American Journal of Civil Engineering and Architecture, 2019, Vol. 7, No. 4, 172-180
Available online at http://pubs.sciepub.com/ajcea/7/4/4
Published by Science and Education Publishing
DOI:10.12691/ajcea-7-4-4

Assessment of Tender Documents Quality Index

Hossam H. Mohammed, Ahmed H. Ibrahim, Ann E. El-Malt*

Construction Engineering & Utilities Department, Zagazig University, Zagazig, Egypt
*Corresponding author: mekky69@yahoo.com

Received June 29, 2019; Revised August 04, 2019; Accepted August 26, 2019

Abstract The success of any tender depends on the quality of tender documents. Factors affecting the quality of tender documents can be summarized within nine main factors and thirty-four secondary ones, which were collected from previous studies. The main purpose of this paper is to get an index that can help to evaluate the quality of tender document. Four steps are included to reach the purpose of this paper. The first step is to make a questionnaire to identify the most important factors affecting the quality of tender document. The second step includes a (AHP) model to get the quality percentage for any tender document and to implement this step a questionnaire was applied by using saaty scale. Depending on the previous steps, the most important factors affecting the quality of tender documents are: (Specifications, Design Drawings, Bill of Quantities, Terms and Conditions of Contract) representing (12%, 27.5%, 46.7% and 13.8%). The third step to set an index that can evaluate any tender document and minimum acceptable percentage for every factor. Finally, four actual case studies are implemented to illustrate the proposed AHP model to get the quality percent for each one and to set the proposed index to check the status of the tender (poor-accepted- good - very good - excellent) and to get the minimum acceptable percent for each factor.

Keywords: *quality, tender documents, AHP, construction management*

Cite This Article: Hossam H. Mohammed, Ahmed H. Ibrahim, and Ann E. El-Malt, "Assessment of Tender Documents Quality Index." *American Journal of Civil Engineering and Architecture*, vol. 7, no. 4 (2019): 172-180. doi: 10.12691/ajcea-7-4-4.

1. Introduction

Tendering is the process by which bids are invited from interested contractors to carry out specific packages of construction work. It is fundamental to the success of a project to adopt and observe the key values of fairness, clarity, simplicity and accountability, and reinforce the idea that the apportionment of risk to the party is best placed to assess and manage [1]. Tender documents are prepared and sent out to potential tenderers to seek tenders as part of the procurement process at tender phase. Tender documents typically comprise documents such as bill of quantities/schedule of rates, drawings, instructions to tenderers, specifications, form of contract, conditions of contract and a list of enclosures [2,3,4,5].

The tender documents of a project should typically contain the design and specification of what the client wants to build. It is the same documentation that a contractor (bidders) needs to calculate and offer a price and programme for a project [6].

Time spent on preparing documents, which aid the contractor's understanding of the work, will benefit the finished product [7]. Tenderers will assess the quality of documentation, partly because poor information can add to the time wasted by site supervisors and partly because unreliable information can lead to claims. If the contractor has enough information, he can avoid guesswork, include all the important items in his tender and will not need to add global sums for poorly defined elements of work [7].

The Coordinating Committee for Project Information (CPI) was set up in 1979 to look for improvements in the way construction documents are produced and presented. The committee published its recommendations in December 1987 for drawings, specifications and bills of quantities for building work; and included proposals for ways by which the following problems may be overcome:

1. Missing information – not produced, or not sent to site.
2. Late information- not available in time to plan the work or order the materials.
3. Wrong information- errors of description, reference or dimension; out-of date information.
4. Insufficient details- both for tender and construction drawings.
5. Impracticable designs- difficult to construct.
6. Inappropriate information- not relevant or suitable for its purpose.
7. Unclear information -because of poor drafting or ambiguity.
8. Not firm-provisional information: often indistinguishable from firm information.
9. Poorly arranged information – poor and inconsistent structure, unclear titling.
10. Uncoordinated information – difficult to read one document with another.
11. Conflicting information – documents which disagree with each other [8].

Table 1. Factors Affecting the Quality of Tender Documents [9]

1-Cover Letter
1-1 The cover letter to be short, clear, direct, and professional
1-2 To include contact information which must be complete and easy to locate
2- Invitation to Tender
2-1 To provide the name and address of the procuring entity
2-2 To include tender number
2-3 To give a clear explanation of how to obtain the tender documents, including the amount of any fees
2-4 To provide an explanation of where and when tenders must be submitted and where and when the tenders will be opened
3- Form of Tender
3-1 To include the renderer's information (brief description of the work and it's cost)
3-2 To provide a bank guarantee for tender security
4- Terms and Conditions of Contract
4-1 To be written with care and precision so as to be clear and unambiguous
4-2 To make the terms and conditions consistent with laws to reduce disagreement between parties later
4-3 To select the most appropriate standard form of contract and let it available for use with any particular contract calls for a detailed knowledge of their contents
5- Bill of Quantities
5-1 To include a description of the work, location of the site, site boundaries, names of parties and lists of drawings
5-2 To provide the form of contract used, with any amendments clearly defined and with contract appendix details giving information such as the retention percentage, liquidated damages, possession and completion dates.
5-3 To include specific requirements which should be priced by the contractor as fixed or time-related items to reflect the actual costs arising from supervision, site accommodation, temporary works, site running costs, general plant, transport, client's requirements and safety
6- Design Drawings
6-1 Accuracy: to have the quality or state of being correct with no missing data
6-2 Clarity: to be clear with no complicated items
6-3 Consistency: drawing and it's details in the context of work or there is a different on the land site
7- Specification
7-1 General specification: to contain mobilization and preparation of site security &Health and safety &Disposal and pollution& Surveys and setting out.
7-2 Particular specification : to contain standard specifications for each item individually
7-3 Specification should be complete: to cover every significant aspect of the work
7-4 Specification should be constructive: to help all the parties to understand what is expected of them
7-5 Specification should be clear
8- Tender Evaluation Criteria
8-1 It requires that all companies are given an equal opportunity to succeed
8-2 The criteria for evaluation must be established prior to Invitation to Tender
8-3 The reasons for rejection must be documented
9- Pre-construction Information
9-1 Description of the project and its program
9-2 Information about the construction work.
9-3 Information about the site as a workplace.
9-4 Client's management and welfare arrangements.
9-5 The CDM (construction design and management) planning period (time allowed for each stage of the project)
9-6 Any relevant information in any existing Health and Safety File
9-7 Schedule of existing information
9-8 Environmental restrictions and risks: design and construction hazards.
9-9 Design and construction hazards (design for construction safety)

Nine main factors and thirty-four secondary factors were collected from previous studies as shown in Table 1. These factors can affect the quality of tender documents [9].

2. Problem Statement

The most important factor affecting successful bids is the quality of tender documents. It can also be the main reason for disputes between the parties of the project. Some problems can include inaccurate design drawings, missing information in the bill of quantities and poor specifications. All these problems can lead to inaccurate estimates, higher margins in bids, claims and disputes.

3. Study Objectives

The objectives of this study are outlined as follows:

1. Identifying the different factors that affect the quality of tender documents from previous studies.

2. Ranking these factors according to their relative importance index to find out the most important ones.

3. Developing a system that can identify the weight of the factors affecting quality of tender documents. The system can be used for evaluating tender documents by using (AHP) technique.

4. Developing quality index for any tender documents.

4. Study Methodology

The following sections present the research steps to achieve the objectives:

1. Questionnaire survey was conducted to identify the most important factors affecting the quality of tender documents.

2. Model of Analytical Hierarchy Process (AHP) was designed to conduct relative weights of the most important factors by conduct a questionnaire survey using saaty scale.

3. Some selected case study applications were considered to get the quality percentage for each project.

4. Interviews with some experts were made to set a quality index which can be used for accepting or refusing project tender documents.

4.1. Questionnaire Survey

The questionnaire was conducted to obtain the most important factors affecting the quality of tender documents. The questionnaire is based on a scale measuring the importance index of factors, ranking the items form (1 to 5).

4.2. Data Collection

The sample size was calculated using the equation of Bartlett et al. (2001) to compute the required sample size for infinite population [10]:

$$n = \frac{k^2 * P(1-P)}{E^2} \quad (1)$$

Where

n= is the required sample size for infinite population.

K= value equals 1.645 when confidence level equals 90%.

P= is the proportion of population i.e. P degree of variance between the elements of population (the critical value of P is 0.5).

E= is the acceptable margin of error= 10% for confidence level 90%.

By substituting of these parameters in the equation (1), then the required sample size of this study for infinite population is 68 samples as a minimum value.

Data were collected from some professionals and experts in construction projects in Egypt, including practicing contractors (cost estimators, civil engineers and project managers) and consultants. A total of 110 questionnaires were administered to professionals and experts in construction projects in Egypt (80) contractor experts and (30) consultant experts. Eighty one questionnaires representing 73.63% of the total questionnaires administered were implemented.

4.3. Data Analysis

Statistical tests were applied to the data of the questionnaire to verify the validity of the results, The following tests have been applied:

1- Reliability test: to measure the reliability of the data as shown in Table 2. The results show that Cronbach's Alpha = 0.851, and this value greater than 0.6. This shows that data have a very high confidence degree.

Table 2. Reliability Statistics

Cronbach's Alpha	No. of Items
0.851	9

2- T-test: Table 3 shows the results after applying T-test. The zero hypothesis can be examined where we depend on its level of significance (Sig. (2-tailed)) that is known as (P_{value}) and estimated by= 0.000 and. this value is less than (0.05 α) so, in this case, null hypothesis H_0 is rejected and an alternative hypothesis H_1 is accepted. This means that there is a fundamental difference representing a statistical significance.

3- ANOVA test: Table 4 shows the results after applying ANOVA Test. The zero hypothesis can be examined where we depend on its level of significance (Sig.) that is known as (P_{value}) and estimated by = 0.000. This value is less than (0.05 α) so, in this case, null hypothesis H_0 is rejected and an alternative hypothesis H_1 is accepted. This means that there is a fundamental difference reflecting a statistical significance.

Table 3. One-Sample Test

	Test Value = 0					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
q1	20.054	80	.000	1.39506	1.2566	1.5335
q2	14.948	80	.000	2.04938	1.7765	2.3222
q3	15.647	80	.000	2.50617	2.1874	2.8249
q4	17.461	80	.000	2.77778	2.4612	3.0944
q5	16.751	80	.000	2.69136	2.3716	3.0111
q6	17.175	80	.000	2.67901	2.3686	2.9894
q7	17.659	80	.000	2.91358	2.5852	3.2419
q8	16.885	80	.000	2.56790	2.2652	2.8706
q9	18.280	80	.000	2.56790	2.2883	2.8475

Table 4. ANOVA Test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	140.642	8	17.580	10.026	.000
Within Groups	1262.494	720	1.753		
Total	1403.136	728			

4.4. The Most Important Factors Affecting the Quality of Tender Documents

After checking the reliability of the data now, the study can obtain the most important factors as shown in Table 5 by using importance index presented in eq.(2) [8].

$$\text{Importance Index} = \frac{\sum_{i=1}^{n} Ii}{a * N} * 100 \quad (2)$$

Where

• $\sum_{i=1}^{n} Ii$ = The sum impact scores of each factor from the total respondents.

• a = the upper scale for each measure which equals 10.

• N= the number of respondents which is constant and equals 81

Table 5. The Most Important Factors Affecting the Quality of Tender Documents

Factors	No. of Res.	Total Score	Importance Index	Weight%	Rank
Cover Letter	81	128	0.32	46.40	9
Invitation to Tender	81	200	0.49	71.00	8
Forms of Tender	81	239	0.59	85.51	6
Terms and Conditions	81	246	0.61	88.40	4
Bill of Quantities	81	279	0.69	100.00	1
Designs of Drawings	81	273	0.67	97.10	2
Specifications	81	264	0.65	94.20	3
Tender Evaluation Criteria	81	245	0.60	86.96	5
Preconstruction Information	81	230	0.57	82.60	7

The most important factors as shown in the previous Table include (Terms and conditions of contract, Bill of quantities, Design drawings and Specifications).

5. Analytical Hierarchy Process (AHP) Model

AHP works on the complex problems and can be converted into a simple and comprehensible hierarchical structure. They state that AHP model by saaty can be conducted by four steps [11]:

1) Factors are then structured into a hierarchy descending from main factors to sub-factors in successive levels as shown in Figure 1.

2) Provide the matrix data for pairwise comparison of the decision elements as shown in Table 6, by using a saaty scale that is presented in Table 7.

3) Using Eigenvector Method (EV) as a prioritization method: The pairwise comparison values produce a ratio scale (a class of numbers whose ratios remain the same when each of them is multiplied by a constant presented in Eq. (3)) of weights of the relative importance. AHP assumes that an evaluator does not know the actual weights represented in vector (W).Therefore the observed pairwise relative weights matrix, A, contains inconsistencies

$$\begin{aligned} &Eigenvector = Total\ Weight \\ &= Total\ Weight\ from\ respondents / N \end{aligned} \quad (3)$$

Where:

N= No. of Respondents; (N=81) and summary of the (81) Interviews

Relative Weight (Wi) = Weight of Main Criteria * Weight of Sub-criteria

Wi; represents relative weight of factor i; relative to the weight of its category relative [12].

4) Aggregate of the relative weights of the decision elements to obtain a rating for a decision alternative Based on satty's equations, the study can make (AHP) model and get relative weight of each factor. Table 8 shows the summary of weights and relative weights of the main factors and sub-factors of the (81) interviews' data.

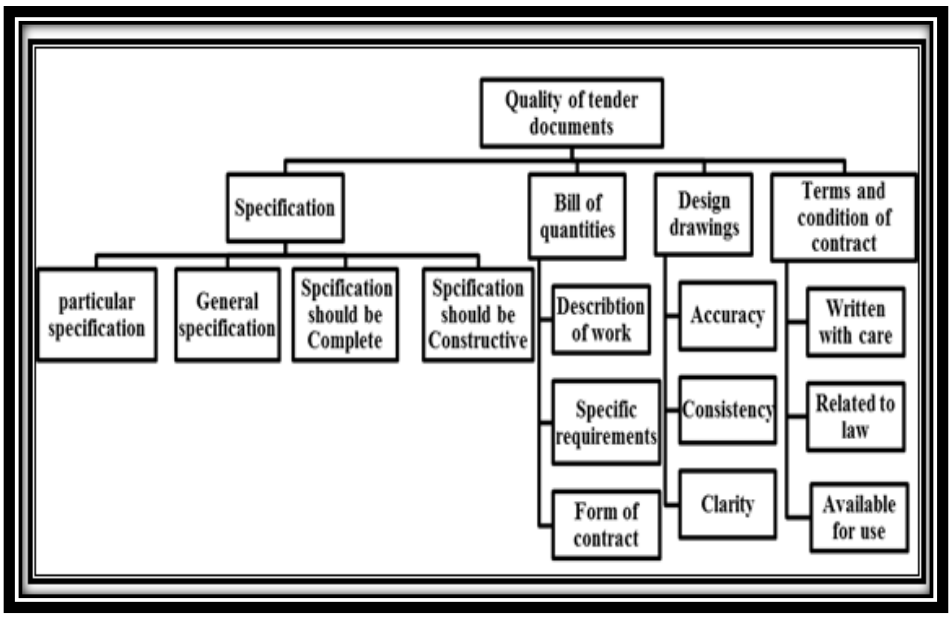

Figure 1. Hierarchy of the most important factors

Table 6. Pairwise Comparison Matrix for Main Factors

	Specification	Design drawings	B.O.Q	Terms and cond.
Specification	1			
Design drawings		1		
B.O.Q			1	
Terms and cond.				1

Table 7. Pairwise Comparison Scale (Saaty's Scale)

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two factors contribute equally to the objective
3	Somewhat more important	Experience and judgment slightly favor one over the other
5	Much more important	Experience and judgment strongly favor one over the other
7	Very much more important	Experience and judgment very strongly favor one over the other
9	Absolutely more important	The evidence of favoring one over the other is of the highest possible validity
2,4,6,8	Intermediate more important	When compromise is needed

Table 8. Summary of Weights and Relative Weights of the Main Factors and Sub-Factors of the (81) Interviews' Data

NO	Factors	Weight%	Relative Weight (Wi)	Sum
a	**Specification**	**12.030**		
a.1	General specification: contain mobilization and preparation of site &security &Health and safety &Disposal and pollution& Surveys and setting out.	13.904	1.673	**12.030**
a.2	particular specifications :contain Standard specifications for each item individually	36.355	4.373	
a.3	Specification should be Complete: To covering every significant aspect of the work	14.893	1.792	
a.4	Specification should be Constructive: To helping all the parties to understand what is expected of them	16.066	1.933	
a.5	Specification should be Clear	18.782	2.259	
b	**Design drawings**	**27.520**		
b.1	Accuracy: have the quality or state of being correct and there is no missing data	36.226	9.969	**27.520**
b.2	Consistency: drawing and it's details in the context of work or there is a different on the land site	29.805	8.203	
b.3	Clarity:clear and not have complicated items	33.969	9.348	
c	**Bill Of Quantites**	**46.653**		
c.1	Description of the work, location of the site, site boundaries, names of parties and lists of drawings	29.277	13.659	**46.653**
c.2	Specific requirements which should be priced by the contractor as fixed or time-related items to reflect the actual costs arising from supervision, site accommodation, temporary works, site running costs, general plant, transport, client's requirements and safety	49.440	23.065	
c.3	The form of contract used, with any amendments clearly defined, with contract appendix details giving information such as the retention percentage, liquidated damages, possession and completion dates and fluctuation provisions	21.283	9.929	
d	**Terms and conditions of contract**	**13.796**		
d.1	written with care and precision so as to be clear and unambiguous	30.154	4.160	**13.796**
d.2	the terms and conditions must related to laws to reduce disagreement between parties later	41.978	5.791	
d.3	the selection of most appropriate of the standard form of contract available for use with any particular contract calls for a detailed knowledge of their contents	27.867	3.845	
		sum	100.000	100.000

6. AHP Model to Evaluate Tender Documents

Now a model to evaluate any tender documents can be established and tender documents can be identified whether they are qualified or not. The following steps have been implemented [13].

- First, the main factors (specifications, design drawings, B.O.Q and terms and conditions of contract) were ranked as follows (a,b,c and d). The secondary factors had the following ranking respectively: (a-1,a-2,a-3,a-4 , a-5), (b-1, b-2 , b-3), (c-1,c-2 , c-3) and (d-1,d-2 , d-3).
- Second, the relative weights (wi) were obtained from the (AHP) Model as shown on Table 8
- Secondary factors were checked to ensure that they were implemented in the project tender document then, data is give=1, if not data give=0.
- The above step was applied to all secondary factors, thus a score for all secondary factors has already been calculated.
- A Score of each secondary factor was calculated using the following formula:

$$Wi * Data = Score \quad (4)$$

- Data of main factors were calculated by the summation of the score of its related secondary factors as shown in the following formulas:

$$S_a = \left(S_{a-1} + S_{a-2} + S_{a-3} + S_{a-4} + S_{a-5}\right) \quad (5)$$

$$S_b = \left(S_{b-1} + S_{b-2} + S_{b-3}\right) \quad (6)$$

$$S_c = \left(S_{c-1} + S_{c-2} + S_{c-3}\right) \quad (7)$$

$$S_d = \left(S_{d-1} + S_{d-2} + S_{d-3}\right) \quad (8)$$

- Finally, by the summation of main factors scores as shown in the next formula, a final score for the project tender documents was calculated

$$Total\ score = S_a + S_b + S_c + S_d. \quad (9)$$

The model is illustrated in Table 9.

Table 9. Model to Evaluate Tender Document

Project	Type of tender	Main factor	Sub-factor	Wi for each factor from AHP model	Score for the project items	Score for each main factor	Total score%
Project 1	Open tender	(a) Specification	a-1 General specification	1.673			
			a-2 particular specification	4.373			
			a-3 Complete	1.792			
			a-4 Constructive	1.933			
			a-5 Clear	2.259			
		(b) Design drawings	b-1 Accuracy	9.969			
			b-2 Consistency	8.203			
			b-3 Clarity	9.348			
		(c) B.O.Q	c-1 Description of work	13.659			
			c-2 Specific requirements	23.065			
			c-3 Form of contract	9.929			
		(d) Terms and condition of contract	d-1 Written with care	4.160			
			d-2 Related to law	5.791			
			d-3 Available for use	3.845			

7. Data Validation

Data results were presented to an expert in Construction Management with the following purpose:

1. Validation the results: The validation model has been conducted through interviews with experts in the construction management field to judge whether or not the study result are logic. Twenty interviews with experts have been conducted. The respondents' judgment was 85% to 15% for the validity of the data results.

2. Determination of a Minimum accepted quality percentage for each factor affecting the quality of tender documents: based on interviews with twenty experts to determine this quality percent, the results can be outlined in eq. (10) and illustrated in Table 10.

$$\textit{Quality weight} = \textit{quality weights from AHP model} \quad (10)$$

**accepted percentage from the total interviews.*

Table 10. Minimum Accepted Percentage for Quality Factors

Factors	Quality Weights From AHP Model%	Accepted Percentage From the Total Interviews (0-100%)	Quality Weight%
Specifications	12.030%	84.75%	10.20%
Design Drawings	27.520%	90.35%	24.86%
B.O.Q	46.653%	93.50%	43.62%
Terms and Conditions of contract	13.796%	96.45%	13.31%

3. Determination of a quality index for tender documents: based on interviews with twenty experts to determine this quality index, the results are illustrated in Table 11.

Table 11. Quality Index for Tender Documents

Quality Index	Minimum Percentage of the Quality Index
Poor	< 62.75
Accepted	≥ 62.75-71.25
Good	≥ 71.25-78.45
Very Good	≥ 78.45-86
Excellent	> 86

8. Case Studies

Four actual case studies discussing factors affecting the Quality of tender documents were collected from actual projects. These cases were collected from a contractor's company. The aim of collecting these cases is to study the factors affecting the quality of tender documents and compare them with those obtained from the questionnaire. Also, these studies will be used to show the actual problems that affect the quality of tender documents in Egypt.

8.1. First Case Study

Abu-shokair airport had to be renewed following the requirements of constructing New Terminal building for R/S Heliport. A study and complete design were conducted and developed in accordance with the enclosed drawings. A foundation system was constructed late in 2005, including footings, ground beams and short columns to the ground level. The scope of this contract is to continue the construction of the building till final stage, consequently this contract is including:

- Repair for the existing foundation system
- Construction of a reinforced concrete skeleton generally composed of slab and columns for ground, first and tower floors over the existing foundation system.
- Construction of walls
- Construction of finishing for interior and exterior walls and floors
- Construction of complete plumbing system
- Construction of electric power and control system
- Construction of fire fighting and HVAC systems
- Construction of new slabs over the existing tarmac slabs
- Construction of tarmac utilities system.

When the model was applied to get the quality percentage, the researcher found that:

- On the part of specification, general and particular specifications were complete and constructive, but there were missing data and unclear specification
- On the part of design drawings, they were accurate but there was some sort of difference on the land site besides the lack of clarity

• On the part of the bill of quantities, (description of work, specific requirements and form of contract) were clear and complete.

• On the part of terms and conditions of contract, they were complete (written with care, related to law and available for use).

Quality percentages are determined in Table 12.

The above Table shows that the quality percentage reaches (78.40%) and this means that this tender is ***(Good)*** according to the quality index on Table 11

• Minimum acceptable percentage for each factor is determined in Table 13.

Second Case Study: Construction of Three Residential Buildings

After the researcher had checked the tender documents presented by the owner and applied the Model, the researcher found that:

• On the part of specification, general and particular specification was complete and it was constructive, but some items were not clear.

• On the part of design drawings, they were neither accurate nor clear, but there was no difference on the land site.

• On the part of bill of quantities, it was complete (description of work, specific requirements and form of contract) and clear.

• On the part of terms and conditions of contract, they were complete (written with care, related to law and available for use).

• Quality percentages are determined in Table 14.

Table 14 shows that the quality percentage reaches (78.42%) and this means that this tender is ***(Good)*** according to the quality index in Table 11.

• Minimum acceptable percentage for each factor is determined on Table 15.

Table 12. Application of the Model to the First Case Study

Project	Type of tender	Main factor	Sub-factor	Wi for each factor from AHP model	Score for the project items	Score for each main factor	Total score%
Project 1	Open tender	(a) Specification	a-1 General specification	1.67	1.67	7.98	**78.40**
			a-2 particular specification	4.37	4.37		
			a-3 Complete	1.79	0.00		
			a-4 Constructive	1.93	1.93		
			a-5 Clear	2.26	0.00		
		(b) Design drawings	b-1 Accuracy	9.97	9.97	9.97	
			b-2 Consistency	8.20	0.00		
			b-3 Clarity	9.35	0.00		
		(c) B.O.Q	c-1 Description of work	13.66	13.66	46.65	
			c-2 Specific requirements	23.07	23.07		
			c-3 Form of contract	9.93	9.93		
		(d) Terms and condition of contract	d-1 Written with care	4.16	4.16	13.80	
			d-2 Related to law	5.79	5.79		
			d-3 Available for use	3.84	3.84		

Table 13. Minimum Acceptable Percentages for the First Case Study

Factors	Minimum Acceptable Quality Weights Percentage %	Percentages of the First Case Study	Accepted or not.
Specifications	10.20%	7.98%	Refused.
Design Drawings	24.86%	9.97%	Refused.
B.O.Q	43.62%	46.65%	Accepted
Terms and Conditions of contract	13.31%	13.80%	Accepted

Table 14. Application of the Model to the Second Case Study

Project	Type of tender	Main factor	Sub-factor	Wi for each factor from AHP model	Score for the project items	Score for each main factor	Total score%
Project 2	Open tender	(a) Specification	a-1 General specification	1.67	1.67	9.77	78.42
			a-2 particular specification	4.37	4.37		
			a-3 Complete	1.79	1.79		
			a-4 Constructive	1.93	1.93		
			a-5 Clear	2.26	0.00		
		(b) Design drawings	b-1 Accuracy	9.97	0.00	8.20	
			b-2 Consistency	8.20	8.20		
			b-3 Clarity	9.35	0.00		
		(c)B.O.Q	c-1 Description of work	13.66	13.66	46.65	
			c-2 Specific requirements	23.07	23.07		
			c-3 Form of contract	9.93	9.93		
		(d) Terms and condition of contract	d-1 Written with care	4.16	4.16	13.80	
			d-2 Related to law	5.79	5.79		
			d-3 Available for use	3.84	3.84		

Table 15. Minimum Acceptable Percent for Second Case Study

Factors	Minimum Acceptable Quality Weights Percentage %	Percentages of the First Case Study	Accepted or not.
Specifications	10.20%	9.77%	Refused.
Design Drawings	24.86%	8.20%	Refused.
B.O.Q	43.62%	46.65%	Accepted
Terms and Conditions of contract	13.31%	13.80%	Accepted

Third Case Study: *Construction a mosque*

After the researcher had checked the tender documents presented by the owner and applied the Model, the researcher found that:

• On the part of specification, general and particular specification was existed, but specification was unclear, unconstructive and incomplete.

• On the part of design drawings, they were accurate but there was some sort of difference on the land site besides the lack of clarity.

• On the part of bill of quantities (description of work and form of contract), it was clear and complete, but specific requirements were not founded.

• On the part of terms and conditions of contract, they were not written with care and were not available for use, but they were in consistence with law.

• Quality percentages are determined in Table 16.

Table 16 shows that the quality Percentage reaches (45.39%) and this means that this tender is ***(Poor)*** according to the quality index in Table 11.

• Minimum acceptable percentage for each factor is determined in Table 17.

Table 16. Application of the Model to the Third Case Study

Project	Type of tender	Main factor	Sub-factor	Wi for each factor from AHP model	Score for the project items	Score for each main factor	Total score%
Project 3	Open tender	(a) Specification	a-1 General specification	1.67	1.67	6.05	45.39
			a-2 particular specification	4.37	4.37		
			a-3 Complete	1.79	0.00		
			a-4 Constructive	1.93	0.00		
			a-5 Clear	2.26	0.00		
		(b) Design drawings	b-1 Accuracy	9.97	9.97	9.97	
			b-2 Consistency	8.20	0.00		
			b-3 Clarity	9.35	0.00		
		(c) B.O.Q	c-1 Description of work	13.66	13.66	23.59	
			c-2 Specific requirements	23.07	0.00		
			c-3 Form of contract	9.93	9.93		
		(d) Terms and condition of contract	d-1 Written with care	4.16	0.00	5.79	
			d-2 Related to law	5.79	5.79		
			d-3 Available for use	3.84	0.00		

Table 17. Minimum Acceptable Percentages of the Third Case Study

Factors	Minimum Acceptable Quality Weights Percentage %	Percentages of the First Case Study	Accepted or not.
Specifications	10.20%	6.05%	Refused.
Design Drawings	24.86%	9.97%	Refused.
B.O.Q	43.62%	23.59%	Refused
Terms and Conditions of contract	13.31%	5.79%	Refused

Table 18. Application of the Model to the Fourth Case Study

Project	Type of tender	Main factor	Sub-factor	Wi for each factor from AHP model	Score for the project items	Score for each main factor	Total score%
Project 4	Open tender	(a) Specification	a-1 General specification	1.67	1.67	10.24	98.21
			a-2 particular specification	4.37	4.37		
			a-3 Complete	1.79	0.00		
			a-4 Constructive	1.93	1.93		
			a-5 Clear	2.26	2.26		
		(b) Design drawings	b-1 Accuracy	9.97	9.97	27.52	
			b-2 Consistency	8.20	8.20		
			b-3 Clarity	9.35	9.35		
		(c) B.O.Q	c-1 Description of work	13.66	13.66	46.65	
			c-2 Specific requirements	23.07	23.07		
			c-3 Form of contract	9.93	9.93		
		(d) Terms and condition of contract	d-1 Written with care	4.16	4.16	13.80	
			d-2 Related to law	5.79	5.79		
			d-3 Available for use	3.84	3.84		

Fourth Case Study: Construction of Residential Tower Consisting of 14 Floors

After the researcher had checked the tender documents presented by the owner and applied the Model, the researcher found that:

- On the part of specification, general and particular specification was complete, constructive and clear, but there were missing data.
- On the part of design drawings, they were accurate and clear; and there was no difference on the land site.
- On the part of bill of quantities, it was complete (description of work, specific requirements and form of contract) and clear.
- On the part of terms and conditions of contract, they were complete (written with care consistent with law and available for use).
- Quality percentages are determined in Table 18.

Table 18 shows that the quality percentages reaches (98.21%) and this means that this tender is ***(Excellent)*** according to the quality index in Table 11.

- Minimum acceptable percentage for each factor is determined from Table 19.

Table 19. Minimum Acceptable Percentages for Fourth Case Study

Factors	Minimum Acceptable Quality Weights Percentages %	Percentages of the First Case Study	Accepted or not.
Specifications	10.20%	10.24%	Accepted
Design Drawings	24.86%	27.52%	Accepted
B.O.Q	43.62%	46.65%	Accepted
Terms and Conditions of contract	13.31%	13.80%	Accepted

9. Conclusion

- The majority of the interviewees have problems with the quality of tender documents, especially with the drawing items and missing data.
- Nine main factors and thirty-four sub-factors that affect turned out to have an effect on the quality of tender documents.
- Based on a survey including different construction experts in Egypt, the most important factors affecting quality of tender documents according to their importance index are: (Specifications, Design Drawings, Bill of Quantities, Terms and Conditions of Contract) with the following respective percentages (12%, 27.5%, 46.7%, 13.8%).
- Based on interviews made with experts, a quality index was presented including a minimum acceptable quality percentage for each factor affecting quality of tender documents.

Declaration

This paper is based on a Master Thesis prepared by the third author and supervised by the first two authors [13].

References

[1] Thenbs (2014). "*Tendering for Construction Projects*". http://www.thenbs.com/topics/contractsLaw/articles/tenderingForConstructinProjects. Asp Last Access Dec. 7, 2014.

[2] Benetly, J.I.W. (1987). "*Construction Tendering and Estimating*", London: E. & F.N. Spon.

[3] Smith, R. C. (1986). "*Estimating and tendering for building work*", Longman: London

[4] Buchan, R.D., Fleming, F.W.E and Grant, F.E.K (2003). "*Estimating for Builders and Surveyors*", 2nd ed., Elsevier, Oxford: Butterworth-Heinemann.

[5] Cook, A.E. (1991). "*Construction tendering: theory and practice*", London: B.T. Batsford Ltd.

[6] Laryea, S. (2011). *"Quality of tender documents: case studies from the UK*". Construction Management and Economics, 29(3), 275-286.

[7] Brook, M. (2004). "*Estimating and Tendering for Construction Work*", 3rd ed., Elsevier, Boston: Butterworth Heinemann.

[8] CPI (1987). "*Co-ordinating Committee for Project Information*". Coordinated Project Information for Building Works, 1987.

[9] Hosny H. E., Ibrahim A. H., Elmalt A. E. (2019). "*Factors Affecting Quality of Tender Documents*". Al-Azhar University Civil Engineering Research Magazine (CERM), 41(1), 346-355.

[10] Bartlett, j. E., Kotrlik, W. and Higgins, C. (2001). "*Organizational Research: Determining Appropriate Sample Size in Survey Research*." Learning and Performance Journal, 19(1), 43-50.

[11] Zakaria, N. F., Dahlan, H. M., and Hussin, A. R. C. (2012). Prioritization method in the analytic *"hierarchy process using evolutionary computing*". International Journal of Innovative Computing, 1, 555-560.

[12] El-Touny, A.E. (2013). "*Estimating Contingency Cost for Highway Construction Projects*," MSc. Thesis, Faculty of Engineering, Zagazig University, Egypt.

[13] El-Malt, A.E. (2019). "*Quality of Tender Documents*," MS_C Thesis, Faculty of Engineering, Zagazig University, Egypt.