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Modeling Negotiating Abilities in the Construction Sector: A Proposed Mathematical Model Using the Confirmatory Factor Analysis Method

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Abstract: This study aims to develop a mathematical model for evaluating the objective abilities needed for negotiation and to provide a tool that companies can use to select a negotiation team. The model was constructed using a Likert pentagonal scale, where numbers from 5 to 1 represented the level of agreement or disagreement, and seven objective abilities were considered, including analytical ability, economic knowledge, legal knowledge, linguistic ability, psychological understanding, normative understanding, and general knowledge. The model was tested using a structured interview (sixteen interviews) with experts and specialists in the construction industry as a case study and then validated by quantitative data analysis method using first-order confirmatory factor analysis (CFA) with a sample of consultants (220 responses) from companies and offices related to the construction sector. The study found that the model is valid for use in the construction industry and can be useful for selecting negotiators. The developed model can be used, adapted, and modified according to the needs of different negotiation situations. This research is the first of its kind to develop a mathematical model for evaluating negotiating abilities and can be used as a model for similar research studies.

Keywords: modeling; negotiation management; negotiation skills; negotiation strategies; CFA; construction industry

MSC: 91C99

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1. Introduction

Negotiations are required in various fields and have become increasingly necessary in sectors that involve multiple parties and intricate details [1–5], such as the construction industry [6]. In this field, there are often shared interests that parties aim to resolve in a peaceful manner, whether it be between companies or even between an individual and a company, particularly when the company primarily deals with individual subcontractors [7]. Negotiations can have two main approaches: one focused on finding common ground and cooperation between parties, and the other centered on resolving conflicts and disputes [8]. In the latter approach, each party tries to maximize their own gains while limiting the gains of the other party through various strategies such as consuming resources, breaking up teams or dividing the issue, or using control, organized aggression, or self-sabotage tactics [1].

Numerous complaints have been made about the significant losses experienced by companies operating in the construction industry in Saudi Arabia, resulting in some closures. One of the major contributing factors, according to Saudi Arabian official reports, is the inadequacy of negotiators representing these companies in front of various stakeholders. This model is considered to be the first of its kind to model negotiating abilities and adopts a new mathematical approach for selecting or nominating individuals or negotiating teams to represent companies, allowing for a move away from reliance on chance and luck in negotiations.

Whatever approach the company adopts in negotiation highlights the importance of selecting a good negotiator or negotiation team [9] who can implement the negotiation strategies to be used in different negotiable cases. The negotiating abilities of the negotiator or the negotiating team appear in the efficiency and validity of the negotiating team and their skills in managing and directing the negotiation in its various stages, which are represented in the abilities and personal characteristics of each person, and on the nature of the negotiator's personality and his relationship with the personality of the other negotiator [10].

According to [11–16], seven abilities are essential for an effective negotiator: (1) the ability to analyze, which includes the capacity to scientifically evaluate the issues and components of negotiation and to connect the causes with outcomes [17]; (2) economic ability, which allows the negotiator to determine the costs and benefits for each aspect of the negotiation [16,18]; (3) legal ability, which gives the negotiator a general understanding of the legal rules and customs that govern the society, and how they apply to the negotiation [14,19,20]; (4) language ability, which is crucial as it involves mastering the language in which the negotiation takes place, having a full comprehension of the meanings of words and phrases, as well as being aware of the differences between idiomatic and linguistic meaning [15,17]; (5) psychological ability, which enables the negotiator to understand psychology, its origins, rules, and theories, thus being able to gauge the psychological state of the other party, and use psychological techniques to exert pressure when necessary [1,2]; (6) standards ability, which refers to the negotiator's capability in converting the negotiation points into quantifiable measures, such as knowledge of production volumes, prices, balance of payments figures, inflation, and other publicly available indices [4,21]; (7) general ability, which encompasses the cultural aspects and encompasses a broad understanding of the negotiator's culture, including general information about various aspects of life, which can give them flexibility and the ability to communicate effectively [5,6,8].

Modeling primarily concentrates on addressing a real-world issue and aims to find a solution to it. A mathematical representation within a specified framework is used to construct a mathematical model, which involves both the mathematical representation and the problem-solving environment. The next step is to find a mathematical solution for the model, which leads to a realistic solution. This process (as seen in Figure 1) can be illustrated in the following diagram as presented by Ang [22].

Mathematical modeling is considered an application of mathematics in addressing real-life problems by transforming the life problem into a mathematical problem to be solved and then generalizing the solution if possible [23]. The challenge that companies face when it comes to selecting a negotiation team to handle their business dealings and relationships is a significant obstacle in developing effective negotiation strategies [1].

Due to the technical and administrative demands of negotiations, companies often choose their team members haphazardly, based on past experiences with individuals, or assign whoever is available, regardless of their negotiation skills, which can negatively impact the company's performance and competitiveness [13,24]. This research aims to develop a mathematical model that can help companies select the most suitable negotiating team for different negotiation tasks, in order to ensure the best outcome for the company and improve overall performance. This, in turn, will help companies design more effective negotiation strategies for all types of negotiations. This model is based on the convergence of various studies, including the alignment of expectations between financial data auditors

and users, as well as the use of multidimensional foundations and structural equation modeling. The model will go through a five-step process, including specifying the model, defining it, estimating it, testing it, and making any necessary modifications [25]. Moreover, the proposed model discusses the ways in which the application of skills affects an individual's professional attributes such as teamwork, written and verbal communication, leadership, problem-solving ability, and team spirit [26–29].

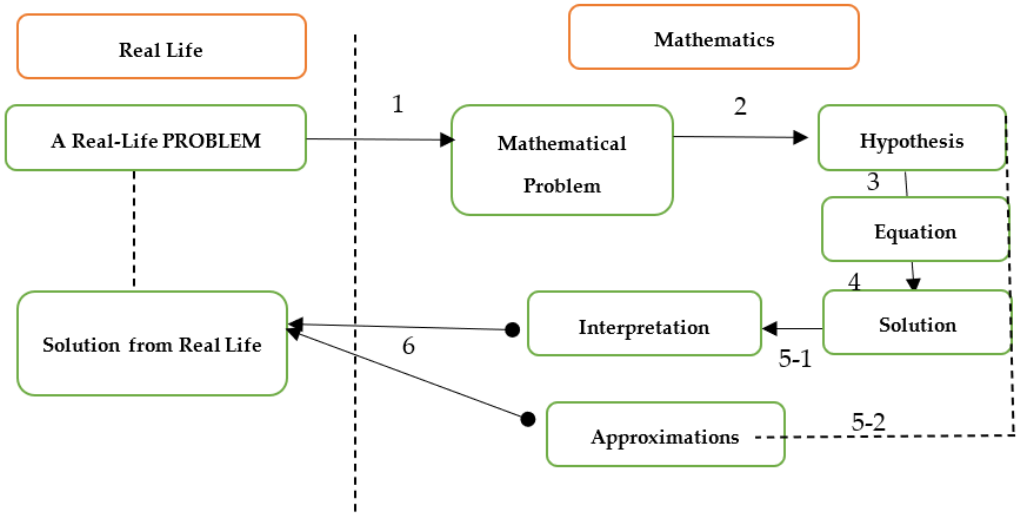

Figure 1. Ang's Model (2010).

The study will focus on the construction sector specifically, which is known for its complexity and fluctuations in demand, and the impact that negotiation processes and outcomes have on not only the construction industry but also the broader economy. Employees in the construction industry are defined as those who are directly involved in the building and construction operations or related activities. The workforce is divided into permanent workers and unskilled workers, including construction workers, plumbers, carpenters, steel structure workers, electricians, and machine and equipment operators, according to the General Authority for Statistics' Building and Construction Activity Survey [30–32].

Construction problems at King Faisal University only started in the past decade, despite projects beginning in 2000. The most notable issues included delays in project completion and some projects being halted due to companies' inability to finish them. These difficulties were primarily due to changes in project conditions and specifications, leading to a need for research into how to negotiate between the university as the project owner, between companies working on its projects, and between companies themselves to address these challenges.

The aim of this research is to (1) assess the viability of utilizing mathematical modeling as a tool in the negotiation process to diminish the dependence on luck when choosing individuals or teams to represent the company; (2) develop a mathematical model to evaluate the negotiation proficiency of potential candidates for negotiations in the construction sector; (3) acknowledge that negotiation skills are complicated and cannot be accurately judged by instinct. The model presents a way to precisely determine an individual's capacity for negotiation.

We aim to find answers to the following questions: (1) Can mathematical modeling be utilized to objectively measure negotiating skills? (2) Can negotiating skills be taken into consideration when selecting corporate representatives? (3) What is a suitable mathematical model for assessing negotiating skills? (4) Is the proposed model for evaluating negotiating skills applicable to the construction industry?

2. Material and Methods

2.1. Likert Scale and Building the Mathematical Model

We will use the five-point Likert scale to construct the mathematical model, utilizing a ladder scale that ranges from 5, indicating full agreement, to 1, indicating complete disagreement. The Likert scale, named after its inventor psychologist Rensis Likert [33], is a technique for assessing attitudes and preferences. It consists of a series of statements to which respondents indicate their level of agreement or disagreement, usually using a scale with three, five, or seven options, with a neutral option typically in the middle. These statements describe a specific behavior or attitude. The widely used scale (as seen in Table 1) is the five-point scale, which ranges from 5 for "Very Agree" to 1 for "Do Not Agree Completely". The interval between each point on the scale is 0.8. When interpreting the results, they are typically distributed accordingly as follows:

Table 1. The five-point Likert scale.

Opinion	Weighted Mean
Completely agree	4.20–5.00
Agree	3.40–4.19
Neutral	2.60–3.39
Not agree	1.80–2.59
Completely not agree	1.00–1.79

Source: The researcher.

It is noted that the length of the period here is (4/5) = 0.8; the length of the period was calculated on the basis that the five numbers 1, 2, 3, 4, and 5 were surrounded by four spaces.

Negotiation experts believe that negotiators should have seven key abilities: the ability to analyze, economic ability, legal ability, language ability, psychological understanding ability, knowledge of industry standards ability, and general abilities. These abilities are considered the objective abilities of a negotiator and can be expressed through the following equation (as seen in Table 2):

$$\mathrm{N(A)} = \sum_{i=1}^{nA} Aa_i + \sum_{i=1}^{nE} Ea_i + \sum_{i=1}^{nT} Ta_i + \sum_{i=1}^{nL} La_i + \sum_{i=1}^{nP} Pai + \sum_{i=1}^{nS} Sa_i + \sum_{i=1}^{nG} Ga_i \quad (1)$$

This is accomplished by utilizing the following five constraints: (1) this equation measures the objective ability of one individual; (2) the individual receives a score based on their response to each question using the Likert scale, where they receive a score of 5 if they fully agree with the ability in question, and the score decreases according to the Likert scale until the individual receives a score of 1 when they indicate that they "Do not completely agree"; (3) no reverse questions are included in our scale; (4) each model has a value that reflects the level of proficiency in the designated ability, determined by the number of statements included in the model. The value is calculated by multiplying the number of statements by 5, which represents the maximum level of agreement with each statement; (5) the objective abilities of the negotiation team can be determined by compiling the results of each individual team member and calculating the arithmetic mean, which represents the abilities of the team as a whole.

2.2. Measures and Questionnaire Development

To determine a model that represents the negotiating skills in the construction industry, full-structured interviews were conducted with industry experts who met the following criteria: having over 15 years of experience in the sector, being directly involved in contract and bid preparation, and having experience handling dispute resolution committees. The researcher carried out 16 structured interviews, 6 of which were with university professors

who specialize in the field of construction and have experience in preparing and overseeing bids and resolving issues during project implementation. Additionally, there were 5 consultant engineers working at consulting firms who are experts in resolving disputes, as well as 5 engineers who work in the contracting industry and have a lot of experience in implementing projects. As a result of these interviews, 28 statements were developed from the interviews and represent 7 negotiation abilities that are considered essential for an individual to possess. Each skill was represented by 4 reflective items (questions) based on the five-point Likert scale (5: completely agree, to one: completely disagree).

Table 2. The employed equation.

N(A)	Negotiator's objective abilities
$\sum_{i=1}^{nA} Aa_i$	The total score of questions that measure the individual's abilities to analyze
$\sum_{i=1}^{nE} Ea_i$	The total score of questions that measure the individual's abilities in economic knowledge
$\sum_{i=1}^{nT} Ta_i$	The total score of questions that measure the individual's abilities in legal knowledge
$\sum_{i=1}^{nL} La_i$	The total score of questions that measure the individual's language abilities
$\sum_{i=1}^{nP} Pa$	The total score of questions that measure the individual's abilities in psychological knowledge
$\sum_{i=1}^{nS} Sa_i$	The total score of questions that measure the individual's abilities in standard knowledge
$\sum_{i=1}^{nG} Ga_i$	The total score of questions that measure the individual's abilities in general knowledge

2.3. Sampling

In order to collect the required data, the researcher targeted respondents from the building and construction projects at King Faisal University (KFU), serving as a case study. This domain meets the three predetermined requirements for building and testing the proposed model: academic supervisors who have a direct connection to the field for over 10 years, consulting offices that oversee contracting work and have the required experience of over 15 years, and executive engineers who possess experience of more than 15 years. The construction project at King Faisal University in Al-Ahsa began in the year 2000 and is still ongoing. The issue of setbacks in companies has emerged in the past decade. Negotiations typically cover all aspects listed in the conditions and specifications booklet that forms the basis of the project, which can take anywhere from three to five years. During this time, factors such as raw materials, prices, supply locations, and other elements may need to be renegotiated by the university administration, considering any losses that contracting companies and consulting firms may face. The university selects a faculty member from the College of Engineering to serve as the academic supervisor for each unit within the administration. Different colleges oversee different areas, such as civil engineering and architectural engineering, and together they form the technical office of the administration.

Since its beginning, 17 major contracting firms and many subcontracting firms have been involved in building and construction projects at KFU university city, and the number of companies fluctuates depending on the projects. The work is supervised by 10 engineering consulting firms on a permanent basis, and this number also changes based on ongoing projects. Additionally, there are 83 offices that provide non-permanent consultations. The technical office is responsible for reviewing all the work carried out by the contracting companies and is made up of a team of 10 specialists in various engineering consulting

fields. The study focused on all individuals in engineering departments within contracting companies and consulting offices, as well as all members of the technical office responsible for overseeing university projects, totaling 386 individuals.

Additionally, a power analysis was conducted prior to data collection to establish the necessary sample size to observe a specific effect size. The analysis adhered to the recommendations of Cohen [34] and Westland [35]. Table 3 illustrates that when utilizing a structural equation model with 7 latent variables and 28 observable variables, at least 170 participants are required to detect an R^2 of 0.30 with a 5% significance level while keeping a statistical power level of 0.8.

Table 3. Results of a priori statistical power analysis for the research model.

Latent (Observed Variables)	Effect Size		Desired Statistical Power Level	Sample Size Required
	Minimum R^2	Actual Power at Sig. Level 5%	%	
7 (28)	0.30	0.95	0.80	170
7 (28)	0.50	0.95	0.80	100

Source: authors.

Moreover, we decided to collect data from a sample of 250 individuals using a drop-and-collect approach to mitigate any potential data collection issues such as low participation, unresponsive participants, or missing data. Ultimately, 220 usable responses were obtained.

Since this study employed a self-reported questionnaire in the second stage of data collection, there is a chance of common method variance (CMV) [36]. To address this potential concern, we used Harman's single-factor method. This method involves performing exploratory factor analysis (EFA) on all the questions using SPSS, with the restriction of extracting only one factor without rotating the data. The results of the analysis showed that CMV was not a problem during the study, as only one variable accounted for approximately 38% (<0.50) of the variance in the data [37].

2.4. Data Analysis Methods

We employed four successive phases to analyze the collected data, in the first phase the respondents' characteristics were analyzed, followed by some descriptive analysis for normality (kurtosis and skewness) and data dispersion analysis (mean and standard deviation), and then we conducted first-order confirmatory factor analyses (CFAs) to test the model validity and reliability, followed by correlation coefficient to test the intercorrelations between negotiator objective abilities dimensions.

3. Results and Discussion

3.1. Profiles of the Targeted Respondents

The survey results indicate that the majority of respondents, 98%, were male, and only 2% were female. As a result, the majority of the answers being analyzed will pertain to men. Additionally, the survey revealed that 55.5% of the respondents hold consulting positions, while 44.5% are in contracting positions, with 5.5% of those being subcontractors and suppliers. The survey participants had a high level of experience, with 56.6% having 15 or more years of experience, 24.5% having 10 or more years of experience, and 16.4% having only 5 years of experience. Additionally, 1.3% of the respondents had an undetermined amount of experience. The survey results show that 40.5% of the respondents dealt with 1 to 5 negotiation crises annually, 27% dealt with 6 to 10 crises, 28.2% dealt with more than 10 crises annually, and 4.3% did not answer the question. In terms of success in managing negotiations, 5.1% of the respondents believed they were 50% successful, 74.8% believed they were 75% successful, and 17.1% believed they were 100% successful. Three percent did not provide complete answers to this question.

3.2. Descriptive Analysis

Table 3 shows the mean and standard deviations, where the participants in the sample all agreed that it is crucial to possess the seven dimensions that make up a negotiator's abilities in the construction industry. However, the level of support for each ability varied. The sample deemed that the most crucial abilities are economic and linguistic, followed by analytical and legal abilities, then standard and general abilities, with psychological abilities being considered the least important. After considering the construction industry, it may be logical to prioritize the ability to calculate financial gains and losses and communicate effectively during negotiations as the most crucial skills for successful negotiations in this sector. Other abilities, such as analysis and legal expertise, are considered secondary in importance. It appears reasonable that negotiators in the construction industry should first focus on using legal and objective evidence to strengthen their negotiating position. They should also have a solid understanding of standard practices and general abilities. In addition, psychological skills are also important, as they can help negotiators deal with individuals who may not have a strong understanding of these matters due to a lack of education or experience in the field.

Table 4 shows how much the sample group agrees with each item that makes up each ability and the variation in their answers for each statement. The findings suggest that the ability to have a strategic perspective during negotiations is the most crucial aspect of analytical ability, as shown by an average score of 3.99 and a deviation of 0.80. On the other hand, proficiency in using scientific analysis tools is the least emphasized aspect of analytical ability, with an average score of 3.81 and a standard deviation of 0.96. Similarly, the most important aspect of economic skill for a negotiator is the ability to handle aggregate data in negotiation topics, as shown by an average score of 4.06 and a deviation of 0.73.

Additionally, it is essential that the negotiator has a basic level of economic knowledge, with an average score of 3.96 and a standard deviation of 0.77. Furthermore, a key aspect of legal ability for a negotiator is the knowledge of laws and regulations pertaining to negotiation topics, as shown by an average score of 3.99 and a deviation of 0.74. Furthermore, it is important that the negotiator has a basic understanding of the rules and regulations related to negotiation topics, as indicated by an average score of 3.83 and a deviation of 0.89. Additionally, a key aspect of linguistic ability for a negotiator is the ability to not rely on a translator when the negotiation language is not their own, unless they are completely confident in their abilities, as shown by an average score of 4.12 and a deviation of 0.71. On the other hand, the least emphasized aspect of this skill is being aware of the meanings of words used by the other party, as indicated by an average score of 3.70 and a deviation of 0.86.

The data in Table 4 also showed that the most crucial aspect of psychological ability for a negotiator is the ability to detect psychological changes in the other party during the negotiation process, as shown by an average score of 4.08 and a deviation of 0.81. On the other hand, the least emphasized aspect of this skill is the negotiator's ability to thoroughly understand the psychology of the other party, as indicated by an average score of 3.70 and a deviation of 0.86. Similarly, a key aspect of standard skill for a negotiator is the ability to use quantitative measurements for the negotiation topics, as shown by an average score of 3.94 and a deviation of 0.80. On the other hand, the least emphasized aspect of this ability is the negotiator's knowledge of measurable negotiation experiences, as indicated by an average score of 3.75 and a deviation of 0.84. Finally, a crucial aspect of general skill for a negotiator is proficiency in using knowledge to manage the negotiation process, as shown by an average score of 3.99 and a deviation of 0.76. On the other hand, the least emphasized aspect of this skill is the negotiator's overall knowledge about their field of work, as indicated by an average score of 3.82 and a deviation of 0.81.

Table 4. The arithmetic means and standard deviations of the objective abilities of the negotiator.

Negotiating Abilities	N	Statement	Mean	Standard Deviation	Skewness	Kurtosis
Analytical Ability (M = 3.89, $S.D.$ = 0.89)	1	The negotiator is familiar with the scientific analysis tools needed for negotiation topics with clients	3.94	0.71	−0.937	0.754
	2	The negotiator is mastering scientific analysis tools for negotiating topics with clients	3.81	0.96	−0.973	0.713
	3	The negotiator has the ability to link results with causes	3.82	0.90	−0.959	0.561
	4	The negotiator has a strategic view during negotiation process that enable him to generate the aspired goals	3.99	0.80	−0.967	0.750
Economic Ability (M = 3.99, $S.D.$ = 0.74)	5	The negotiator has sufficient economic knowledge to conduct negotiations with clients	3.96	0.77	−0.699	0.862
	6	The negotiator is good at linking cost and returns accounts in negotiation	3.98	0.79	−0.790	1.171
	7	The negotiator has abilities that enable him to deal with totals in negotiation process	4.06	0.73	−1.149	1.833
	8	Having the skills that enable him to gain profits in multiple ways during the negotiation process	3.97	0.68	−1.104	1.270
Legal Ability (M = 3.88, $S.D.$ = 0.82)	9	The negotiator has sufficient knowledge of the general legal rules governing negotiating case	3.99	0.74	−1.219	1.734
	10	The negotiator has sufficient knowledge of the rules and regulations governing cases under negotiation	3.83	0.89	−1.235	1.779
	11	The negotiator has mechanisms for implementing legal rules in various negotiating cases	3.84	0.86	−1.247	1.872
	12	The negotiator is good at using the rules of rights and duties in his management of negotiation	3.85	0.79	−1.199	1.406
Language Ability (M = 3.97, $S.D.$ = 0.77)	13	The negotiator only negotiates in the language he masters	4.01	0.78	−1.518	2.672
	14	The negotiator uses clear expressions that have only one meaning	4.06	0.75	−1.540	2.773
	15	The negotiator is fully aware of the meanings of the words he uses with the other negotiating party	3.70	0.86	−1.558	2.829
	16	The negotiator refuses to use an interpreter if the negotiation language is different, unless he has complete confidence in him	4.12	0.71	−1.540	2.773
Psychological Ability (M = 3.84, $S.D.$ = 0.87)	17	The negotiator has high abilities in understanding the psychology of the other negotiating party	3.40	0.99	−0.672	0.343
	18	The negotiator has sufficient knowledge to analyze the characters being negotiated with	3.94	0.84	−0.653	0.275
	19	The manager always enjoys psychological calm when conducting negotiations with clients	3.94	0.85	−0.677	0.367
	20	The negotiator has high abilities in capturing the psychological changes that occur on the other party	4.08	0.81	−0.685	0.334
Standard Ability (M = 3.85, $S.D.$ = 0.81)	21	The negotiator has sufficient knowledge on which to measure the negotiating issues	3.83	0.78	−0.895	1.054
	22	The negotiator has a high ability to quantify the topics under negotiation	3.94	0.80	−0.696	0.688
	23	The negotiator has knowledge of many negotiating experiences on which he can made a benchmark	3.75	0.84	−0.745	0.747
	24	The negotiator has the skill to employ quantitative measurements to resolve the negotiation in his favour	3.88	0.82	−0.863	0.968
General Ability (M = 3.90, $S.D.$ = 0.80)	25	The negotiator enjoys wide knowledge in wide cultures in different aspect of life	3.85	0.82	−1.227	2.117
	26	The negotiator is good at employing his various knowledge in managing negotiation	3.99	0.76	−1.261	1.842
	27	The negotiator is always keen to know something about everything	3.94	0.82	−1.266	1.968
	28	The negotiator is keen to know everything about his field of work	3.82	0.81	−1.232	1.867

3.3. First-Order Confirmatory Factor Analysis Results

The study used a first-order confirmatory factor analysis (CFA) method with Amos software version 24 to assess the validity and reliability of the proposed model [32,37,38]. CFA is a statistical technique used to test the validity of a measurement scale. The purpose of CFA is to determine whether the underlying structure of a scale is consistent with the model that emerged from the interview (28 statements with 7 dimensions) [32]. It involves specifying a hypothesized factor structure and testing the fit between the observed data and the specified model [37]. The goal is to confirm that the factors identified in the model

accurately reflect the underlying construct. CFA is typically used to assess the validity of self-report measures, such as surveys, questionnaires, interviews, and psychometric tests. The process involves specifying a factor structure based on the theoretical model of the construct and then estimating the factor loadings, which are the correlations between the observed items and the underlying factors [32].

The results, presented in Table 5 and Figure 2, indicate that the model fits the data well, with a chi-squared statistic of 1043.588 ($p < 0.001$), with 329 degrees of freedom, a normalized chi-squared of 3.172, a root mean square error of approximation of 0.049, a standardized root mean squared residual of 0.034, and a comparative fit index of 0.951. Additionally, the Tucker Lewis index (TLI), and normed fit index = 0.964, and 0.92, respectively, while parsimony comparative fix index (PCFI) and parsimonious normed fit index (PNFI) equal 0.692, and 0.673, respectively.

All of the items have Cronbach's alphas and composite reliability scores above the recommended 0.80, indicating high internal reliability. Additionally, all factor loadings for the items are between 0.883 and 0.972, which is higher than the desired score of 0.7, and have *t*-values above 22.947 (Table 5).

The factor loadings presented in Figure 2 and Table 5 show a strong correlation between the items used to measure the study's dimensions, which confirms the convergent validity of the study [38–40]. Additionally, the AVE scores for all dimensions (analytical ability = 0.961, economic ability = 0.980, legal ability = 0.969, language ability = 0.961, psychological ability = 0.970, standard ability = 0.979, and general ability = 0.90) exceed the recommended minimum of 0.50, further supporting the convergent validity [37].

Table 5. Psychometric properties of the study scale.

Negotiating Abilities Dimensions	Items	Loadings	*t*-Value	*p*-Value	*a*	C.R.	AVE	MSV
Analytical Ability	Aa_1	0.948	b	b	0.941	0.961	0.860	0.341
	Aa_2	0.883	22.947	***				
	Aa_3	0.965	32.478	***				
	Aa_4	0.912	25.637	***				
Economic Ability	Ea_1	0.952	b	b	0.921	0.980	0.925	0.424
	Ea_2	0.963	34.227	***				
	Ea_3	0.961	33.822	***				
	Ea_4	0.972	36.213	***				
Legal Ability	Ta_1	0.963	b	b	0.932	0.969	0.888	0.293
	Ta_2	0.941	31.407	***				
	Ta_3	0.919	28.115	***				
	Ta_4	0.945	32.161	***				
Language Ability	La_1	0.919	b	b	0.901	0.961	0.861	0.449
	La_2	0.921	23.909	***				
	La_3	0.950	26.433	***				
	La_4	0.922	23.945	***				
Psychological Ability	Pa_1	0.943	b	b	0.948	0.970	0.891	0.397
	Pa_2	0.954	30.487	***				
	Pa_3	0.961	31.599	***				
	Pa_4	0.917	25.839	***				
Standard Ability	Sa_1	0.965	b	b	0.951	0.979	0.922	0.258
	Sa_2	0.984	44.258	***				
	Sa_3	0.946	33.394	***				
	Sa_4	0.946	33.475	***				
General Ability	Ga_1	0.969	b	b	0.925	0.973	0.900	0.449
	Ga_2	0.937	32.008	***				
	Ga_3	0.956	35.847	***				
	Ga_4	0.933	31.283	***				

b: constatnt to run the model, ***: significant level < 0.001.

Furthermore, two common methods for determining discriminant validity are the AVE square root method and the maximum shared value (MSV) method. The AVE square root method involves comparing the AVE of each dimension to the shared correlations between that dimension and other dimensions in the same row and column, as proposed by Fornell and Larcker [41] and presented in Table 6. The MSV method, recommended by Hair, Black, Babin, and Anderson [37], involves comparing the AVE with the highest shared correlation between that dimension and other dimensions. The results shown in Table 6 indicate that the AVE scores for each dimension surpass the MSV and that all items within

the dimension have a higher loading on that factor than on any other factor, indicating that the proposed model has satisfactory discriminant validity.

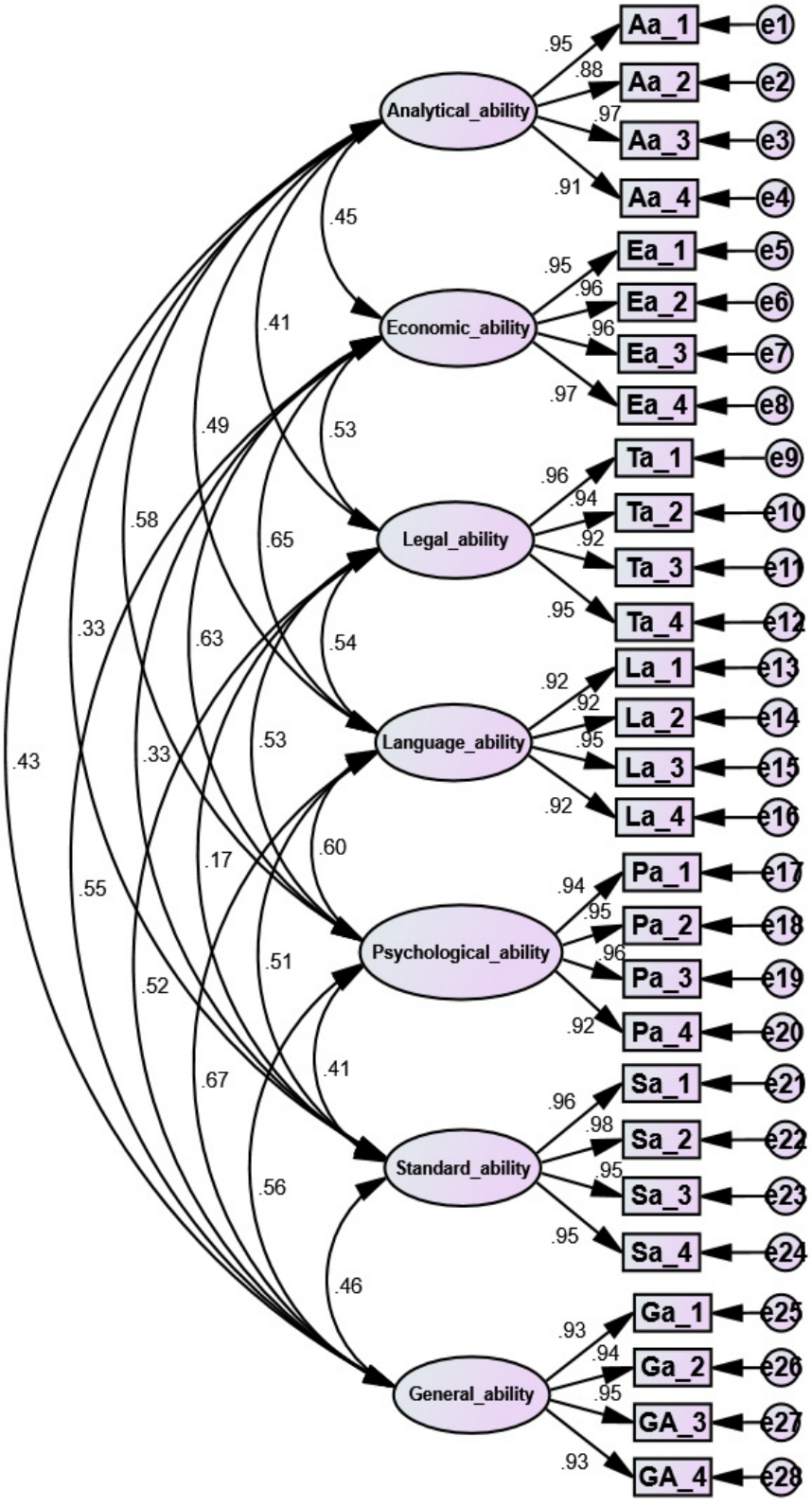

Figure 2. CFA model.

Table 6. Fornell–Larcker criterion analysis for discriminant validity.

	1	2	3	4	5	6	7
1. Psychological ability	**0.944**						
2. Analytical ability	0.584	**0.928**					
3. Economic ability	0.630	0.451	**0.962**				
4. Legal ability	0.532	0.406	0.532	**0.942**			
5. Language ability	0.598	0.494	0.651	0.541	**0.928**		
6. Standard ability	0.413	0.327	0.328	0.165	0.508	**0.960**	
7. General ability	0.560	0.424	0.549	0.513	0.670	0.459	**0.949**

It is worth noting that the numbers on the diagonal of the table represent the square root of the average variance extracted (AVE) for each corresponding facto, bold value are the squared root of AVE.

Table 7 shows the correlation analysis of the study dimensions that make up the objective capabilities of the negotiator in the construction sector. All the study dimensions have a significant positive correlation with each other.

Table 7. Correlation analysis.

Correlations			Estimate	*t*-Value	*p*-Value
Analytical ability	<-->	Economic ability	0.451	5.874	***
Analytical ability	<-->	Legal ability	0.406	5.367	***
Analytical ability	<-->	Language ability	0.494	6.230	***
Analytical ability	<-->	Standard ability	0.327	4.464	***
Analytical ability	<-->	General ability	0.424	5.590	***
Economic ability	<-->	Legal ability	0.532	6.726	***
Economic ability	<-->	Language ability	0.651	7.654	***
Economic ability	<-->	Standard ability	0.328	4.504	***
Economic ability	<-->	General ability	0.549	6.900	***
Legal ability	<-->	Language ability	0.541	6.714	***
Legal ability	<-->	Standard ability	0.165	2.356	*
Legal ability	<-->	General ability	0.513	6.553	***
Language ability	<-->	Standard ability	0.508	6.430	***
Language ability	<-->	General ability	0.670	7.837	***
Standard ability	<-->	General ability	0.459	6.015	***
Analytical ability	<-->	Psychological ability	0.584	7.131	***
Economic ability	<-->	Psychological ability	0.630	7.559	***
Legal ability	<-->	Psychological ability	0.532	6.686	***
Language ability	<-->	Psychological ability	0.598	7.188	***
Psychological ability	<-->	Standard ability	0.451	5.874	***
Psychological ability	<-->	General ability	0.406	5.367	***

***: significant level less than 0.001; * significant level less than 0.05.

As shown in Table 7, negotiator language ability was found to have a strong correlation with general ability (r = 0.67), economic ability (r = 0.65), psychological ability (r = 0.59), legal ability (r = 0.54), standard ability (r = 0.50), and analytical ability (r = 0.49). These results indicate that language ability is a key factor in the ability of a negotiator in the construction sector. Effective communication is essential for success in any negotiation, and the ability to express oneself clearly and persuasively in a common language is a critical component of this. Research has shown that individuals with strong language skills are better able to build trust with other parties, convey their positions effectively, and negotiate favorable outcomes as individuals with stronger language skills were better able to understand the perspectives of other parties and effectively communicate their own positions [15,17,42].

Furthermore, Table 7 gives evidence that a negotiator's legal abilities have highly significant correlations with economic ability (r = 0.53), general ability (r = 0.513), psychological ability (r = 0.53), and analytical ability (r = 0.40). These results imply that negotiators require a combination of legal, economic, psychological, and analytical abilities to be effective. These abilities often work together to help negotiators navigate complex negotiations and reach mutually beneficial agreements [20,43–46].

Additionally, the Amos correlation analysis presented in Table 7 indicated that a negotiator's psychological ability has a significant positive correlation with analytical ability (r = 0.58), economic ability (r = 0.63), standard ability (r = 0.45), and general ability (r = 0.40). These results demonstrate that negotiators who possess psychological abilities

such as emotional intelligence, cultural intelligence, and creativity play a key role in negotiation [6,47,48]. For instance, according to a study by the authors of [48], negotiators high in emotional intelligence are more likely to be able to navigate and manage the emotional aspects of negotiation which can be beneficial for achieving successful outcomes. Finally, as shown in Table 7, the weakest correlations were between standard ability and analytical ability (r = 0.32), economic ability (r = 0.32), and legal ability (r = 0.16). The findings suggest that while possessing standard abilities can be beneficial for negotiators, it is not a requirement for success in real-world negotiations [9,49,50].

By employing the developed model of negotiating abilities, organizations can identify their strengths and weaknesses in the negotiation process, develop strategies for improving their negotiating abilities, and continuously monitor and improve their performance over time. Modeling negotiating abilities in the construction sector is a crucial step toward improving the outcomes of construction projects and the relationships between organizations involved in these projects. This study's findings highlight the importance of understanding the negotiation process and its multidimensional structure in construction projects and provide a framework for modeling negotiating abilities in the construction sector.

4. Conclusions and Implications

The construction industry is considered one of the sectors that requires the most expertise in negotiation, as it is a complex and interconnected field with many potential points of conflict. As a result, the need for negotiation between parties is higher. The selection of an effective negotiator or negotiation team is crucial in resolving disputes and addressing differences, as reported by the General Authority for Statistics, Building and Construction Activity Survey, 2018. This research presents an approach to selecting an effective negotiator or negotiation team using a mathematical model. The model was developed with the help of 16 interviews and validated with 220 experts and specialists in the construction sector at King Faisal University, to identify the most qualified individuals within a company for negotiation. The proposed model introduces seven key negotiator abilities (analytical ability, economic ability, legal ability, language ability, psychological ability, standard ability, and general ability), and each has four reflective items. The validity and reliability of the proposed model were tested using first-order CFA on a sample of 220 individuals from the university city administration, consulting firms, and contracting companies operating there. The correlation analysis of the seven abilities of a negotiator revealed a positive, significant relationship, indicating that all the dimensions used should be considered together for a successful negotiation process.

Modeling negotiating abilities in the construction sector has theoretical and practical implications for organizations and individuals involved in the industry. Theoretically, this approach can provide a framework for understanding the abilities and characteristics that contribute to successful negotiation in the construction sector. This can inform the development of training programs and selection criteria for negotiators and negotiation teams in the industry. Modeling negotiating abilities in the construction sector can provide a better understanding of the negotiation process, including the factors that influence negotiations. This knowledge can contribute to the development of a comprehensive theory of negotiation in the construction sector and provide a basis for further research in this area.

From a practical perspective, the use of a mathematical model for selecting negotiators and negotiation teams in the construction sector can have significant benefits for organizations. By identifying the most qualified individuals for negotiation, organizations can improve their ability to effectively resolve disputes and address differences, leading to more successful project outcomes and increased efficiency. Additionally, the use of a mathematical model can provide a more objective and systematic approach to selecting negotiators, reducing the potential for bias in the selection process. Research on modeling negotiating abilities in the construction sector is relatively limited, but our study has shown that the use of a mathematical model can be effective in identifying the best negotiators and

negotiation teams. The mathematical model for selecting negotiators in the construction sector can be an effective tool to identify individuals with the necessary skills and abilities for successful negotiation and team performance.

5. Limitations and Future Research Opportunities

The use of mathematical models for selecting negotiators in the construction sector has several limitations that should be considered. One limitation is that the model may not fully capture the complexity of negotiation in the construction sector. The construction sector is highly dynamic and multifaceted, and negotiation in this field involves a wide range of variables and factors that may not be fully captured by a mathematical model. Another limitation is that the model may not be generalizable to all organizations and contexts (i.e., the energy sector). The model may be most applicable to a specific type of organization or context, such as a university city administration, consulting offices, and contracting companies operating in it. Additionally, the model may not be able to fully account for the role of emotions and interpersonal dynamics in negotiation. These factors can play a significant role in negotiation and can be difficult to quantify or measure using a mathematical model.

Despite these limitations, there are several opportunities for future research in this area. One opportunity is to further implement the proposed model to better capture the complexity of negotiation in the construction sector. This could involve incorporating more variables and factors into the model, such as the role of emotions and interpersonal dynamics in negotiation. Another opportunity is to test the model in a wider range of organizations and contexts. This could help to determine the generalizability of the model and its applicability to other types of organizations and contexts. Additionally, future research could investigate the effectiveness of training programs and selection criteria for negotiators and negotiation teams in the construction sector based on the model.

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