

## **Factors Affecting the Accuracy of Pre-Tender Cost Estimates in the Gaza Strip**

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**Abstract:** Pre-tender cost estimates of construction projects require extensive knowledge and expertise. The aim of this paper is to identify, evaluate and rank essential factors affecting the accuracy of pre-tender cost estimating from the perspective of clients and consultants. A survey questionnaire was conducted to elicit professionals' views on and experiences with factors affecting the accuracy of pre-tender cost estimates; a total of 70 organisations (i.e., 46 clients and 24 consultants operating in the Gaza Strip, Palestine) responded to the survey. The results of analysing a total of 64 factors considered in the questionnaire reveal that the top five factors affecting the accuracy of pre-tender cost estimating are (1) materials (prices/availability/supply/quality/imports), (2) closure and blockade of borders, (3) project team's experience in the construction type, (4) the experience and skill level of the consultant and (5) clear and detailed drawings and specifications. Kendall's coefficient of concordance was used as a measure of agreement between the two groups of respondents (i.e., clients and consultants) who ranked various factors and it appears that they are generally in agreement. Both clients and consultant groups should focus on the main factors identified in this study to develop effective strategies for accurate cost estimating, which would ultimately lead to successful projects.

**Keywords:** Cost estimation, Accuracy, Clients, Consultants

### **INTRODUCTION**

The success or failure of a project is dependent on the accuracy of several estimates done throughout the course of the project (Ahuja, Dozzi and Abou Rizk, 1994). Therefore, the preparation of a cost estimate of the project is one of the most difficult tasks in project management because it must be done before the work is accomplished (Oberlender, 1993). Pre-tender cost estimating is simply the final costing of the work carried out by a consultant (i.e., quantity surveyor or engineer) on behalf of a client (Oduami and Onukwube, 2008) before tenders are received. It sits somewhere between cost planning and post-contract cost control, provides an indication of the probable construction cost prior to contract-awarding and involves collecting, analysing and summarising all available data related to the construction of the project (Holm et al., 2005). Thus, for a contractor to secure a job, his cost estimate must be as accurate and competitive as possible (Marjuki, 2006). Inadequate estimating invariably leads to misallocation of scarce resources (Flyvbjerg, Holm and Buhl, 2002).

An estimate can be accurate, low or high. An accurate estimate generally results in the most economical project cost, while either an underestimation or an overestimation often leads to greater actual expenditures. Inaccuracy in the estimate of a project may arise from two sources: bias associated with the project itself and bias associated with the estimating techniques used and the operating environment (Aibinu and Pasco, 2008).

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Accurate estimation of construction costs is heavily dependent on the availability of quality historical cost data and the level of professional expertise, among other things. The limited information available at the early stages of a construction project may mean the quantity surveyor must make assumptions about the design details of a project, which may not eventuate as project design, planning and construction evolve (Liu and Zhu, 2007).

Professional estimators have access to reliable cost and productivity references for estimating labour, material, equipment and other major work components. These major cost items have a high visibility factor and consequently receive adequate attention in the preparation of the pre-tender estimate. However, there are little-known low visibility factors affecting the estimate accuracy, such as procurement forms and contract arrangements, that should be considered in the preparation of pre-tender estimates. Unfortunately, these factors are either entirely overlooked or sadly neglected by estimators in the Gaza Strip. Identification of these low visibility factors is very important for improving the overall performance of the construction industry. The purpose of this paper is to identify, evaluate and rank essential factors affecting the accuracy of pre-tender cost estimating from clients' and consultants' perspectives.

#### **FACTORS INFLUENCING THE ACCURACY OF ESTIMATES: A LITERATURE REVIEW**

Various studies have focused on identifying the factors that have some influence on the accuracy of estimating the costs of construction work. Based on previous studies, Gunner and Skitmore (1999) identified 12 factors: building function, type of contract, conditions of contract, contract sum, price intensity, contract period, number of bidders, good/bad years, procurement basis, project sector (public, private or joint), number of priced items and number of drawings. Ling and Boo (2001), using data from 42 projects in Singapore, found similar results when they compared five variables against Gunner and Skitmore's work. Skitmore and Picken (2000) studied the effects of four independent variables (building type, project size, sector and year) on estimating accuracy and tested these variables against 217 projects from a quantity surveyor based in the United State of America (USA). They found that bias existed in project size and year and consistency errors existed in project type, size and year.

By reviewing 67 process industry construction projects around the world, Trost and Oberlender (2003) identified and grouped a total of 45 factors that contribute to the accuracy of early stage estimates into 11 orthogonal factors. Of these 11 factors, the five most important are process design, team experience and cost information, time allowed to prepare estimates, site requirements and bidding and labour climate. Elhag, Boussabaine and Ballal (2005) stated that the technological and project design, the contractor's expertise and management ability and the client's desired level of construction sophistication play important roles in determining the cost of a project. According to them, most of the significant factors affecting project costs are qualitative, such as client priorities (e.g., completion time, procurement methods, market conditions, etc.).

Enshassi, Mohamed and Madi (2007) examined cost estimating practices in contracting companies operating in the Gaza Strip. Their study revealed that the most important factors affecting contractors' cost estimates are the financial

status of client, the type of current contractor workload and the project's location relative to hostile "hot-spot" areas. According to Liu and Zhu (2007), two types of factors, control factors and idiosyncratic factors, influence and contribute to the cost of a project. Control factors are the factors that can be controlled by estimators to improve the performance of estimation, while idiosyncratic factors influence cost estimation but are outside the control of the estimators and include market conditions, project complexity, weather, contract size, site constraints, resource availability, type of procurement system and contract work type (Liu and Zhu, 2007). Considering the unstable political and economic conditions in the Gaza Strip, idiosyncratic factors can be regarded as more relevant and influential for cost estimation in this part of the world.

## **RESEARCH METHODOLOGY**

### **Sample and Response Rate**

This research was conducted in the Gaza Strip, Palestinian National Authority (PNA). The targeted research population consisted of construction engineers and managers from diverse public clients and consultancy organisations experienced in tendering and estimation. The selected organisations (either public client organisations or consulting firms) represented the top 20% of all organisations listed by the relevant government agency as ranked by their total project value procured or designed in 2010/2011. Targeted organisations are seen as key players in the provision of construction projects and consultancy services. To increase the response rate, where possible, more than one potential respondent was approached within each of these organisations to solicit the required information. However, to avoid response bias, no more than three questionnaires were sent to the same organisation. To illustrate, for a consulting organisation where a number of principal partners are listed as contact persons, no more than three questionnaires were sent out. In total, 50 questionnaires were distributed to 19 targeted clients and 28 questionnaires to 17 local consulting organisations.

The response rate from client organisations was 6% higher than from the consultancy firms, 92% (46 responses) compared to 86% (24 responses). A response rate of more than 30% is likely to produce results subject to non-response bias. Hence, the obtained response rates should produce reliable results. On average, the respondents have an average of 20 years' experience in tendering and estimating.

### **Questionnaire design**

A questionnaire survey was undertaken to determine the opinions of clients and consultants regarding factors affecting the accuracy of pre-tender cost estimates in the Gaza Strip. The questionnaire was constructed based on a literature review, five face-to-face interviews with clients and consultants and the personal professional experience of the researchers.

A total of 85 factors that were identified and reported in 12 previous studies (Al-Khaldi, 1990; Al-Thunaiyan, 1996; Akintoye, 2000; Madi, 2003; Trost and Oberlender, 2003; Elhag et al., 2005; Shash and Ibrahim, 2005; Babalola and

Aladegbaiye, 2006; Dysert, 2006; Enshassi et al., 2007; Liu and Zhu, 2007; Odusami and Onukwube, 2008) were considered in this research. To better reflect the nature of the local construction industry, 15 of these factors were deleted, 15 of them were modified and 12 factors were merged, while six new factors were added. In total, 64 factors were grouped into the following five groups as advised by experts who participated in a pilot study (Table 1):

1. Factors related to clients' characteristics
2. Factors related to consultants, design parameters and design information
3. Factors related to project characteristics
4. Factors related to contract requirements and procurement methods
5. External factors and market conditions

Table 1. List of Factors Affecting the Accuracy of Pre-Tender Cost Estimates

<b>Factor</b>	<b>Source</b>	<b>Comment</b>	<b>Final Name Used</b>
<b>Factors related to clients' characteristics</b>			
Type of client	Literature	Modified	Type of client (Government/UN agencies/NGOs, etc.)
Client experience level	Literature	Selected	Client experience level
Client's financial situation and budget	Literature	Modified	Financial capabilities of the client
Client's financial situation/ability/payment record	Literature	Modified	Client's method of payment
Project finance method/appropriate funding in place on time	Literature	Merged	
Partnering arrangements	Literature	Deleted	
Priority on construction time/deadline requirements	Literature	Deleted	
Experience of procuring construction	Literature	Selected	Experience of procuring construction
Client requirements on quality	Literature	Modified	Clear scope definition for the client
Previous relationship and communication level with the partners	Literature	Deleted	
Client's evaluation and awarding policy	Interviews with clients	Added	Client's evaluation and awarding policy

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Table 1. (continued)

<b>Factor</b>	<b>Source</b>	<b>Comment</b>	<b>Final Name Used</b>
<b>Factors related to consultants, design parameters and design information</b>			
Expertise of the consultant	Literature	Modified	The experience and skill level of the consultant
Project team's experience in the construction type	Literature	Selected	Project team's experience in the construction type
Designer's experience level	Interviews with consultants	Added	Designer's experience level
Number of estimating team members	Literature	Selected	Number of estimating team members
Availability of all fields of specialisation in a project team	Researchers' experience	Added	Availability of all fields of specialisation in a project team
Project team's capability to control the project	Literature	Selected	Project team's capability to control the project
Impact of team integration and alignment	Literature	Selected	Impact of team integration and alignment
Level of involvement of the project manager	Literature	Selected	Level of involvement of the project manager
Quality of information and information flow requirements	Literature	Selected	Quality of information and information flow requirements
Database of bids on similar projects (Historical cost data)	Literature	Selected	Database of bids on similar projects (Historical cost data)
Completeness of cost information	Literature	Selected	Completeness of cost information
Accuracy and reliability of cost information	Literature	Selected	Accuracy and reliability of cost information
Applicability of cost information	Literature	Selected	Applicability of cost information
Procedure for updating cost information	Literature	Selected	Procedure for updating cost information
Utilisation of checklists to ensure completeness and technical basis	Literature	Selected	Utilisation of checklists to ensure completeness and technical basis
Quality of the assumptions used in preparing the estimate	Literature	Selected	Quality of the assumptions used in preparing the estimate
Estimating method used	Literature	Selected	Estimating method used
Volume of consultant's workload during estimation	Literature	Selected	Volume of consultant's workload during estimation

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Table 1. (continued)

<b>Factor</b>	<b>Source</b>	<b>Comment</b>	<b>Final Name Used</b>
<b>Factors related to consultants, design parameters and design information</b>			
Time allowed for preparing the cost estimate	Literature	Selected	Time allowed for preparing the cost estimate
Completeness and timeliness of project information (design, drawings, specifications)	Literature	Modified	Completeness of project documents
Quality of design and specifications	Literature	Modified	Clear and detailed drawings and specifications
Buildability of design	Literature	Selected	Buildability of design
Inspection, testing and approval of completed works (Type and number)	Literature	Deleted	
Frequency of construction variations	Literature	Deleted	
Frequency of construction variations	Literature	Deleted	
Variation orders and additional works	Literature	Deleted	
Working relationships with client/contractors/other design team consultants (previous/present)	Literature	Modified	Level of communication with client and other design team consultants
Submission of early proposals for costing/cost planning	Literature	Deleted	
Absence of alterations and late changes to design	Literature	Deleted	
<b>Factors related to project characteristics</b>			
Type of project (residential, commercial, industrial, etc.)	Literature	Selected	Type of project (residential, commercial, industrial, etc.)
Type of structure (concrete, steel, masonry, etc.)	Literature	Selected	Type of structure (concrete, steel, masonry, etc.)
Scale and scope of construction	Literature	Deleted	
Expected project organisation	Literature	Deleted	
Project size	Literature	Selected	Project size
Project duration	Literature	Selected	Project duration
Location of project	Literature	Selected	Location of project

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Table 1. (continued)

Factor	Source	Comment	Final Name Used
<b>Factors related to project characteristics</b>			
Site conditions/site topography	Literature	Modified	Site conditions (topography, hot area, etc.)
Site constraints (access, storage, electricity, etc.)	Literature	Selected	Site constraints (access, storage, electricity, etc.)
Site requirements	Literature	Selected	Site requirements
Project complexity	Literature	Selected	Project complexity
Construction method/technology/ construction techniques	Literature	Modified	Method of construction /construction technique requirements
Technology required	Literature	Deleted	
Phasing requirements (areas to be handed over first or initial non-availability)	Literature	Deleted	
Impact of project schedule	Literature	Selected	Impact of project schedule
<b>Factors related to contract requirements and procurement methods</b>			
Type of contract	Literature	Selected	Type of contract
Tender selection method (open, selected, negotiation, etc.)	Literature	Selected	Tender selection method (open, selected, negotiation, etc.)
Method of procurement (traditional, design and build, etc.)	Literature	Selected	Method of procurement (traditional, design and build, etc.)
Form of procurement	Literature	Merged	
Spread of risk between construction parties (client/consultant/ contractors)	Literature	Modified	Risk sharing between construction parties
Claims and disputes resolution methods (litigation/arbitration/others)	Literature	Modified	Content of disputes resolution methods clause (litigation/arbitration/others)
Amount of specialist work	Literature	Selected	Amount of specialist work
Advanced payment	Literature	Selected	Advanced payment
Tax and insurance	Literature	Modified	Taxes and other financial requirements on tender
Clear contract conditions	Researchers' experience	Added	Clear contract conditions
Type and value of insurance	Literature	Merged	
Bid bonds amount and maintenance period	Literature	Merged	

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Table 1. (continued)

<b>Factor</b>	<b>Source</b>	<b>Comment</b>	<b>Final Name Used</b>
<b>Factors related to contract requirements and procurement methods</b>			
Project including VAT or excluding VAT	Literature	Merged	
Retention ratios of the value of contractor payments	Literature	Merged	
Liquidated damages amount	Literature	Merged	
<b>External factors and market conditions</b>			
Material (prices/availability/supply/quality/imports)	Literature	Selected	Material (prices/availability/supply/quality/imports)
Labour (costs/availability/performance/productivity)	Literature	Selected	Labour (costs/availability/performance/productivity)
Equipment (costs/availability/supply/condition/performance)	Literature	Selected	Equipment (costs/availability/supply/condition/performance)
Availability and supplies of labour and materials	Literature	Merged	
Weather conditions	Literature	Modified	Weather effects
Impact of government regulations requirement	Literature	Selected	Impact of government regulations requirement
Number of competitors in the market	Literature	Selected	Number of competitors in the market
Classification and level of competitors in the tendering	Literature	Selected	Classification and level of competitors in the tendering
Economic situation	Literature	Modified	Prevailing economic climate
Stability of market conditions	Literature	Merged	
Competitiveness of bidding	Literature	Selected	Competitiveness of bidding climate
Inflation rate	Literature	Merged	
Closure and blockade	Literature	Selected	Border closure and blockade
Political situation	Literature	Merged	
Multiple projects being advertised at the same time	Interviews with clients and consultants	Added	Multiple projects being advertised at the same time
Bank interest rate	Literature	Deleted	

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Table 1. (continued)

Factor	Source	Comment	Final Name Used
<b>External factors and market conditions</b>			
Currency exchange	Literature	Modified	Currency exchange fluctuation
Type of tender's currency	Literature	Merged	
Price of the tender documents	Literature	Deleted	
Method of paying VAT	Literature	Deleted	
Social and cultural impact	Literature	Selected	Social and cultural impact
Donor type	Researchers' experience and interviews with clients	Added	Donor type

UN = United Nations, NGOs = Non-governmental organisations, VAT = value added tax

### Pilot study

A pilot study, as suggested by Naoum (1998), provides a trial run for the questionnaire and involves testing the wording of questions, identifying ambiguous questions, testing the techniques used to collect data and measuring the effectiveness of standard invitations to respondents. A pilot study was conducted by distributing the modified questionnaire to six seasoned clients and four consultants. The results revealed that the questions were generally regarded as being clear, although some respondents had difficulties understanding a limited number of questions. Accordingly, these problematic questions were modified.

### Instrument Validity

According to Polit and Hungler (1985), validity refers to the degree to which an instrument measures what it is supposed to be measuring. Instrument validity can be evaluated in two ways: (1) content validity and (2) statistical validity, which includes criterion-related validity and construct validity.

For this research, the content validity of the questionnaire was tested by an expert panel of ten experts in the project management field consisting of two academics, four consultants and four seasoned clients. Each expert was requested to evaluate the content validity for each item based on rating the index of content validity. Based on the comments of the experts, the final questionnaire included 64 factors grouped into five categories.

To ensure the validity of the questionnaire and following Polit and Hungler (1985), two statistical tests were applied. The first used a criterion-related validity test (Spearman test) and the correlation coefficient and *p*-value were calculated for each of the five factor groups. The results revealed that the *p*-values are less than 0.05, so the correlation coefficients of the field are statistically significant at  $\alpha = 0.05$  ( $0.01 < p\text{-value} < 0.05$ ). Thus, it can be concluded that the factors of all groups are consistent and valid to measure what they are intended to measure.

The second test was a structure validity test (Spearman) to test the validity of the questionnaire structure by testing the validity of each group and the validity of the whole questionnaire. The test results showed that the p-value for each group is less than 0.05, so the correlation coefficients of all the groups are significant at  $\alpha = 0.05$  ( $0.01 < p\text{-value} < 0.05$ ).

Cronbach's Coefficient Alpha test was also employed to measure the consistency of the questionnaire. This method is designed as a measure of internal consistency to determine whether all items within the instrument measure the same thing (George and Mallery, 2003). The Alpha value varies between 0.0 and +1.0, with higher values reflecting a higher degree of internal consistency. The results revealed that the calculated Alpha values for each group range from 0.676 to 0.841, demonstrating the reliability of each group in the questionnaire. For the entire questionnaire, this value was found to be 0.911, indicating very high reliability.

Respondents were asked to rate the importance of each factor using a five-point Likert scale. To measure attitudes with respect to surveyed variables, the Relative Importance Index (RII) technique was employed. This technique is widely used to analyse the factors affecting the accuracy of cost estimating (Akintoye, 2000; Madi, 2003; Elhag, Bossabaine and Ballal, 2005; Odusami and Onukwube, 2008).

In addition to the above techniques, two non-parametric methods, Kendall's Coefficient of Concordance and the Man-Whitney test, were utilised in this research. Non-parametric methods are widely used for studying populations that take on a ranked order. Kendall's Coefficient of Concordance ( $W$ ) is used to evaluate the degree of agreement between the two groups, clients and consultants, regarding the ranking of key factors and it ranges from 0 (no agreement) to 1 (complete agreement) (Siegel and Castellan, 1988). The degree of agreement between the clients and consultants was tested using the following two hypotheses across the five factor groups:

Null Hypothesis, $H_0$ :	There is an insignificant degree of agreement between clients and consultants.
Alternative Hypothesis, $H_1$ :	There is a significant degree of agreement between clients and consultants.

The Mann-Whitney test is utilised to test the null hypothesis that two populations have identical distribution functions against the alternative hypothesis that the two distribution functions differ only with respect to location (median), if at all (Siegel and Castellan, 1988). This test is used to determine whether there is a significant difference at  $\alpha \leq 0.05$  in rank means of the respondents' agreement between clients and consultants.

The relative index technique has been widely used in construction research for measuring attitudes with respect to surveyed variables. Likert scaling was used for ranking questions that have an agreement level. The respondents were required to rate the importance of each factor on a 5-point Likert scale using 1 for not important, 2 for of little importance, 3 for somewhat important, 4 for important and 5 for very important. Then, the relative importance index was computed using the following equation:

$$\text{Relative Importance Index} = \frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

where  $W$ , which is the weighting given to each factor by the respondent, ranges from 1 to 5;  $n_1$  = the number of respondents for not important;  $n_2$  = the number of respondents for of little importance;  $n_3$  = the number of respondents for somewhat important;  $n_4$  = the number of respondents for important; and  $n_5$  = the number of respondents for very important.  $A$  is the highest weight (i.e., 5 in the study) and  $N$  is the total number of samples. The relative importance index ranges from 0 to 1 (Tam and Le, 2006).

## RESULTS AND DISCUSSION

### Group 1: Factors Related to Clients' Characteristics

Group 1 contains seven factors. The ranks and the RIs of these factors related to client characteristics are shown in Table 2. Client experience level was ranked first with an RI of 0.889 by the clients and second with an RI of 0.758 by the consultants. The combined ranking by both clients and consultants placed this factor at the top of the list with an RI of 0.843 and 12th in the overall ranking of all 64 factors. These results are in agreement with the findings of Trost and Oberlender (2003) and Babalola and Aladegbaiye (2006) who have shown that the client experience level plays a significant role in cost estimate accuracy.

Table 2. Ranks and RIs of Factors Related to Clients' Characteristics

Factors	Clients		Consultants		Total Sample		Overall Rank
	RI	Rank	RI	Rank	RI	Group Rank	
Type of client (Government/UN Agencies/NGOs, etc.)	0.662	6	0.717	3	0.683	6	54
Client experience level	0.889	1	0.758	2	0.843	1	12
Clear scope definition for the client	0.844	2	0.783	1	0.826	2	16
Financial capabilities of the client	0.693	4	0.717	3	0.697	4	50
Client's method of payment	0.644	7	0.700	5	0.666	7	59
Experience of procuring construction	0.764	3	0.650	7	0.723	3	45
Client's evaluation and awarding policy	0.676	5	0.700	5	0.686	5	52
<b>All factors</b>	<b>0.739</b>		<b>0.718</b>		<b>0.732</b>		

UN = United Nations, NGOs = Non-governmental organisations.

Clear scope definition for the client was ranked second by the clients and first by the consultants, with RII scores of 0.783 and 0.844, respectively. This factor was ranked second by both groups with an RII of 0.826 and was ranked 16th in the overall ranking.

The results are in agreement with previous studies, asserting that the accuracy of a cost estimate is highly dependent on the level of detail and adequate project scope because it is a definition of the client's requirements for space, function and quality of the proposed project (Akintoye, 2000; Trost and Oberlender, 2003; Babalola and Aladegbaiye, 2006; Dysert, 2006; Liu and Zhu, 2007; Odusami and Onukwube, 2008).

Client's method of payment was ranked last by both clients and consultants for this group with an RII of 0.666 and was ranked 59th in the overall ranking. Both client and consultant groups agreed that this factor does not play a significant role in pre-tender cost estimate accuracy. This result somehow contradicts the findings of Al-Khalidi (1990), in Saudi Arabia, who concluded that client's method of payment has a very strong effect on the accuracy of the estimated cost.

For the Group 1 factors,  $W$  was 0.760 with a  $p$ -value (Sig.) less than the level of significance,  $\alpha = 0.05$ . Thus, the null hypothesis ( $H_0$ ) was rejected and there is sufficient evidence to support the alternative hypothesis,  $H_1$ . There is also a significant degree of agreement among the clients and consultants in this group. For Group 1, the Mann-Whitney test revealed that the obtained  $p$ -value (Sig.) was 0.35, which is much greater than the level of significance,  $\alpha = 0.05$ , for this group. Therefore, there is an insignificant difference between the clients and consultants in terms of the factors related to client characteristics.

## **Group 2: Factors Related to Consultants, Design Parameters and Information**

Relative Importance Index (RII) and ranks of the 23 factors included in this group are shown in Table 3. Project team's experience in the construction type was ranked first by both clients and consultants with an RII of 0.933 and 0.950, respectively. This factor was also ranked third by the combined total sample. This emphasises that this factor is considered a key factor affecting estimate accuracy. The results are consistent with the findings of two previous studies by Trost and Oberlender (2003) and Odusami and Onukwube (2008) in which this factor was ranked second and third, respectively.

The experience and skill level of the consultant was ranked second by both clients and consultants with an RII of 0.917 and it ranked fourth in the overall ranking. The clients ranked this factor third with an RII of 0.916, while the consultants ranked it second with an RII of 0.933. This result indicates that to produce an accurate estimate, those involved in the estimating process must have the relevant professional knowledge and skills. This result agrees with Odusami and Onukwube's (2008) findings in which the respondents ranked this factor first. Moreover, the obtained results are in line with Aibinu and Pasco (2008), Trost and Oberlender (2003) and Madi (2003), who stated that the accuracy of a cost estimate is highly dependent on the level of estimator experience. Having an experienced estimator is critical for producing high-quality and reliable cost estimates. Dysert (2003) emphasised that if an estimator were more professional, budget and other related problems could be greatly reduced.

Volume of consultant's workload during estimation and number of estimating team members were considered the least influential factors by both clients and consultants, with RIIs of 0.677 and 0.600 and overall rankings of 55th and 63rd, respectively. Clients and consultants are satisfied that these factors do not significantly affect the accuracy of cost estimates. These results are justified because the volume of construction projects in the last five years in Gaza has been reduced dramatically after experiencing a boom period, so time is available for consultants to adequately prepare the required cost estimate. Size of estimating team is not that influential if the estimating team members were well-qualified and experienced. These results match findings by Odusami and Onukwube (2008) and Akintoye (2000).

For the Group 2 factors,  $W$  was 0.894 with a  $p$ -value (Sig.) less than the level of significance,  $\alpha = 0.05$ , so the null hypothesis was rejected. Therefore, it can be concluded that there is sufficient evidence to support the alternative hypothesis: there is a significant degree of agreement among the clients and consultants in this group.

According to the Mann-Whitney test, the obtained  $p$ -value (Sig.) was 0.394, which is greater than the level of significance,  $\alpha = 0.05$ , for this group. As such, there is an insignificant difference between the responses of clients and consultants.

Table 3. Ranks and RIIs of Factors Related to Consultants, Design Parameters and Information

Factors	Clients		Consultants		Total Sample		Overall Rank
	RII	Rank	RII	Rank	RII	Group Rank	
The experience and skill level of the consultant	0.916	3	0.933	2	0.917	2	4
Project team's experience in the construction type	0.933	1	0.950	1	0.937	1	3
Designer's experience level	0.836	11	0.800	9	0.823	9	17
Size of estimating team	0.631	23	0.550	23	0.600	23	63
Availability of all fields of specialisation in a project team	0.840	10	0.842	7	0.840	8	13
Project team's capability to control the project	0.689	22	0.733	19	0.706	21	48
Impact of team integration and alignment	0.764	16	0.758	14	0.766	15	29
Level of involvement of the project manager	0.733	18	0.767	13	0.743	18	39
Availability of database of bids on similar projects (Historical cost data)	0.849	8	0.742	18	0.814	11	20

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Table 3. (continued)

Factors	Clients		Consultants		Total Sample		Overall Rank
	RII	Rank	RII	Rank	RII	Group Rank	
Quality of information and flow requirements	0.886	5	0.904	3	0.894	4	6
Completeness of cost information	0.884	6	0.900	4	0.891	5	7
Accuracy and reliability of cost information	0.902	4	0.867	6	0.891	5	7
Applicability of cost information	0.804	13	0.783	10	0.797	12	23
Procedure for updating cost information	0.805	12	0.757	15	0.788	13	25
Utilisation of checklists to ensure completeness and technical basis	0.733	18	0.717	20	0.729	19	43
Quality of the assumptions used in preparing the estimate	0.764	16	0.748	17	0.759	17	34
Estimating method used	0.844	9	0.775	11	0.823	9	17
Volume of consultant's workload during estimation	0.698	21	0.650	22	0.677	22	55
Time allowed for preparing the cost estimate	0.796	14	0.775	11	0.786	14	26
Buildability of design	0.773	15	0.750	16	0.766	15	29
Clear and detailed drawings and specifications	0.929	2	0.883	5	0.914	3	5
Completeness of project documents	0.876	7	0.833	8	0.863	7	11
Level of communication with client and other design team consultants	0.733	18	0.717	20	0.729	19	43
<b>All factors</b>	<b>0.809</b>		<b>0.788</b>		<b>0.802</b>		

### Group 3: Factors Related to Project Characteristics

A total of 11 factors were analysed in this group, as shown in Table 4.

Project complexity was ranked first by both clients and consultants with an RII of 0.806 and it ranked 22nd overall. Additionally, clients and consultants separately ranked this factor first, with RIIs of 0.814 and 0.783, respectively. In this survey, complexity entails the technical complexity of the task, the amount of overlap and interdependencies in the construction stage, the project organisation, the site layout and the unpredictability of work and site construction. This result is supported by Madi (2003), who illustrated that the complexity of projects in the Gaza Strip is likely to increase construction costs. In another study performed by Akintoye (2000) in the United Kingdom (UK) on factors influencing contractors' cost estimating practices, it was established that this factor was the

most important. Project complexity has also been addressed by Elhag, Boussabaine and Ballal (2005), who considered it to be a key factor.

The site conditions factor was ranked second by both clients and consultants with an RII of 0.766 and was ranked 29th overall. Both clients' and consultants' separate rankings placed this factor third with RIIs of 0.769 and 0.750, respectively. This finding emphasises that the estimator must have prior knowledge of site conditions to produce an accurate estimate. The result is consistent with the case study by Enshassi, Mohamed and Madi (2007) in which the winning contractor decreased his estimate because the project location was classified as a quiet area. Moreover, this result closely matches that obtained by Elhag, Boussabaine and Ballal (2005).

Location of project and type of structures were ranked 10th and 11th by both clients and consultants with RIIs of 0.646 and 0.637 and overall rankings of 61st and 62nd, respectively. Clients and consultants believed that these factors have the least influence on the accuracy of pre-tender cost estimates. This result may be because cities and towns in the Gaza Strip are reasonably accessible by means of suitable road infrastructure and the size of projects in the Gaza Strip cannot be classified as mega projects, so these factors have little effect on tender estimation. These results are still consistent with the findings of previous studies undertaken by Akintoye (2000), Elhag, Boussabaine and Ballal (2005) and Odusami and Onukwube (2008).

For the Group 3 factors,  $W$  was 0.768 with a  $p$ -value (Sig.) less than the level of significance,  $\alpha = 0.05$ ; the null hypothesis was rejected. The alternative hypothesis, that there is a significant degree of agreement among the clients and consultants in this group, was justified.

The obtained  $p$ -value (Sig.) from the Mann-Whitney test was 0.781, which is greater than the level of significance,  $\alpha = 0.05$ , for this group and indicates that there is an insignificant difference between the client and consultant respondents toward the factors related to project characteristics.

Table 4. Ranks and RIIs of Factors Related to Project Characteristics

Factors	Clients		Consultants		Total Sample		Overall Rank
	RII	Rank	RII	Rank	RII	Group Rank	
Type of project (residential, commercial, industrial, etc.)	0.653	10	0.692	8	0.669	9	58
Type of structures (concrete, steel, masonry, etc.)	0.618	11	0.667	9	0.637	11	62
Project size	0.786	2	0.700	6	0.759	5	34
Project duration	0.676	8	0.700	6	0.686	8	52
Location of project (town, village camp)	0.671	9	0.592	11	0.646	10	61
Site conditions (hostile area, etc.)	0.769	3	0.750	3	0.766	2	29

(continued on next page)

Table 4. (continued)

Factors	Clients		Consultants		Total Sample		Overall Rank
	RII	Rank	RII	Rank	RII	Group Rank	
Site constraints (access, storage, electricity, etc.)	0.760	4	0.750	3	0.760	3	32
Site requirements	0.711	7	0.650	10	0.694	7	51
Project complexity	0.814	1	0.783	1	0.806	1	22
Method of construction/construction techniques requirements	0.756	5	0.767	2	0.760	3	32
Impact of project schedule	0.738	6	0.748	5	0.743	6	39
<b>All factors</b>	<b>0.723</b>		<b>0.709</b>		<b>0.720</b>		

#### Group 4: Factors Related to Contract Requirements and Procurement Methods

A total of nine factors in Group 4 were analysed, as shown in Table 5. The clear contract conditions factor was voted the most important factor by both clients and consultants with an RII of 0.866 and was ranked 10th overall. It was also ranked first separately by clients and consultants with RIIs of 0.858 and 0.875, respectively. These results agree with Dysert (2006), who stated that clear contract conditions and specifications ensure the proper delivery of services by the contractors and protect the organisation from losses or damages.

Tender selection method was assessed as the second most important factor by both clients and consultants with an RII of 0.814 and it was 20th in the overall ranking. Advanced payment and content of disputes resolution methods clause factors were placed in the last two positions by both clients and consultants, with RIIs of 0.703 and 0.674 and overall rankings of 49th and 56th, respectively. These results were supported by Madi (2003), who argued that these two factors have moderate effects. Moreover, these results are in complete agreement with Elhag et al. (2005), whose results placed this factor 55th out of 67 factors.

For the Group 4 factors,  $W$  was 0.800 with a  $p$ -value (Sig.) less than the level of significance,  $\alpha = 0.05$ , which leads to a rejection of the null hypothesis. Hence, there is a significant degree of agreement among the clients and consultants in this group and the alternative hypothesis is justified.

From the Mann-Whitney test, the obtained  $p$ -value (Sig.) was 0.662, which is greater than the level of significance,  $\alpha = 0.05$ , for this group. Therefore, there is an insignificant difference between the client and consultant respondents toward the factors related to contract requirements and procurement methods.



Table 5. Rank and RIIs of Factors Related to Contract Requirements and Procurement Methods

Factors	Clients		Consultants		Total Sample		Overall Rank
	RII	Rank	RII	Rank	RII	Group Rank	
Type of contract	0.782	3	0.767	4	0.774	4	28
Tender selection method (open, selected, negotiation, etc.)	0.813	2	0.833	2	0.814	2	20
Clear contract conditions	0.858	1	0.875	1	0.866	1	10
Method of procurement (traditional, design and build, project management, etc.)	0.711	6	0.750	6	0.723	6	45
Risk sharing between construction parties	0.742	5	0.758	5	0.749	5	37
Content of disputes resolution methods clause (litigation/arbitration/others)	0.689	8	0.642	9	0.674	9	56
Amount of specialist work	0.769	4	0.825	3	0.791	3	24
Taxes and other financial requirements on tender	0.711	6	0.725	7	0.717	7	47
Advanced payment	0.689	8	0.725	7	0.703	8	49
<b>All factors</b>	<b>0.752</b>		<b>0.767</b>		<b>0.757</b>		

### Group 5: External Factors and Market Conditions

As shown in Table 6, the 14 factors analysed in this group are related to the external factors and market conditions.

Both clients and consultants evaluated material as the most important factor, with an RII of 0.954 and 1st overall ranking. Separate voting of clients and consultants also placed this factor first, with RIIs of 0.947 and 0.967, respectively. This result came as no surprise because in the case of a border closure, available stocks of construction materials would soon run out, leading to price escalation. Enshassi, Mohamed and Madi (2007) reported that a continuous increase in materials consumption may be justified by the repeated border closures and the instability of local markets. During any closure, construction activities would usually be suspended, so this factor has to be considered very carefully by estimators when preparing their pre-tender estimates. The variation between this research and others can be attributed to the different environmental conditions between the Gaza Strip, the UK and Nigeria.

Closure and blockade was ranked second by both the clients and consultants with an RII of 0.951 and second overall. The clients ranked this factor first with an RII of 0.947 and the consultants ranked it second with an RII of 0.954. This result is in line with findings reported by Al-Shanti (2003), who noted that a

closure has a large effect on the prices of basic construction materials such as cement, steel and aggregate, resulting in substantially increased project costs.

Impact of government regulations requirement and Social and cultural impact were assessed as the two least important factors by both clients and consultants, with RIIs of 0.649 and 0.540, respectively and overall rankings of 60th and 64th, respectively. These results were supported by Al-Khaldi (1990), who argued that these two factors have little influence on the estimating process and scored 50% and 61%, respectively.

Table 6. Rank and RIIs of Factors Related to Market Conditions

Factors	Clients		Consultants		Total Sample		Overall Rank
	RII	Rank	RII	Rank	RII	Group Rank	
Material (prices/availability/supply/quality /imports)	0.947	1	0.967	1	0.954	1	1
Labour (costs/availability/performance/productivity)	0.840	4	0.800	5	0.829	5	15
Equipment (costs/availability/supply/condition/performance)	0.827	6	0.800	5	0.820	6	19
Impact of government regulations requirement	0.667	13	0.608	12	0.649	13	60
Number of competitors in the market	0.800	8	0.633	11	0.746	9	38
Classification and level of competitors in the tendering	0.809	7	0.708	8	0.777	7	27
Competitiveness of bidding climate	0.796	9	0.683	10	0.757	8	36
Multiple projects being advertised at the same time	0.764	10	0.692	9	0.743	10	39
Prevailing economic climate	0.836	5	0.842	4	0.840	4	13
Currency exchange fluctuation	0.889	3	0.850	3	0.877	3	9
Weather effects	0.711	12	0.574	13	0.670	12	57
Social and cultural impact	0.551	14	0.508	14	0.540	14	64
Closure and blockade	0.947	1	0.958	2	0.951	2	2
Donor type	0.738	11	0.725	7	0.734	11	42
<b>All factors</b>	<b>0.794</b>		<b>0.740</b>		<b>0.778</b>		

The  $W$  was equal to 0.842 with a  $p$ -value (Sig.) less than the level of significance,  $\alpha = 0.05$ , so the null hypothesis is rejected and the alternative hypothesis is justified. That is, there is a significant degree of agreement among the clients and consultants in this group.

From the Mann-Whitney test, the  $p$ -value (Sig.) was 0.058, which is slightly greater than the level of significance,  $\alpha = 0.05$ , for this group. Therefore, there is an

insignificant difference between the client and consultant respondents toward the factors related to external factors and market conditions.

### Group Comparison

The comparison of the five groups of factors affecting the level of accuracy of pre-tender cost estimates in the Gaza Strip is shown in Table 7.

Table 7. Rank and RIs of All Groups

Group	Clients		Consultants		Total Sample	
	RII	Rank	RII	Rank	RII	Rank
Factors related to consultants, design parameters and information	0.809	1	0.788	1	0.802	1
Factors related to external factors and market conditions	0.794	2	0.740	3	0.778	2
Factors related to contract requirements and procurement methods	0.752	3	0.767	2	0.757	3
Factors related to clients' characteristics	0.739	4	0.718	4	0.732	4
Factors related to project characteristics	0.723	5	0.709	5	0.720	5

The factors related to consultants, design parameters and information group was ranked first by clients and consultants, with RIs of 0.809 and 0.788, respectively. The presence of six of the ten highest ranked factors from this group of factors indicates that this is the most important group of factors affecting cost estimate accuracy of pre-tender. This result agrees with Trost and Oberlender (2003) and Elhag, Boussabaine and Ballal (2005).

Factors related to external factors and market conditions was ranked second by clients and consultants, with RIs of 0.794 and 0.740, respectively. Three factors from this group were within the 10 highest ranked factors and two of these three, material and closure and blockade, were ranked as the two most important factors by both clients and consultants.

While factors related to contract requirements and procurement methods group was ranked third by both the clients and consultants, the clear contract conditions factor of this group achieved the 10th highest score overall. This result indicates that the clear contract conditions have a clear effect on tender prices.

Factors related to clients' characteristics and factors related to project characteristics were ranked fourth and fifth, respectively, by clients and consultants. It is evident that both clients and consultants regarded these two groups as having relatively little effect on the accuracy of pre-tender cost estimates in the Gaza Strip.

## **CONCLUSIONS**

An exploratory study of factors affecting the accuracy of pre-tender cost estimates was conducted to determine the relative level of influence of each factor. The ranking of 64 factors revealed that the ten most influential factors affecting cost estimate accuracy are as follows:

1. Material (prices/availability/supply/quality/imports)
2. Borders closure and blockade
3. Project team's experience in the type of construction
4. Experience and skill level of the consultant
5. Having clear and detailed drawings and specifications
6. Quality of information flow
7. Completeness of cost information
8. Accuracy and reliability of cost information
9. Currency exchange fluctuation
10. Clear contract conditions

The five least influential factors, as evaluated by clients and consultants, are impact of government regulations requirement, project location, type of structures, size of estimating team and social and cultural impact.

From the above results, it was concluded that both clients and consultants generally agree on the ranking order of the factors affecting cost estimate accuracy. This agreement confirms the influential effects of those factors on the accuracy of cost estimates and provides a level of validation for this research. This validation was confirmed by the high values of the Kendall's coefficients of concordance achieved within each group. According to the Mann-Whitney test, there is no difference of opinion between clients and consultants in the factors affecting accuracy of pre-tender cost estimates at the significance level of 0.05.

It is recommended that clients and consultants give more attention to the most important factors that affect the accuracy of pre-tender cost estimates in order to achieve more reliable and realistic estimates. They should monitor the performance of their estimates in terms of accuracy and hire a qualified technical staff to obtain accurate estimates. Clear identification of project requirements is essential before the start of the estimating process. Clients and consultants should also obtain as much accurate information as possible from manufacturers and suppliers pertaining to the costs of procured materials and/or systems. If clients and consultants have a poor understanding of materials (prices/availability/supply/quality/imports), this would undoubtedly affect the accuracy of cost estimates. Clients and consultants should make sure that contract conditions are very clear to both parties.

Finally, it is also recommended that training courses on factors affecting the accuracy of cost estimates should be conducted. These activities would improve the local practice of cost estimating and increase the capabilities of estimators by using estimating software packages. A number of case studies from real life projects are being conducted to gather empirical data.

The findings of this study will help clients and consultants focus on the main causes affecting the accuracy of pre-tender cost estimating and develop effective strategies for accurate cost estimating.

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