables to improve the efficiency of data operations. For supporting more users mediating online by logrolling system at the same time and reduce data processing, internet information services (IIS) could be enhanced by technical optimisation, for example, larger data cache size and more resources allocation. Besides, this platform can also be extended and immigrated as a web service, which is a software system designed to support interoperable machine-to-machine interaction over a network. In this way, the users can use smart devices, such as mobile phone, other than just personal computer to use the logrolling system promptly and conveniently.

20.7 Chapter Summary

Reaching "win–win" settlement is the desired outcome of mediation. A "win–win" settlement can be seen as one that encourages parties to uphold their contracts when one party achieve its profits and the other party would still be better off. However this cannot be easily achieved. Logrolling is a strategy for achieving "win–win" trade-off, by which each party concedes on low priority issues in exchange for concessions on issues of higher priority to them. In this study, the logrolling strategy in mediation is proposed through which parties can improve the joint value by bargaining exchange and get convergence along the efficient frontier. A multi-objective decision making (MODM) model is employed to propose the efficient frontier and assist parties to engender "win–win" settlement. To operationalise the logrolling strategy, a web-based logrolling system is developed to assist parties to achieve "win–win" settlement in a user-friendly environment. The logrolling system can help parties to make efficient trade-off, by suggesting (1) when to concede (2) on which issue (3) for which party and (4) how much should be conceded. Finally a mock mediation experiment was conducted to examine whether the logrolling system can assist parties to achieve "win–win" settlement, where the system simulates a *Mediator* in action. The results are evaluated by comparing the difference between the mediator's expected logrolling outcomes and the subjects' actual logrolling outcomes. The logrolling-difference degree (L-DD) is used to measure this difference. It is found that the average of L-DD in bargaining range and reaching agreement are 11.43 % and 8.46 % respectively, which indicates that the logrolling system is having good potential in assisting parties to achieve "win–win" settlement.

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