

# Virtual Construction Negotiation Game – An Interactive Learning Tool for Project Management Negotiation Skill Training

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## Abstract

The ability of construction managers to negotiate effectively influences project performance. Although there is a lot of literature in the area of negotiation skills training, a little attention has been dedicated to the development of an interactive computer-based negotiation game. This paper proposes an innovative tool for negotiation skills training by developing an on-line multiplayer game which allows users in different remote areas to play the game under a highly attractive and entertaining learning environment. The result of our study shows that this on-line negotiation game is an effective and useful tool for training negotiation skills. By repeatedly playing the game, users can develop key negotiation skills particularly in planning the negotiation systematically, identifying Zone of Possible Agreements (ZOPA) and understanding value exchange concepts.

**Key words:** Game, Negotiation, Training

## **Introduction**

Negotiation is an important aspect of construction projects. Negotiation can take place at any stage of a construction project. Hence, the ability of engineer-managers to negotiate effectively is crucial for success or failure of the project. In spite of this importance, proper negotiation-skill training is not well addressed within the construction industry. Negotiations are an important activity but they receive little research or educational attention (Dudziak and Hendrickson, 1988). Engineering managers seem to learn negotiating skills only through experience and observation (Smith, 1992).

The purpose of our research is to develop a new and innovative computer tool for training negotiation skills. Therefore the system called Virtual Construction Negotiation (VCON) was developed. It is an internet multi-user game that allows users to play the game across the Internet so that trainees can freely play a simulated contract negotiation of a construction project with other users under an engaging and dynamic virtual environment.

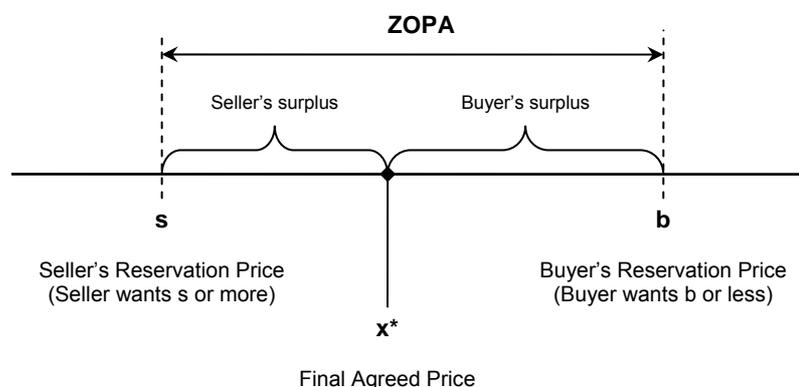
In this paper, fundamental knowledge of negotiation is briefly reviewed. Following that, the VCON system – Virtual Construction Negotiation game – is introduced. Discussion on system design is also included. Finally, the testing of VCON system, conducted with a selected group of construction management students in order to evaluate the operability and playability of the game, is presented.

### **Fundamental Knowledge of Negotiation**

Negotiation is defined as a joint decision-making process of two or more parties working together to reach a mutually acceptable agreement over one or more issues (Cohen, 2002). Negotiation can be classified into two broad categories: distributive negotiation (positional bargaining) that usually results in a win-lose situation and integrative negotiation (interest-based) that results in a win-win situation (Raiffa et al., 2002).

Any negotiation takes place at two levels. First level involves *negotiation of the substantive issues* (e.g. contract price). The next level of negotiation refers to *the procedure for dealing with the substantive issues* (Fisher et al., 1991). This ‘upper’ level dictates how one and the other party play the game of negotiation. For instance, one can negotiate by hard positional bargaining, by cooperative approach, or by some other methods (Fisher et al., 1991).

When dealing with substantive issues, negotiation can be represented as shown in Figure 1. If the highest price the buyer is willing to pay is greater than the lowest price the seller can accept ( $b > s$ ), then the agreement is possible, otherwise no agreement would be possible. The range in the middle between these two reservation prices is referred to as ZOPA (Zone of Possible Agreement). The problem with ZOPA is that both parties usually have an imprecise reservation price and make no formal attempt to assess probabilistic information about the other’s reservation price (Raiffa et al., 2002).



**Figure 1** - Zone of Possible Agreement (adapted from Raiffa et al., 2002)

Fisher et al (1991) argued that BATNA (Best Alternative To a Negotiated Agreement) concept can also be used as an effective way to establish the reservation price. By establishing a realistic reservation price based on BATNA prior to a negotiation, not only can it increase the likelihood of a successful deal, but also improve one’s confidence and bargaining power on the negotiation table. The negotiation process will become more complex if several issues are included in the negotiation because negotiators are now required to establish not just one but several

reservation prices for all issues. In this circumstance, a careful preparation and systematic planning must be carried out prior to the negotiation.

Additive scoring system can be used to plan the negotiation process. The negotiator is urged to prepare a template for the up-coming negotiation similar to Table 1. This template lists all issues to be negotiated, importance of each issue, and potential alternatives. The negotiator can systematically convert negotiating elements of subjective nature into quantitative figures. For instance, since issue no.6 is the most important for John (Table 1), he would rather go from A to E than go from worst to best on any other issue. In addition, using scoring template, the negotiator can determine the minimum acceptable score (i.e. the reservation point).

**Table 1 - Additive Scoring Template (Adapted from Raiffa et al., 2002)**

Issues	Solutions	Value to John	Issues	Solutions	Value to John
1	A	0	4	A	0
	B	10		B	3
	C	15		C	5*
	D	20*	5	A	0
2	A	0		B	7
	B	6		C	12
	C	8		D	15*
	D	10*	6	A	0
3	A	0		B	8
	B	12		C	15
	C	20*		D	21
				E	26
				F	30*

\* The asterisked figures in column 3 and 6 sum to 100.

### **Virtual Construction Negotiation Game (VCON)**

One of the most widely used methods is classroom simulations in which students are assigned to take different roles in pre-defined negotiations (Raiffa et al., 2002). The negotiations are normally simplified so that inexperienced students do not get confused with the subject matter. Prior to the negotiation, they are given common information about the scenario as well as issues to be resolved. Each side is also supplied with confidential information regarding their reservation prices on negotiating elements. After the deal is reached, each student is evaluated according to

a pre-defined scoring system. A notable research regarding simulated negotiations was conducted by Dudziak and Hendrickson (1988). In their work, they developed a paper-based game of simulated contract negotiation between a gas company and a design-and-build construction firm. The concept applied in this research was similar to classroom simulations discussed earlier.

Without a doubt, this kind of paper-based simulated negotiation represents a highly effective tool for training negotiating skills. Nonetheless, such training method is still conducted under a conventional classroom environment in which there are several limitations that should be improved. This research therefore tries to further enhance the effectiveness of aforementioned paper-based negotiation simulation by alleviating current limitations.

Conventional classroom environment is normally perceived as boring and might not have enough motivational power to persuade the trainees to participate actively. This is primarily due to the fact that most students of the younger generations are more familiar with TV shows and digital entertainment such as computer games and the Internet. By converting a simulated negotiation into a digital game and adding key elements of a game such as fun, competition, and win/lose, it can enhance attractiveness and enthusiasm of the trainees towards the training contents through the concept of “learning by playing”. This would result in an innovative training tool that offers greater motivational power than other learning methodologies, especially conventional classroom teaching (Prensky, 2001). If properly designed, game-based training programs would provide a highly engaging environment for learning, while simultaneously delivering the substance that they are intended for (Filipczak, 1997).

Another obvious disadvantage of a conventional classroom setting involves time and place limitations. By contrast, utilizing a digital game by incorporating web technologies can surpass these boundaries and promote greater exposure to cultural diversity.

Given the reasons in the preceding paragraphs, it is highly recommended that the idea of on-line multi-player game should be adopted as a new and innovative tool for training negotiating skills. Hence, VCON – Virtual Construction Negotiation game –

has been designed to incorporate many advantages of on-line multiplayer game (see Table 2 for a summary of key system features) while still maintaining the essence of negotiation. In the following sections, the paper discusses the development of VCON, overview of VCON, how it can be used to improve negotiating skills, as well as system testing to evaluate the effectiveness of VCON as a training tool.

**Table 2 - Key Features of VCON Game**

Features	Description
<i>Realistic Negotiating Scenario</i>	VCON allows players to participate in a simulated contract negotiation of construction projects under a highly engaging and realistic scenario. The contents of negotiation included in the game are based on interviews and information gathered from practitioners in the industry.
<i>Real-time Multiplayer System</i>	VCON fully utilizes web technologies, allowing users to communicate with other players on a real-time basis. The current status of the system, e.g. users currently on-line, is also updated simultaneously.
<i>Systematic and Consistent Scoring System</i>	VCON employs the additive scoring system discussed earlier for assessing players' performance. This enables a highly consistent and reliable performance-measuring technique in which the players can easily track their own improvement.
<i>Adaptive Scenario Based on Level of Difficulty</i>	VCON offers flexibility for users at all levels. The easy scenario is provided for beginners, while a more difficult, constrict scenario (e.g. higher minimum score required, smaller chance of possible agreements) has been designed especially for advanced players.
<i>On-line User Database</i>	VCON stores a succession of user information which can be readily accessed on-line. This includes information such as user profiles, cumulative scores, player history, as well as other interesting stats.
<i>On-line Votes</i>	VCON allows players to express their views on previous negotiations. For example, they can evaluate their previous opponent's negotiating styles. All votes are stored in the on-line user database. This provides valuable information for preparation for negotiation with the next opponent.

### **VCON Development: Requirement Identification**

Development of the VCON game can be classified into four major phases, namely: game requirements identification, system design, software development, and system testing. In this paper, only the identification is discussed.

Information necessary for the development of VCON game was formulated. This phase was done in order to ensure that the contents of contract negotiation included into the game were accurate and practical. Therefore, interviews and questionnaires were conducted to gather necessary information from the construction industry. The main purpose was to identify the important elements usually discussed during contract

negotiation for building projects. Several interviews were organized with experienced practitioners who had been involved in contract negotiations. Results from these interviews were used in developing the questionnaire for assessment of contract negotiation.

To collect data from the industry, a total of 202 questionnaires were randomly distributed to local contractors, consulting firms, as well as property developers in Thailand. In addition to paper-based questionnaire, an on-line questionnaire was developed in order to gather more data from construction firms in other countries. It was found that a total of 39 respondents (19.3%) returned the paper-based questionnaires, while additional 5 respondents participated in the on-line survey. Data collected was classified into two groups: contractors and owners (including consultants). To simplify the analysis, only data from respondents involved in contract negotiations of building projects were considered. In the questionnaire, respondents were asked to rank the importance of each negotiating elements (e.g. contract price, payment terms, etc.) according to their actual preferences of the most recent project. As a result, the rankings of elements according to their importance from owners' and contractors' perspectives were formulated as in Table 3 and 4 respectively.

**Table 3 - Importance Ranking of Negotiating Elements from Owners' Perspective**

Negotiating elements	Rank	N (valid cases)	Mean*	Std. Dev
Construction duration	1	15	7.73	1.03
Contract price	2	15	7.60	1.64
Quality and scope of work	3	15	7.20	1.42
Warranty	4	15	7.20	1.26
Retention	5	15	6.87	1.30
Numbers of management staffs	6	15	6.80	1.37
Payment schedule	7	15	6.67	1.80
Time spent on-site by management staffs	8	14	6.64	1.50
Contract type	9	15	6.60	1.59
Progress report frequency	10	15	6.53	1.64
Performance bonds	11	14	6.50	1.91
Approval of supplier list (ASL)	12	15	6.33	1.54
Progress report format	13	15	6.00	1.85
Liquidated damages	14	15	5.80	1.93
Advance payment	15	15	5.07	1.91
Contractor's right to modify approved supplier list (ASL)	16	14	5.00	2.35
Subcontract works	17	13	4.92	1.71
Payment bonds	18	11	4.91	2.07
Early-completion bonus	19	9	4.56	1.88

**Table 4** - Importance Ranking of Negotiating Elements from Contractors' Perspective

Negotiating elements	Rank	N (valid cases)	Mean*	Std. Dev
Contract price	1	12	7.75	1.29
Construction duration	2	12	7.17	1.53
Quality and scope of work	3	12	6.75	1.66
Payment schedule	4	12	6.75	1.48
Contractor's right to modify approved supplier list (ASL)	5	12	6.00	1.91
Contract Type	6	12	5.92	1.24
Approval of supplier list (ASL)	6	12	5.92	1.24
Liquidated damages	6	12	5.92	1.78
Retention	9	11	5.91	1.58
Numbers of management staffs	10	12	5.75	1.22
Payment bonds	11	11	5.73	1.42
Performance bonds	12	12	5.58	1.31
Early-completion bonus	13	11	5.55	1.63
Warranty	14	12	5.42	2.27
Advance payment	15	11	5.36	2.16
Subcontract works	16	9	5.00	1.87
Progress report frequency	17	11	4.91	1.92
Time spent on-site by management staffs	18	12	4.83	2.25
Progress report format	19	11	4.45	1.81

\* Means were calculated from ratings given by respondents. Rating ranges from 1 (very low importance) to 9 (very high importance), where a rating of 5 indicates moderate importance of negotiating elements.

From the tables, it is obvious that both owners and contractors felt that time, cost, and quality were the three most important elements during the contract negotiation, while contract type and payment schedule were also fairly important. These were crucial issues that both sides are likely to compete over. It was also found that there were some elements important for one side, but were not so important for the other side (e.g. warranty period). Such elements offer an opportunity for trading of value between both sides. In summary, negotiating elements can be classified into four types according to their relative importance (see Table 5).

**Table 5** - Classification of Negotiating Elements

Important to both (both sides compete)	Important to owner (tradable by contractor)	Important to contractor (tradable by owner)
Construction duration	Warranty	Contractor's right to modify approved supplier list (ASL)
Contract price	Numbers of management staff	Liquidated damages
Quality and scope of work	Time spent on-site by management staff	
Payment schedule	Frequency of progress reports	
Retention	Format of progress reports	
Contract type	Performance bonds	
Approval of supplier list (ASL)		

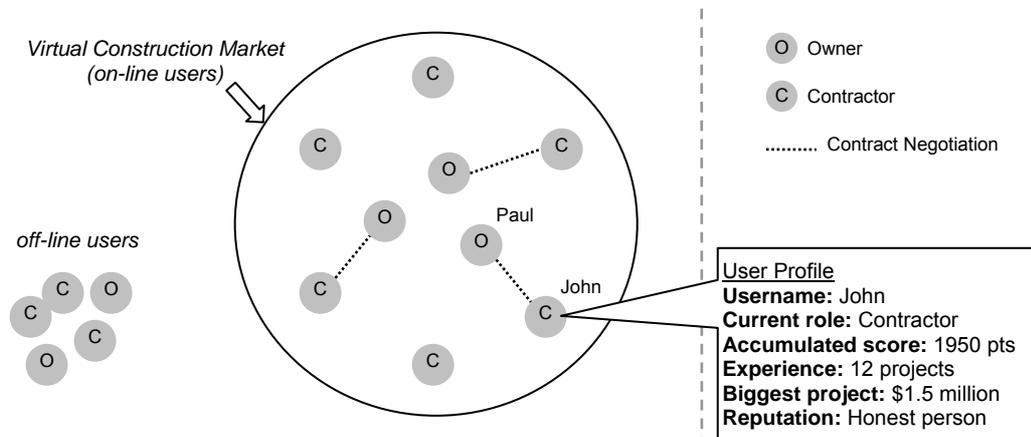
## Overview of the VCON Game

By utilizing web technologies, the game creates a virtual construction market comprising project owners and contractors (see Figure 2). Users can freely choose to play the role of either an owner or a contractor. They are encouraged to continually engage in simulated contract negotiations with other players by following the playing sequence as illustrated in Figure 3. The primary reason for creating a virtual market is to promote the realism of the game so that the users would be more encouraged to actively participate in simulated negotiations. They can try different strategies and learn from the outcome of negotiations. It is possible that a player may employ an aggressive strategy with little regard towards relationship, but later find out that such positional bargaining seriously hampers his or her long-term business relationship with other players. Ultimately, the more realistic and engaging environment in the virtual market would result in a far more effective learning experience.

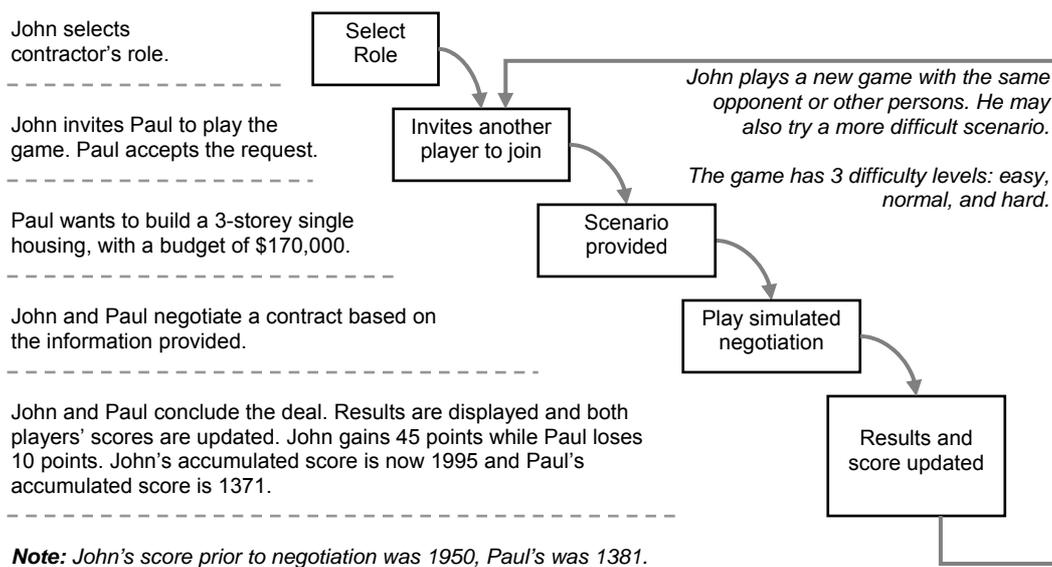
By repeatedly playing these simulated negotiations, VCON users can develop four key skills:

- Ability to plan properly: Before each negotiation, trainees are required to carefully read necessary information given to them in a clear and systematic way (e.g., score sheet). Negotiation will only commence after both sides have notified VCON system that they are ready.
- Ability to identify ZOPA: Negotiation is pre-defined so that ZOPA exists for all negotiating elements. It therefore depends largely on the ability of trainees to find possible solutions within ZOPA that maximize the satisfaction of both sides.
- Ability to apply value exchange and value creation concept: Trainees should be able to improve attractiveness of the deal, where applicable, by trading values between parties.
- Ability to recognize and respond effectively to the other party's tactics: The game keeps records of each trainee's negotiating styles by asking the opponent 'what do you think about his/her negotiation styles' at the end of each game. The data can be used for future games. Users can review such information before they negotiate. Reviewing the other side's style allows

trainees to plan effectively how to respond the negotiating style (tactics) of the other party.



**Figure 2 - Virtual Construction Market Overview**



**Figure 3 - VCON's Game-play Sequence**

### Testing of VCON Game

As a training tool, the VCON system should be able to fulfill its main objective of improving trainees' negotiation skills. Moreover, it is crucial that the trainees must consider this game as both an effective and attractive tool that would help them in

learning negotiation. Testing of VCON system was conducted through a workshop with 28 graduate students in the field of construction management. The workshop consisted of a brief introduction to the concept of negotiation and its importance in the construction industry, an introduction to the VCON game, and a negotiation playing session.

### Case-Based Testing

The hypothetical case study given to students was a contract negotiation of a two-storey residential housing project (see Table 6). All students were asked to form pairs of two persons in which one student played the role of the owner, while the other took the contractor's role. Before the negotiation, both sides were instructed to carefully review all the information given to them. Each player was given: 1) shared information (e.g. project profiles) known to both sides, 2) confidential information known only by each player, and 3) scoring template listing all issues and possible solutions for each issue.

**Table 6** - Summary of Hypothetical Project Used for System Testing

Profile	Description
<b>Project title:</b>	John Doe's Luxury House
<b>Location:</b>	Bangkok, Thailand
<b>Type of work:</b>	Residential housing
<b>Project description:</b>	2-storey single-family house with 4 bedrooms, 3 bathrooms, one living room, and Italian-style kitchen
<b>Project attractiveness:</b>	Attractive (low project risk, good minimum rate of return)
<b>Complexity:</b>	Medium
<b>Quality standard:</b>	High-quality materials and defect-free final product
<b>Time pressure:</b>	Low (normal construction pace, completion may be delayed with minor losses)
<b>Estimated cost/duration:</b>	(There are 5 options available for this project)
<i>Fully-decorated house, garage, and garden</i>	\$156,500 for the duration of 7 months
<i>Fully-decorated house, garage, pool, and garden</i>	\$163,000 for the duration of 8 months
<i>Basic-interior house and garage</i>	\$136,500 for the duration of 6 months
<i>Basic-interior house, garage, pool, and garden</i>	\$148,000 for the duration of 7.5 months
<i>Basic-interior house, garage, and garden</i>	\$141,500 for the duration of 6.5 months
<b>Market price for each work package:</b>	
<i>Garage for three cars</i>	Price range: \$1,590-\$1,650 / estimated time: 0.5 months
<i>Garden</i>	Price range: \$5,300-\$5,500 / estimated time: 0.5 months
<i>Swimming pool</i>	Price range: \$6,890-\$7,150 / estimated time: 1 months
<i>House (basic interior design)</i>	Price range: \$143,100-\$148,500 / estimated time: 5.5 months
<i>House (fully-decorated interior design)</i>	Price range: \$159,000-\$165,000 / estimated time: 6 months

**Table 7 - Players' Data Sheet and Scoring Template**

Type of Information	Contractor	Owner
Negotiation Instruction	- Minimum score required = 39 points - Bonus 1.5 points for every 10 points higher than minimum score - Penalty if deal falls through = -30 points	
Confidential	- Minimum profit margin = 7.5%	- Available budget = \$175,000 - Completion deadline = 8 months
List of negotiating issues and assigned scores	- Price 20 pts - Duration 17 pts - Quality 15 pts - Contract type 10 pts - Payment schedule 15 pts - Warranty period 8 pts - Change to supplier list 11 pts - Engineer's time on site 4 pts <u>Total: 100 pts</u>	- Price 16 pts - Duration 17 pts - Quality 14 pts - Contract type 11 pts - Payment schedule 12 pts - Warranty period 14 pts - Change to supplier list 4 pts - Engineer's time on site 12 pts <u>Total: 100 pts</u>
<b>Score Sheet (Some issues only)</b>		
Duration	- 4 months 0 pts - 5 months 0 pts - 6 months 1 pts - 7 months 9 pts - 7.5 months 13 pts - 8 months 15 pts - 9 months 17 pts	- 4 months 17 pts - 5 months 16 pts - 6 months 14 pts - 7 months 11 pts - 7.5 months 8 pts - 8 months 0 pts - 9 months 0 pts
Contract Type	- Reimbursable 10 pts - Lump-sum 8 pts	- Reimbursable 6 pts - Lump-sum 11 pts
Payment Schedule	- Monthly payment 15 pts - Payment on milestones 7 pts	- Monthly payment 6 pts - Payment on milestones 12 pts
Warranty Period	- None 8 pts - 1 year 4 pts - 2 years 0 pts	- None 0 pts - 1 year 10 pts - 2 years 14 pts

Remark: This data sheet is based on medium-level difficulty. VCON system can adjust the scenario and numerical values to make the negotiation harder or easier according to user's selected difficulty level.

As seen from Table 7, the scoring template was designed in a way that there were issues important to both sides (e.g. price and duration), and also issues of differing interests tradable between players (e.g., warranty and supplier list). Such scenario opens the door for a win-win situation whereby players can mutually reach an agreement that satisfies both sides. Once both sides reviewed all the information provided, they were allowed to play a simulated negotiation. During the negotiation, the VCON system provided a user interface that allowed players to negotiate under a real-time, highly interactive environment (see Figure 4). When the deal was reached, the system automatically calculated the scores and displayed the results on each player's screen (Figure 5). Each player's score depended largely on his or her ability to negotiate effectively. VCON system also provided a joint rating indicating how well both players performed in achieving a win-win agreement.

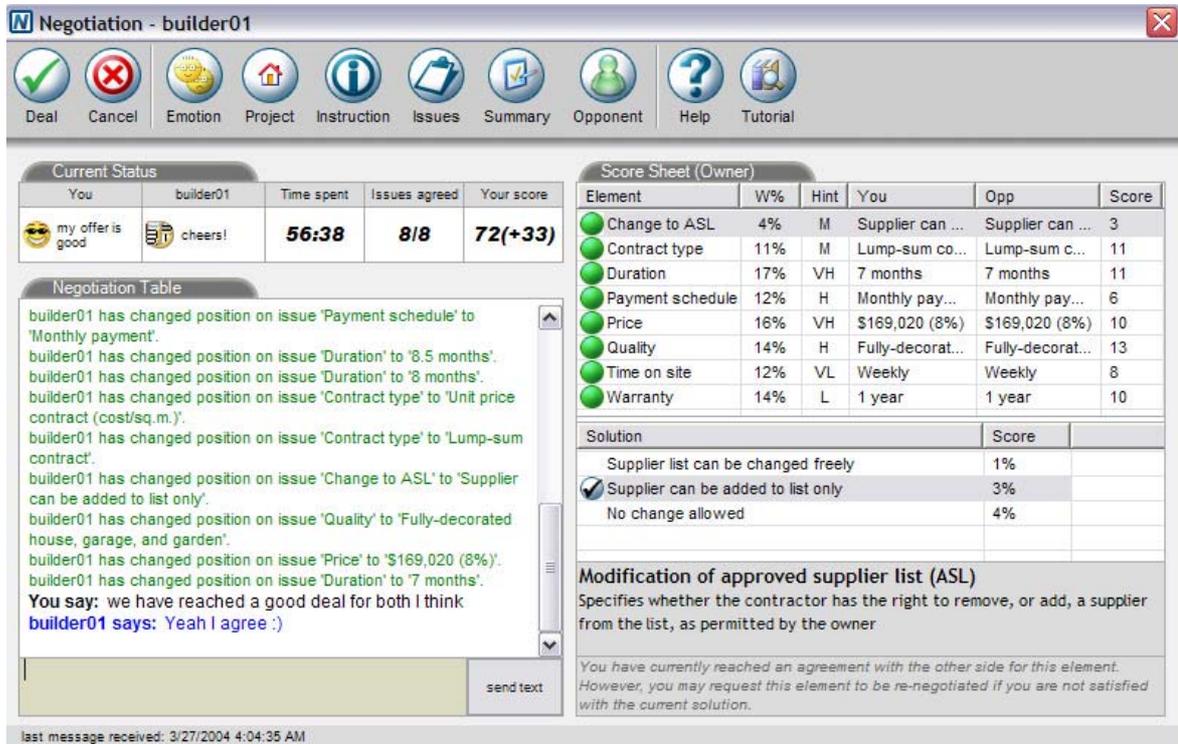


Figure 4 - User Screen during Negotiation

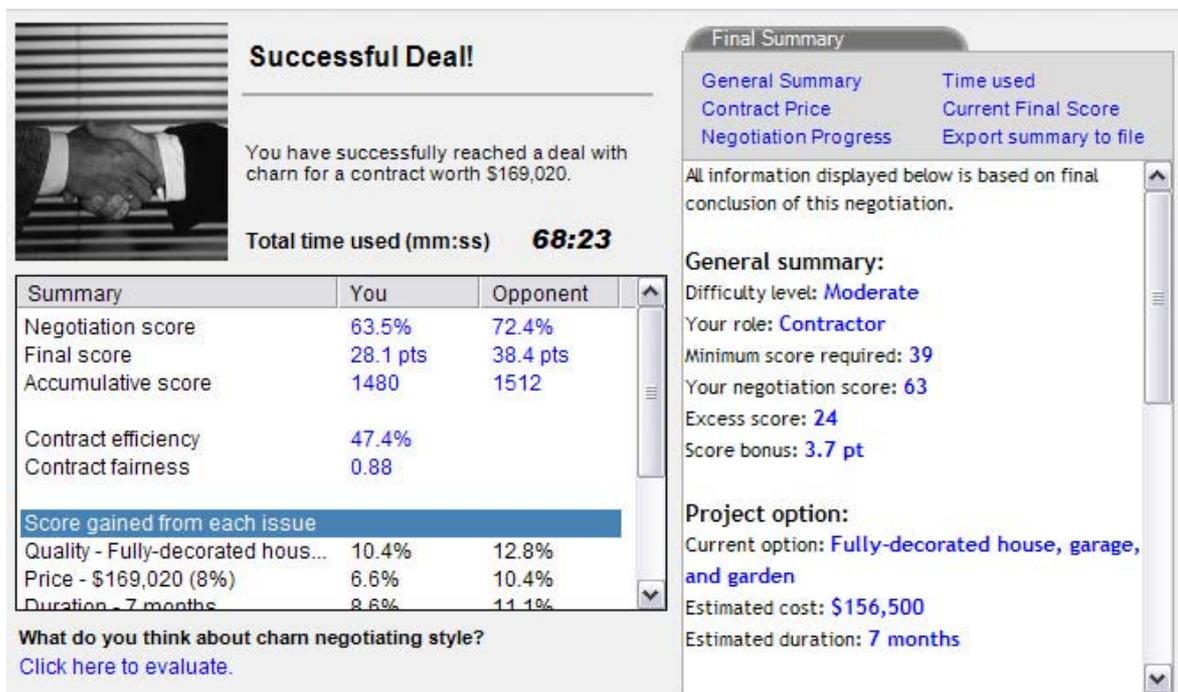


Figure 5 - User Screen Displaying Negotiation Results

## Users' Experience on VCON System

After the workshop, all student participants were requested to complete an evaluation form. The questions generally asked about their opinions and experience towards the game in three major aspects including: 1) the game's effectiveness in enhancing negotiating skills of the trainees, 2) the game's applicability as a negotiation training tool, and 3) the game's functionality (see Table 8).

**Table 8** - Users' Evaluation on Effectiveness, Applicability and Functionality

Validation Statement	Students' Opinion* N = 28 (average score)
<b>EFFECTIVENESS</b>	
My overall understanding of negotiation has improved after playing the game.	1.36
I learnt how to plan for negotiation systematically from playing the game.	1.46
I learnt how to apply ZOPA and value exchange concepts from playing the game.	1.00
I learnt new strategies and tactics in negotiation from playing the game.	1.18
<b>APPLICABILITY</b>	
Overall I feel that this game is an appropriate tool for training negotiation.	1.61
Overall I feel that this game can help me in improving negotiating skills (effectiveness)	1.50
Overall I feel that I can learn negotiation faster from playing this game than other methods (efficiency)	1.18
Overall I feel that this game is an attractive tool for training negotiation.	1.71
<b>FUNCTIONALITY</b>	
This game is easy to use.	1.29
The game interface is user-friendly.	1.39
The game runs smoothly without any error.	0.96
Information provided for negotiation is sufficient (not too much or too little).	0.79
Performance evaluation method for negotiation (using a score) is easy to understand.	1.14
Feedback from negotiation is sufficient and useful for you.	1.43

\* Rating ranges from -2 to 2, where -2 = disagree, 0 = neither agree nor disagree, and 2 = agree. Scores of -1 and 1 indicate a less extreme opinion on each side.

Interpretation of the result:

- 2.00 ≤ x < -1.50 Disagree with a given statement
- 1.50 ≤ x < -0.50 Quite disagree with a given statement
- 0.50 ≤ x < 0.50 Neither agree nor disagree with a given statement
- 0.50 ≤ x < 1.50 Quite agree with a given statement
- 1.50 ≤ x ≤ 2.00 Agree with a given statement

From the evaluation results, it was found that students who attended the workshop generally agreed that their overall understanding of negotiation improved after this workshop. They strongly felt that they learnt how to systematically plan for negotiations. They also agreed that the game was an effective training tool for

learning key negotiation concepts such as ZOPA, value exchange concept, and negotiating strategies and tactics.

In regard to the applicability of the game, students were asked to rate their opinions on several aspects, including appropriateness, effectiveness, efficiency, and attractiveness. According to the results, most students strongly felt that this game was a highly applicable tool for training negotiation in regards to the game's appropriateness, effectiveness, and attractiveness. However, they seemed less convinced on the efficiency of the game. This might be because they needed some basic knowledge in negotiation to take full advantages of the game.

During the workshop, one interesting issue was experienced by students who were paired with people from other nationalities. They observed that cultural differences might have an impact on negotiating styles of the players. While some nationalities had a compromising style, others tended to be more aggressive and demanding. Another interesting fact was experienced by one pair who failed to reach a deal mainly because both sides employed hard bargaining strategies, while all other pairs were able to reach an agreement.

### **Conclusion**

The primary aim of this research is to develop a new and innovative tool for training negotiation in the construction industry. To achieve the goal, the system called "Virtual Construction Negotiation Game (VCON)" was developed. It is an on-line game which utilizes internet technologies that enhance the capability of ordinary computer-based training tools. In this game, trainees can freely practice their negotiating skills with other users under an engaging and dynamic environment in which the simulation of contract negotiations is used as the training material. Several features are incorporated into the game including: realistic negotiation scenarios, real-time multi-player system, well-established and consistent player scoring system, adaptive scenarios based on level of difficulty, on-line user database, and on-line voting system. VCON can be effectively used to train users how to plan systematically for the negotiation, and also how to apply ZOPA and value exchange concepts. For further research, BATNA concept can be added to the VCON game.

Further study on impacts of cultural differences on negotiating styles is also possible by organizing negotiation workshops with carefully selected groups of international students and then utilizing information gathered from the VCON game and the questionnaires.

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