Chapter 12
Online Construction Dispute Negotiation

Sai On Cheung and Tak Wing Yiu

Abstract Disputes are common in construction projects and negotiating disputes is part of the daily routine of construction professionals. The advance in Information Technology (IT) has made tremendous impact on the way businesses operate. Making use of IT technology, a computerised construction dispute negotiation programme namely CoNegO (Construction Negotiation Online) is proposed. CoNegO utilises the Smartsettle™ software technology. With the built-in facilities of Smartsettle™, it is possible to conduct negotiation online, hence removing geographical barriers between negotiators. Smartsettle™ is developed on the concept of 'Even Swaps' in which negotiators are required to evaluate possible options available on the basis of their relative importance. As construction disputes are characterised by multiple factors and dimensions, the problem fits nicely with the 'trade-off' methodology that underpins Even Swaps. The use of CoNegO is illustrated by a simulated negotiation.

12.1 Introduction

The application of Information Technology (IT) has attracted world-wide attention. In construction, ample research has been conducted to investigate the applications of IT (Aouad and Price 1994; Aouad et al. 1996; Betts et al. 1991; CICA 1990; O'Brien and Al-Soufi 1994; Samuelson 1998; Shash and Al-Amir 1997).

S. O. Cheung (✉)
Construction Dispute Resolution Research Unit, Department of Civil and Architectural Engineering, City University of Hong Kong, Hong Kong, People's Republic of China
e-mail: saion.cheung@cityu.edu.hk

T. W. Yiu
Department of Civil and Environmental Engineering, Faculty of Engineering, The University of Auckland, Auckland, New Zealand
e-mail: k.yiu@auckland.ac.nz

S. O. Cheung (ed.), *Construction Dispute Research*,
DOI: 10.1007/978-3-319-04429-3_12,

Advancement in IT enables construction activities to be programmed and executed in a speedy and cost-effective manner. It is no longer regarded as an enhancement to traditional business, but an innovative agent. Ahmad et al. (1995) suggested that IT makes previously impossible things possible for the enterprises in the industry. The rapid development of software products has made the most impact. For example, 3-Dimensional Computer-Aided Drafting Tools such as AutoCAD and Integra, are indispensable planning and design tools for architects, engineers and contractors (Reinschmidt et al. 1991). In addition, Project Information Management System (PIMS) is now widely used to handle tasks such as construction programming, information storage and retrieval (Lloyd et al. 2001). Access to project information through the Internet is also well-documented (Huang et al. 1999; Lam and Chang 2001). As for the use of information technology in construction dispute resolution, reported studies include the use of: computer simulation for claim assessment during a mediation process (AbouRizk and Dozzi 1993); computer-supported conflict mitigation system (Pena-Mora et. al. 1993), computer agents to facilitate negotiation (Pena-Mora and Wang 1998), and projects for improving communication to help engineers to carry out negotiation tasks (Cutkosky and Tennenbaum 1996; Divita et. al. 1998; Fruchter 1996; Rezgui et. al. 1998; Roddis 1998; Schmitt 1998). Nonetheless, the use of online systems to facilitate construction dispute resolution remains few. In practice, dealing with construction disputes is in fact an important part of project managers' daily routine. Hence, with the effective and cost-saving dispute resolution process, they could easily settle the disputes without the intervention of third parties. This is also the reason why negotiation is always the preferred option other than mediation, arbitration and litigation among the various dispute resolution procedures, In fact, negotiation is the most commonly used dispute resolution procedure (Fisher and Ury 1986; Merna and Bower 1997). Due to the important role that negotiation plays in construction management, the use of on-line facilities to assist in negotiation is not only of academic interest but also invaluable to improving communication at the project operation level.

12.2 Current Development

Computer-based negotiation support system (NSS) and other group decision-support system (GDSS) products have been developed to deal with negotiations and decision making in response to the needs of industry. These systems are often used in group decision-making, which take place in an electronic meeting room environment, such as PLEXZSYS (Nunamaker et al. 1987). Bui and Shahun (1997) introduced the utility of a conflict resolution framework 'Evolutionary Systems Design' (EDS) by utilising a Negotiation Support System. Kersten and Noronha (1999) developed a negotiation support system known as InterNeg Project, assisting users to analyse decisions. This study discusses an on-line construction negotiation system, named 'CoNego' hereafter. The concept of CoNegO

(Construction Negotiation Online) is first introduced, followed by examining the SmartSettle™ system (platform for CoNegO) and its associated online facilities. The development of CoNegO is then presented.

12.3 Underpinning Concepts

The aim of negotiation is to settle a dispute. In the negotiation process, proactive communication, exchange of ideas and prioritisation of issues are essential. Incidentally, the computing abilities of speedy communication, data accessibility and a common system make it ideal for the development of CoNegO (Ahmad et al. 1995). Figure 12.1 presents the conceptual framework for the development of CoNegO.

In CoNegO, the communication component is the internet. The data accessibility component manages the sharing of information by the negotiators. In negotiation, fact or evidence is often called upon to justify an argument. Hence, a well-organised set of project data is not only useful but essential. The common system component is concerned with tools that can be used to aid decision-making and help to reach a settlement in a more systematic manner. Commonly used tools are Knowledge-based Expert Systems and the Case-based Reasoning Approach (Li 1996).

To be a useful tool, CoNegO needs to provide a set of standard and rational principles to guide negotiators. This is vital as it is common that negotiation principles are often neglected during the negotiation process. SmartSettle™ Program is negotiation software, which takes advantage of the power of the network to bring disputants to negotiate despite in different locations. It can take any tentative agreement and suggest alternative approaches that the parties can consider. It also makes use of a trade-off technique called Even Swaps (Cheung et al. 2002; Hammond et al. 1998, 1999) that provides a practical way of making trade-offs among a given set of objectives across a range of alternatives. The built-in online facility of SmartSettle™ is also central to the CoNegO (ICAN 2000).

12.4 CoNegO

The advancement of IT has further removed geographical barriers to communication. SmartSettle™, via internet, enables online negotiation. SmartSettle™ is the central component of CoNegO. It is a software with an interactive online facility for the negotiating parties. During negotiation, SmartSettle™ elicits the case description, preference information and proposals from all parties. The primary objective of SmartSettle™ is to help parties reach a settlement.

The contents of negotiation can easily be stored in the computer database for further retrieval and record. In an e-negotiation environment, two disputing parties

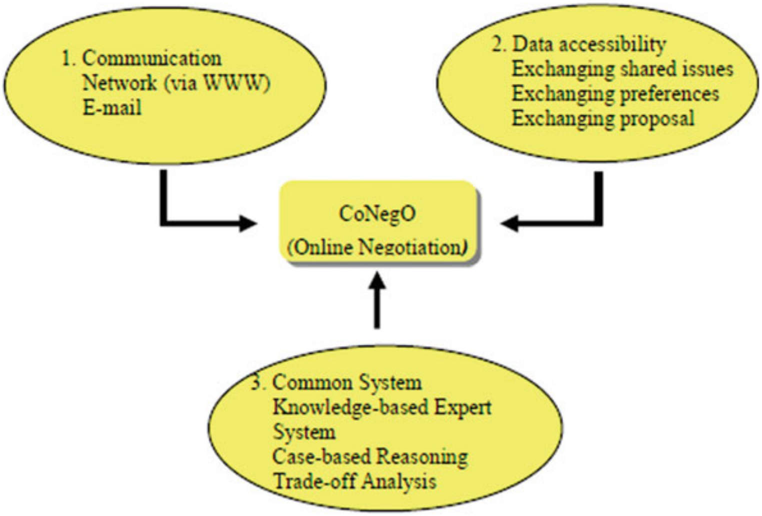


Fig. 12.1 Development framework of CoNegO

are communicating with each other by using a neutral server. Figure 12.2 shows the mechanism of online facilities of SmartSettle™. The server assists in the negotiation process by providing instantaneous responses from either party on accepting or exchanging proposals so that each party can acquire the updated information as the negotiation progresses. Furthermore, the server stores details of the case so that the users can extract information from the server instantaneously or through a subsequent continuation if the negotiation stopped midway or could not be concluded in one setting.

12.5 Illustration

To illustrate the use of CoNegO, a hypothetical case is utilised. The hypothetical case was concerned with a negotiation between contractor and client regarding the settlement of a dispute involving Extension of Time, Loss/Expenses and Cost of Acceleration. Extension of Time (EOT) refers to the additional time granted to the Main Contractor under the stipulated ground of the contract. Loss/Expenses (L/E) refers to the amount reimbursed to the Contractor due to the causes for which the employer is responsible. Cost of Acceleration refers to the additional cost reimbursable to the Contractor for catching up with qualifying delay. In this respect, one of the experts was selected from a consultant firm and the other was from a contractor firm. They were invited to participate and negotiate on the hypothetical case using CoNegO. Both experts have over 10 years of experience in dealing with construction claims and negotiations, and are referred to as ‘negotiators’ hereafter.

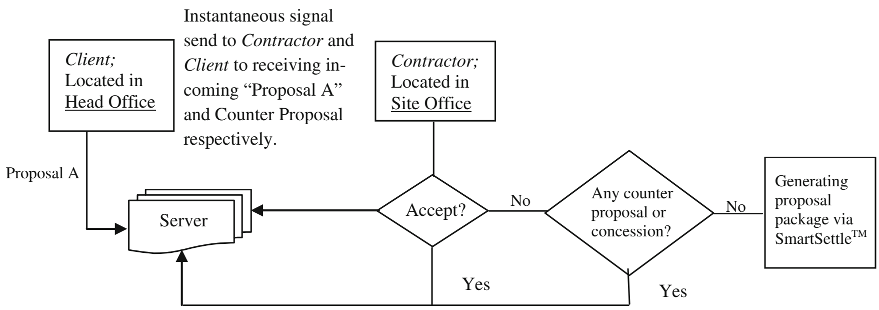
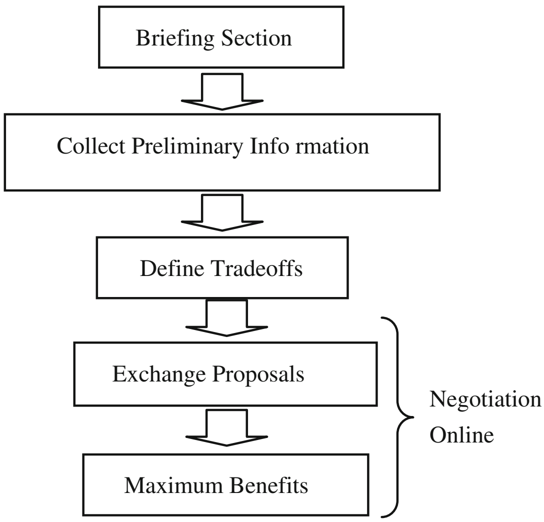


Fig. 12.2 Mechanism of online SmartSettle^{TM} facilities

Fig. 12.3 Arrangements of the simulation



The simulation process was arranged as shown in Fig. 12.3. Negotiators were briefed with the working of CoNegO before actual simulation.

During the simulation, both negotiators were physically separated. Briefing was first given to the negotiators to introduce the SmartSettle^{TM} program and explain the procedures involved in the simulated environment. These included a brief description of the hypothetical case and a fill-in Data In-take form. The Data In-take form collected preliminary information on the negotiators such as the case information, individual preferences and bargaining ranges of each issue.

The two negotiators first studied the hypothetical construction claim case. Having understood the circumstances of the case, the negotiators then formulated the bargaining ranges for each of the three issues to be negotiated. A bargaining range is a set of possible decision values for a particular issue (ICAN 2000). These ranges were then recorded in the Data In-take Form (D.I.F.). The form was designed to record their bargaining ranges in numeral values. Table 12.1 shows the

Table 12.1 Acceptable ranges of the negotiator

	Pessimistic value	Optimistic value
(a) *Client*		
E.O.T. (Unit: day)	40	30
L/E (Unit: $/day)	6,500	3,200
Acceleration cost pay to contractor (Unit: $/day)	13,000	7,000
(b) *Contractor*		
E.O.T. (Unit: day)	35	55
L/E (Unit: $/day)	6,000	7,000
Acceleration cost pay to contractor (Unit: $/day)	10,000	20,000

Table 12.2 Bargaining ranges with relative importance weights

Issue abbreviation	RI	Bargaining range	
		Worst	Best
(a) *Client side*			
1. EOT	30	40	30
2. L/E	40	6,500	3,200
3. AccCost	30	13,000	7,000
Total	100		
(b) *Contractor side*			
1. EOT	60	35	55
2. L/E	30	6,000	7,000
3. AccCost	10	10,000	20,000
Total	100		

Client and Contractor acceptable bargaining ranges. The pessimistic value represents the baseline of the negotiator for a particular issue which implies that no further concession will be offered beyond this value. While the optimistic value represents the value with the highest satisfaction for the negotiator.

Having familiarised themselves with the case and established the acceptable range for each issue, the negotiators were then required to assess the relative importance of the issues. The relative importance is an indication of how important one issue is relative the other. Basing on the information from Tables 12.1 and 12.2 shows the D.I.F. with relative importance weights included.

The next task was to define Tradeoffs by using the Even Swaps Method. As shown in Table 12.3, Swap 1, Swap 2 and Swap 3 were performed by the negotiators. The term 'Ref.' stands for reference alternative package. It is the value which the negotiators consider to be a possible final outcome. In going from the reference alternative package to Swap 1, the client side reasoned that a one day increase in EOT would sufficiently counter 100 decrease of L/E from 4000 to 3900. Hence, three equivalent alternatives are generated in this way.

Finally, negotiators were asked to provide satisfaction ratings for the range of acceptable values. By default, the satisfaction graphs are linear for all issues. In order to fine-tune the satisfaction value of each party, SmartSettle™ allows

Table 12.3 Even swaps exercise

Issue abbr.	Ref.	Swap 1		Swap 2		Swap 3	
(a) *Client side*							
EOT	32	+1	31		32	−1	31
L/E	4,000	−100	3,900	−200	3,800		4,000
AccCost	9,500		9,500	−1,000	8,500	−500	9,000
(b) *Contractor side*							
EOT	50	+1	51		50	+1	51
L/E	6,800	+100	6,900	+200	7,000		6,800
AccCost	18,000		18,000	+1,500	19,500	+750	18,750

Table 12.4 Assessment of satisfaction rating

Issue abbreviation	Least preferred value	25 % satisfaction scale	50 % satisfaction scale	75 % satisfaction scale	Most preferred value
(a) *Client side*					
EOT	40	39	38	36	35
L/E	6,500	6,000	5,500	4,000	3,200
AccCost	13,000	12,000	11,000	9,000	7,000
(b) *Contractor side*					
EOT	35	37	39	45	55
L/E	6,000	6,100	6,400	6,600	7,000
AccCost	10,000	13,000	15,000	17,500	20,000

negotiators to plot satisfaction graphs. In this simulation, the data for these graphs are set in stages of a 25 % satisfaction scale. Table 12.4 summarises the results.

12.6 Negotiation online

Based on the data from the D.I.F., the rating and satisfaction graphs of each issue are generated. The satisfaction graph of the Client is shown in Fig. 12.4. The satisfaction graphs are linear by default. The negotiators can adjust these graphs in accordance with their bargaining range and issue values. The results of such mathematical function can accurately predict the level of satisfaction for each value of the related issue.

12.7 Processing Even Swaps Method in SmartSettle™

The Relative Importance (R.I.) weightings shown in Table 12.2 are the values subjectively assessed by the negotiating parties. These values may not accurately predict the relative importance of each issue. Based on the satisfaction scale and

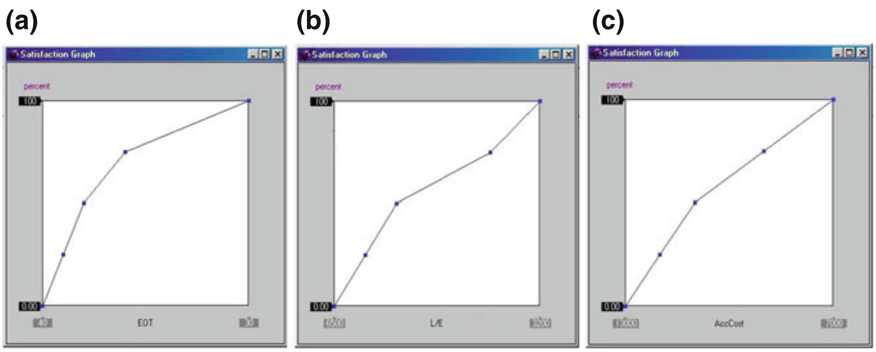


Fig. 12.4 Satisfaction graph from client side **a** E.O.T.; **b** Loss and expense; **c** Cost of acceleration

Client

Issues

Abbrev	Left Bound	Right Bound	Conf	Desired Importance	Current Importance	Previous Importance
EOT	40.0	30.0	1		60	30
L/E	6500.0	3200.0	1		27	40
AccCost	13000.0	7000.0	1		13	30

(a)

Packages

Group	Name	Include	Conf	Desired Rating	Current Rating	Previous Rating
Private	Best	N	50		100	100
Private	Worst	N	50		0	0
Tradeoff	Reference	Y	50		84	78
Tradeoff	Swap 1	Y	50		88	81
Tradeoff	Swap 2	Y	50		88	84
Tradeoff	Swap 3	Y	50		88	81

(b)

Contractor

Issues

Abbrev	Left Bound	Right Bound	Conf	Desired Importance	Current Importance	Previous Importance
EOT	35.0	55.0	1		80	60
L/E	6000.0	7000.0	1		11	30
AccCost	10000.0	20000.0	1		8.9	10

(a)

Packages

Group	Name	Include	Conf	Desired Rating	Current Rating	Previous Rating
Private	Best	N	50		100	100
Private	Worst	N	50		0	0
Tradeoff	Reference	Y	50		87	87
Tradeoff	Swap 1	Y	50		90	90
Tradeoff	Swap 2	Y	50		90	92
Tradeoff	Swap 3	Y	50		90	89

(b)

Fig. 12.5 Rating comparisons after Even Swaps (Client and contractor) **a** Issues; **b** Packages

the Even Swaps Method, R.I. can be defined in a rational way. By analysing the data in Table 12.3, Even Swaps Method can successfully be applied in such a way to make the three packages (e.g. Swap 1, Swap 2 and Swap 3) equivalent to the Reference and to each other in terms of satisfaction. The changes in rating and relative importance are tabulated in SmartSettle^{TM} and the screenshot of such tables are shown in Fig. 12.5. By comparing the current and previous R.I., it is found that both parties regard E.O.T. as the most important issues in this simulation.

In terms of the Algorithms adopted in SmartSettle^{TM} for analysing the preference of each party, alternatives which equivalent to the reference, are required to enable SmartSettle^{TM} to determine more precisely the total satisfaction levels by comparing the alternatives. In this hypothetical case, for example, on the Client side, the rating of the alternative (E.O.T. = 31 days, L/E = 3,900 and AccCost = 9,500) is equivalent to (E.O.T. = 32 days, L/E = 3,800 and AccCost = 8,500). The total satisfaction TS_j for each party j associated with equivalent alternative k will be equal to the sum over all decisions i of the weighted relative additional satisfaction functions $R_{ij}(V_{ijk})$ selected by that party. Thus, for each of the party j, such as the Client side (Cl) in this hypothetical case, the total satisfaction associated with the first alternative (k = 1) is:

$$TS_{Cl} = w_{1(Cl)} \times R_{1(Cl)}\left(E.O.T._{(Cl)1}\right) + w_{2(Cl)} \times R_{2(Cl)}\left(L/E_{(Cl)1}\right) + w_{3(Cl)} \times R_{3(Cl)}\left(AccCost_{(Cl)1}\right) + C_{Cl} \quad (12.1)$$

where C is an unknown scale adjustment constant. Thus, for the other alternatives (say k = 2 and 3), the satisfaction equations are:

$$TS_{Cl} = w_{1(Cl)} \times R_{2(Cl)}\left(E.O.T._{(Cl)2}\right) + w_{2(Cl)} \times R_{2(Cl)}\left(L/E_{(Cl)2}\right) + w_{3(Cl)} \times R_{3(Cl)}\left(AccCost_{(Cl)2}\right) + C_{Cl} \quad (12.2)$$

and

$$TS_{Cl} = w_{1(Cl)} \times R_{1(Cl)}\left(E.O.T._{(Cl)3}\right) + w_{2(Cl)} \times R_{2(Cl)}\left(L/E_{(Cl)3}\right) + w_{3(Cl)} \times R_{3(Cl)}\left(AccCost_{(Cl)3}\right) + C_{Cl} \quad (12.3)$$

In these three equations, for each party j, the weights w_{ij} are still unknown, as is the total additional satisfaction TS_j. We can also introduce two other equations defining the zero and 100 % levels of total satisfaction as:

$$0 = w_{1j} \times R_{1j}\left(E.O.T._{jn}\right) + w_{2j} \times R_{2j}\left(L/E_{jn}\right) + w_{3j} \times R_{3j}\left(AccCost_{jn}\right) + C_j \quad (12.4)$$

where the $E.O.T._{jn}$, L/E_{jn} and $AccCost_{jn}$ are the least preferred values in the identified bargaining ranges and

$$100 = w_{1j} \times R_{1j}\left(E.O.T._{jm}\right) + w_{2j} \times R_{2j}\left(L/E_{jm}\right) + w_{3j} \times R_{3j}\left(AccCost_{jm}\right) + C_j \quad (12.5)$$

where the $E.O.T._{jm}$, L/E_{jm} and $AccCost_{jm}$ are the most preferred values in the identified bargaining ranges. With the above equations, the unknown value can be solved. The calculation of total satisfaction functions can also be performed for the expanding decision variables.

After the preferences and relative importance were clearly defined, the two negotiators are ready to negotiate on-line. In this hypothetical case, a total of six

Fig. 12.6 First proposal

proposals were exchanged between the Contractor and Client negotiators. The screenshots of the initial proposal of both sides are shown in Fig. 12.6.

The ‘flags’ in Fig. 12.6 show the value of each issue. The given rating beside each proposal reflects the users’ satisfaction in respect of that issue. The distance between the flags becomes closer every time the parties make a concession. When the flag on a particular issue is overlapped, agreement on that issue becomes possible.

In the first proposal, the satisfaction rating of the first proposal on the Client side and Contractor side is 96 and 94 respectively. On the other hand, the rating of the Contractor’s proposal (assessed by the Client’s satisfaction curve) is −242. The rating of Client’s proposal, (assessed by the Contractor’s satisfaction curve) is −119. Thus, in the first proposal, both parties cannot reach an agreement and further proposals are needed in this simulation.

On the second proposal, concession was offered by the parties. The Client’s view is shown in Fig. 12.7. The ratings of the second proposal are reduced. The distant between the flags are now shortened as compared with the first proposal.

Further progress was made in the third proposal (Fig. 12.7 refers). In particular, agreement is reached for the acceleration cost issue due to the great concession on the Contractor side. Figure 12.8 shows that the flags on the AccCost issue are overlapped. No further negotiation on this issue was required. When comparing the two outstanding issues, E.O.T. appeared to be a barrier to reaching an agreement. With the concession on the Client side in the fourth proposal, a further

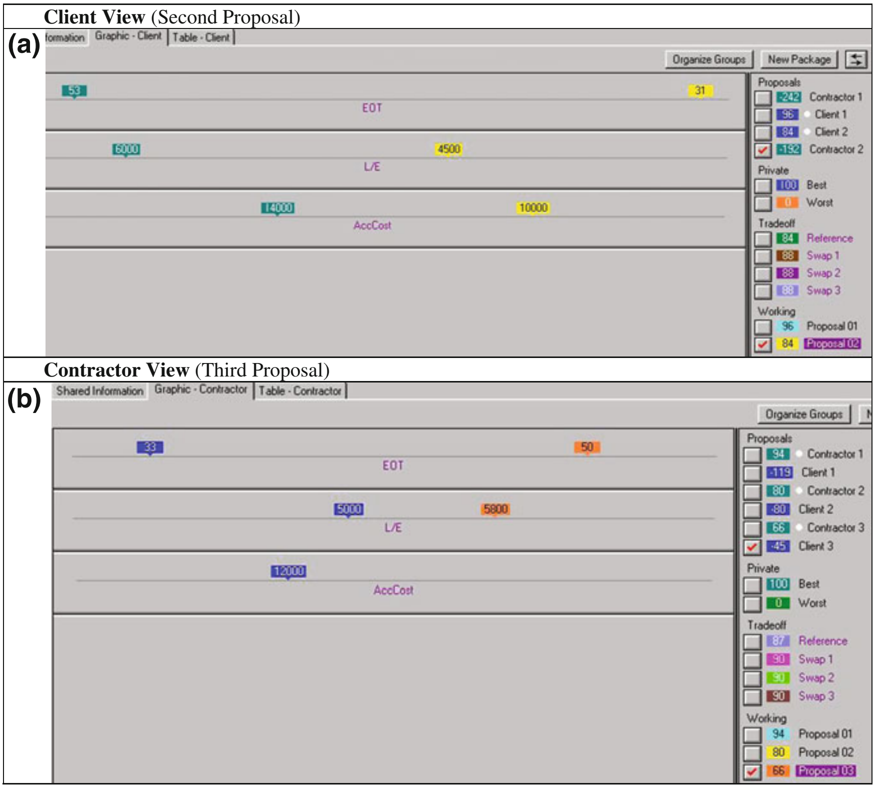


Fig. 12.7 Second and third proposal

step was made to reach an agreement on L/E (Fig. 12.8 refers). However, the difference with regard to E.O.T. remains large. Both parties must consider further concession in order to reach the agreement.

In the fifth proposal (Fig. 12.9 refers), both parties decided to offer a larger concession on this outstanding issue. However, such concession was not adequate to reach mutual agreement and a further exchange was made (sixth proposal, Fig. 12.10 refers). The simulation came to the end with mutual agreement regarding to the three issues of this dispute.

12.8 Maximise Benefits

After tentative agreement was reached, the negotiators can achieve further ‘Improvement’. The “Improvement” function of SmartSettle^{TM} enables the search for an optimal package on the efficiency frontier that distributes benefits to all the negotiating parties according to their level of influence (ICAN 2000). The concept

Fig. 12.8 Fourth proposal (Client's view)

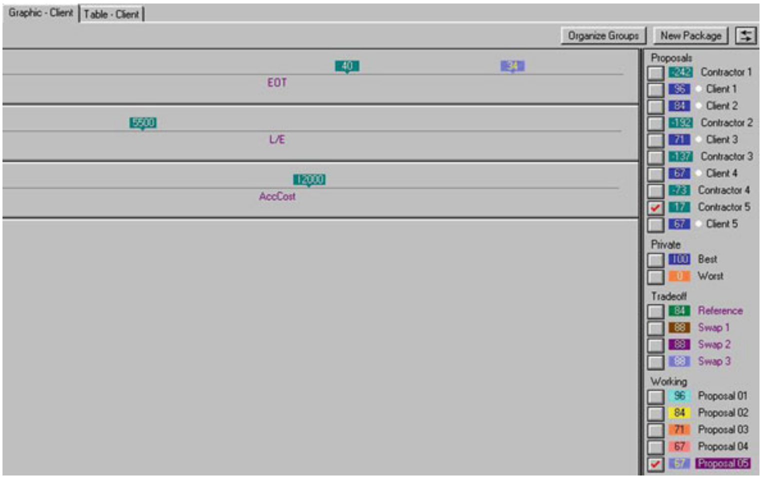


Fig. 12.9 Fifth proposal (Client's view)

of efficiency frontier can easily illustrate the benefit of CoNegO (Fig. 12.11 refers). Referring to the hypothetical case, the efficiency frontier represents the best possible outcomes for both parties. Based on the tentative agreement, SmartSettle^{TM} attempts to divide benefits fairly to each party by generating an Improvement package that moving towards the efficiency frontier. The rating of such a package is certainly higher than the tentative solution made by both parties, who can consider the suggestion as the new settlement agreement.

The improved package generated has a higher satisfaction rating than the tentative agreement. It is found that the rating of the improved package is 68, which is higher than that of the tentative agreement (with satisfaction rating of 62).

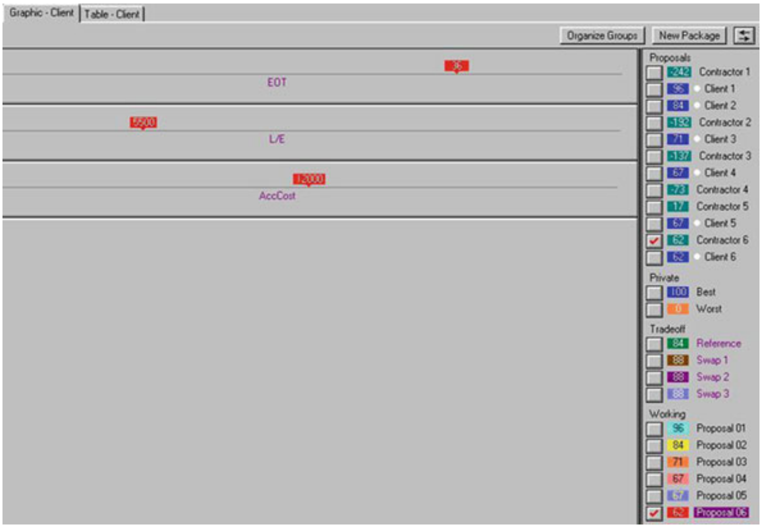
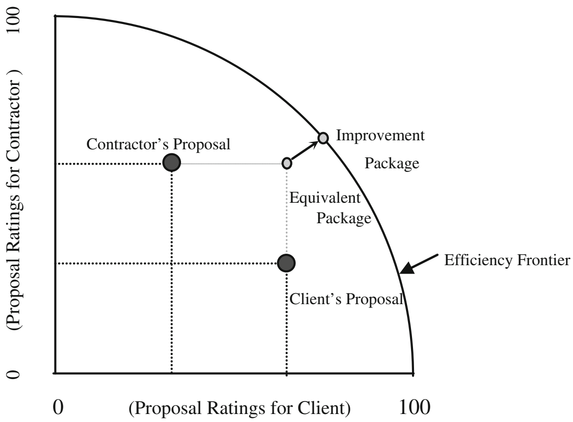


Fig. 12.10 Sixth proposal (Client's view)

Fig. 12.11 Efficiency frontier in CoNegO



This is shown in Fig. 12.12. After several proposal submissions, negotiation and the generation of improvement, both parties have no hesitation in accepting the 'Improvement' package as the mutual agreement in this Simulation. Figure 12.13 summarises the proposals made by the negotiating parties.

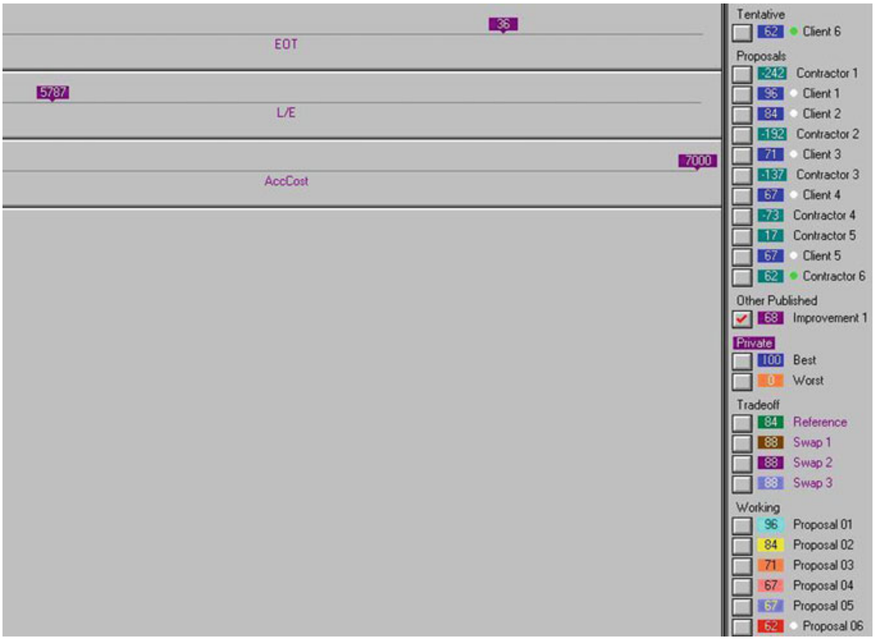


Fig. 12.12 Improvement of the client view

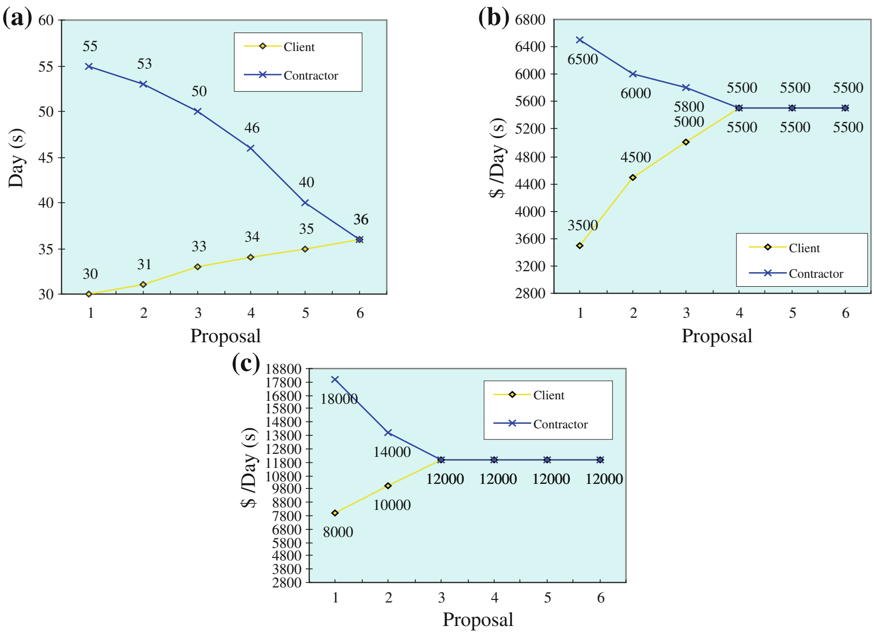


Fig. 12.13 Proposal trends **a** E.O.T.; **b** Loss and expenses; **c** Cost of acceleration

12.9 Discussion

The hypothetical case illustrates the working of CoNego, the main advantages of which include:

12.9.1 Enhanced Efficiency of Negotiation Preparation

CoNegO formalises the process involved in typical construction negotiation. The Internet connection of CoNegO enables the negotiation take place at a distance. Negotiators can exchange their offers, counteroffers data through a secure neutral server. Thus, the time for document presentation, negotiation meetings can be reduced. Furthermore, the use of the Data In-take Form improves the negotiation preparation stage which enables negotiators to list, define and eventually evaluate their alternatives on disputing issues.

12.9.2 Computing Facilitates of CoNegO

CoNegO, utilising the computing capacity and the communication strength of the Internet, provides a user-friendly and interactive environment. Through constructing the Satisfaction Graphs, negotiators can better understand their satisfactions on each issue and define trade-offs with a set of unique equivalent alternatives using the Even Swaps Method. CoNegO, by making use of the computing power to conduct trade-off, can devise satisfaction and suggest improvement. These tools can reduce negotiating time and cost.

12.9.3 Flexible Management and Involvement

In the preliminary stage of negotiation, it is normally started at the site level between the Contractor and the Client's agent. With CoNegO, senior staff can observe or even supervise the negotiation through access to the neutral server. This can lead the senior members to understand the development of the negotiation thus avoiding failure due to discontinuity of negotiators involved.

12.10 Chapter Summary

CoNegO is an Internet-based computerised construction negotiation support system. It is developed based on the SmartSettle^{TM} program that embraces the Even Swaps method for trade-off analysis. Construction negotiation typically involves multiple issues, systematic prioritising and making trade-offs assist the formulation of a settlement package. CoNegO is an invaluable tool to complement the often subjective approach to negotiation. It is aimed primarily to provide a structured approach in construction negotiation. With the help of experts in the field, use of CoNegO was simulated with a hypothetical case.

Acknowledgments The content of this chapter has been published in Volume 130(6) of the Journal of Construction Engineering and Management and is used with the permission from ASCE.

References

AbouRizk, S. M., & Dozzi, S. P. (1993). Application of computer simulation in resolving construction disputes. *Journal of Construction Engineering and Management, 119*(2), 355–373.

Ahmad, I., Russell, J., & Abou-zeid, A. (1995). Information technology (IT) and integration in the construction industry. *Construction Management and Economic, 13*, 163–171.

Aouad, G., Alshawi, M., & Bee, S. (1996). Priority topics for construction information technology. *International Journal of Construction Information Technology, 4*(2), 45–66.

Aouad, G., & Price, A. (1994). Construction planning and information technology in the UK and US construction industries: A comparative study. *Construction Management and Economics, 12*, 97–106.

Betts, M., Cher, L., Mathur, K., & Ofori, G. (1991). Strategies for the construction sector in the information technology era. *Construction Management and Economics, 9*, 509–528.

Bui, T., & Shahun, M. F. (1997). Negotiation processes, evolutionary systems design and negotiator. available from http://www.vacets.org/vtic97/txbui3.htm.

Cheung, S. O., Yiu, T. W. & Suen, H. (2002). Construction negotiation: An even swaps APPROACH. In: *Proceedings of first international conference on construction in the 21st century*, 25–26 April, Miami, Florida, USA.

Construction Industry Computing Association (CICA). (1990). *Building on IT for the 1990s: A survey of the IT trends and needs in the construction industry*. London: Peat Marwick McLintock.

Cutkosky, M. R., & Tennenbaum, J. M. (1996). Collaborative engineering over the internet. *Communications of the ACM, 39*(9), 78–87.

Divita, E. L., Kunz, J. C., & Fischer, M. A. (1998). *Collaborative desktop engineering. AI in structural engineering, lecture notes in AI*. New York: Springer.

Fisher, R., & Ury, W. (1986). *Getting to yes: Negotiating agreement without giving in*. London: Hutchinson Business.

Fruchter, R. (1996). Conceptual, collaborative building design through shared graphics. IEEE Expert, Intelligent System & their Applications, *11*(3), 33–41.

Hammond, J. S., Keeney, R. L. & Raiffa, H. (1998). Even swaps: A rational method for making trade-offs. Harvard Business Review, March-April, 137–148.

Hammond, J. S., Keeney, R. L., & Raiffa, H. (1999). *Smart choices: A practical guide to making better decisions*. Boston: Harvard Business School Press.

Huang, Y. P., Huang, C. Y., Chan, S. S., & Lin, W. C. (1999). The world wide web and the databases for retaining wall design. *Advances in Engineering Software, 30*(9–11), 799–808.

ICAN System Inc. (2000). SmartSettle^{TM} user guide for SmartSettle^{TM} software beta build 789. Abbotsford, BC.

Kersten, G. E., & Noronha, S. J. (1999). WWW-based negotiation support: Design, implementation, and use. *Decision Support Systems, 25*, 135–154.

Lam, H. F. & Chang, T. Y. (2001). Internet-based construction project information management system (I. Construction). In: *Proceedings of international conference on construction*, (Vol. 1, pp. 450–461). Hong Kong.

Li, H. (1996). Case based reasoning for intelligent support of construction negotiation. *Information and Management, 30*, 231–238.

Lloyd, R. H., Boughton, G. S. & Siu, K. C. (2001). A project information management system, providing greater collaboration and improved communications on major construction works. In: *Proceedings of international conference on construction*, (Vol. 1, pp. 462–473). Hong Kong.

Merna, A., & Bower, D. (1997). *Dispute resolution in construction and infrastructure projects*. Hong Kong: Hong Kong Asia Law & Practice Publishing Ltd.

Nunamker, J. F., Applegate, L. M., & Konsynki, B. R. (1987). Facilitating group creativity: Experience with a group decision support system. Journal of Management Information Systems, *3*(4), 5–19 Spring.

O'Brien, M., & Al-Soufi, A. (1994). A survey of data communications in the UK construction industry. *Construction Management and Economics, 12*, 457–465.

Pena-Mora, F., Sriram, D., & Logcher, R. (1993). Design rationale for computer-supported conflict mitigation. *Journal of Computing in Civil Engineering, 9*(1), 57–72.

Pena-Mora, F., & Wang, C. Y. (1998). Computer-supported collaborative negotiation methodology. *Journal of Computing in Civil Engineering, 12*(2), 64–81.

Reinschmidt, K. F., Griffis, F. H., & Bronner, P. (1991). Integration of engineering, design and construction. *ASCE Journal of Construction Engineering and Management, 117*(4), 756–772.

Rezgui, Y., Cooper, G., & Brandon, P. (1998). Information management in a collaborative multifactor environment: The COMMIT approach. *Journal of Computing in Civil Engineering, ASCE, 12*(3), 136–143.

Roddis, W. M. K. (1998). *Knowledge-based assistants in collaborative engineering. AI in structural engineering, lecture notes in AI*, New York: Springer.

Samuelson, O. (1998). A study of the use of IT in the construction industry, The life cycle of construction IT innovations. In: *Proceedings CIB W78 conference*, Stockholm. 3–5 June.

Schmitt, G. (1998). *A new collaborative design environment for engineers and architect, AI in structural engineering, lecture notes in AI*, New York: Springer.

Shash, A. A., & Al-Amir, M. (1997). Information technology in contractors' firms in Saudi Arabia. *Construction Management and Economics, 15*, 187–200.