

## **Detailed Estimating Practices of Construction Firms in Pakistan**

Rizwan U. Farooqui

*Department of Construction Management, Florida International University, Miami, Florida, USA  
Department of Civil Engineering, NED University of Engineering and Technology, Karachi, Pakistan  
rfaro001@fiu.edu*

Farrukh Arif

*Department of Civil Engineering, NED University of Engineering and Technology, Karachi, Pakistan  
farrukh@neduet.edu.pk*

Syed M. Ahmed

*Department of Construction Management, Florida International University, Miami, Florida, USA  
ahmeds@fiu.edu*

Sarosh H. Lodi

*Department of Civil Engineering, NED University of Engineering and Technology, Karachi, Pakistan  
civchair@neduet.edu.pk*

### **Abstract**

The cost estimate is considered one of the most important and critical phases of a construction project. Preparing reliable and accurate estimates to help decision makers is the most challenging assignment that cost engineers and estimators face. Pakistan, a developing country supplemented by fast growing population, needs adequate and careful allocation of funding for projects of basic amenities and infrastructure. Cost estimating practices play a vital role in procuring the necessary funding for these projects as well to undertake these endeavors successfully. This research presents the results of a questionnaire survey, based on the responses of 46 local construction contracting firms in Pakistan, to assess the current cost estimating practices followed by the contracting firms in Pakistan, along with identifying their cost estimating needs, requirements, considerations, procedures, information items needed for estimating, problems hindering the abilities of estimators, and use of information technology to produce accurate cost estimates. The paper identifies the need for a professional construction management information system to provide timely, accurate and consistent project costing, the need for good communication with subcontractors and material suppliers to keep pace with market trends, and a need to replace the current low bid project procurement environment by a performance based award system for the local construction industry.

### **Keywords**

Detailed estimating, Information items, Computerized estimation, Contractors, Pakistan.

### **1. Introduction**

Detailed cost estimating is the process whereby the contractor arrives at an expenditure of resources necessary to complete a construction project in accordance with plans and specifications (Stewart, 1986). Detailed cost estimating process is extremely important since it enables construction companies to

determine what their direct costs will be, and to provide a 'bottom line' cost below which it would not be economical for them to carry out the work (Smith, 1995). The preparation of a detailed cost estimate for a particular construction project requires collecting, retrieving, and manipulating massive amounts of independent, but related, cost and non-cost data and information (Al-Harbi et al., 1994). Accurate prediction of construction costs is heavily dependent upon the availability of quality historical cost data, strong estimating procedures, the level of professional expertise and extent of use of information technology among other things (Liu and Zhu, 2007). The judgment of these factors is of prime importance for measuring the strength of cost estimating systems and procedures of any construction industry. However, such measurements available for developing countries cover limited aspects only.

Pakistan is a developing country that is currently enjoying relatively strong growth in construction activities. After the lost decade of the 1990s, Pakistan's economy has bounced back and has been exhibiting growth rates of above seven percent in recent years (Economic Survey of Pakistan, 2006-07). This, coupled with population growth rates of over two percent (Economic Survey of Pakistan, 2006-07), places an acute demand on basic and advanced infrastructure, which in turn needs adequate and careful allocation of funding for projects of basic amenities and infrastructure. Cost estimating practices play a vital role in procuring the necessary funding for these projects as well to undertake these endeavors successfully.

This research is an effort to assess the current cost estimating practices of construction firms in Pakistan along with identifying cost estimating needs, considerations, estimating procedures, issues that hinder the abilities of estimators and use of information technology to produce accurate cost estimates by the contracting firms in Pakistan. Remaining competitive implies efforts to continuously implement quality improvement in contractor activities, including the estimating process. As a result of this study, a set of recommendations has been put forward to improve the current systems and procedures of cost estimation.

## **2. Context**

Most construction contracts are fixed price contracts with incentives for cost saving and early completion as well as penalties for cost overrun and delays. Central to cost-based competition is the capability to accurately predict the cost of delivering a project. For constructors, successful bidding is critical for survival and this depends to a large extent on estimates of project cost to the constructor (Skitmore, 1989). Overestimated cost could result in misjudgment for the feasibility of a project or loss of a contract to competitors. On the other hand, an underestimated cost could lead to a situation where a contractor incurs significant losses. This, coupled with the fact that the profitability in the construction industry is generally low as compared to other industries (Akintoye and Skitmore, 1991), can be financially devastating to a contractor organization. As succinctly stated by Hicks (1992), "without an accurate cost estimate, nothing short of an act of God can be done to prevent a loss, regardless of management competence, finance strength of the contractor."

To be competitive, a contractor must be able to create a cost estimate as part of the bid in a way that enables him, on a regular and repetitive basis, to provide a lower price than other contractors, but still be able to recognize a profit. Cost estimating process can be described as "the technical process or function undertaken to assess and predict the total cost of executing an item(s) of work in a given time using all available project information and resources" (Kwakye, 1994). In general terms, a cost estimate in the construction industry is simply a value developed by a contractor that is believed to be adequate to construct a given project. Cost estimates serve many purposes, all of which are important in the planning and construction of a project.

Typically, estimation of project effort needs to be made at various stages of a project. At the conceptual stage, a ballpark figure is needed to ascertain whether the feasibility of the project should be investigated.

Similarly, budget estimates are generated in the schematic design phase to help an owner to determine the proper scope and suitability of his plan. The budget estimate will help an owner define or redefine his scope, and apply for and secure the necessary funding for the project. These initial estimates, although not carrying any direct financial risk, must still be sufficiently accurate and complete to provide an owner the needed information on which he or she will base decisions. Later at the bidding and construction stages, fairly reliable and detailed estimates are needed for bidding and budget control purposes. Due to differences at different project stages in estimation objectives and in the availability of information required for using various estimation methods, effective estimation at different project stages is likely to depend on different sets of factors at each stage. For example, clear scope definition and specification of a project could have more significant effect on the level of estimate accuracy in the early stage than in the later stages.

Cost estimating effort is largely up to the estimator in charge, but it is the contractor's responsibility, as a business organization, to secure the talent necessary that will produce responsible and competitive bids. The ability to attract and retain this talent is paramount to the contractor's success and growth. Having an experienced, knowledgeable, and dedicated estimator is mandatory to a contractor's ability to compete and succeed in the marketplace.

### **3. Research Objectives**

The core objective of the research was to assess the detailed project cost estimating practices in the construction firms in Pakistan. The study target was various types of construction contracting firms, including general contractors, specialty contractors, construction management contractors and design-build contractors. Assessment of practices included identifying cost estimating needs, requirements, considerations, information items needed, and procedures. Furthermore, issues that hinder the abilities of estimators were also diagnosed, as well as extent of usage of information technology to produce more accurate cost estimates was also evaluated.

### **4. Methodology**

The methodology of the study was a six-step process, described as follows:

1. A thorough literature review was done as well as expert opinions were taken from a selected cross-section of local industry experts to identify the key elements of a survey that may provide a good means of judging the local cost estimation practices.
2. A questionnaire was developed to elicit information about the detailed cost estimating practices of local contracting firms.
3. A structured survey was conducted via postal mail.
4. Validation of survey was done via personal interviews with selected personnel.
5. Assessment of feedback from survey was made.
6. Relevant conclusions and recommendations were drawn.

The methodology is explained as follows. In the first step, a thorough literature review was performed to identify the key elements of a survey that may provide a good means of judging the local cost estimation practices. The literature review was done through books, conference proceedings, internet, and leading construction management and engineering journals. Most useful works studied included: Al-Harbi et al., (1994); Hicks (1992); Liu and Zhu (2007); Skitmore (1989); Smith (1995); and Stewart (1986).

Following the identification of the key elements of the survey, expert interviews were conducted from a selected cross-section of local construction industry experts, including representatives from general

contracting organizations, specialty contracting contractors, design-build contractors, construction management professionals and project owners. The objective was to verify the key elements as well as identify any further elements relevant to the local construction industry cost estimating practices and issues. As a result of the interviews, the components and constituent elements of the survey were finalized.

In the next step, a structured questionnaire consisting of two parts was designed – parts A and B. Part A consisted of requesting respondent's personal information (e.g. work experience, experience as cost estimator, etc.) and company information (e.g. type of organization, types of construction works performed, years in business, annual volume of work, number of permanent employees, cities of operation etc.). Part B consisted of requesting information about the detailed cost estimating practices of local contracting firms. This included collecting data on the following aspects: *cost estimation requirements, considerations and setup in the responding organizations; cost estimation procedures and issues in the responding organizations; and computerized estimation process – extent of use and issues.* Part B of the questionnaire is explained in more detail in section 5.

The data of this study were collected from the participants through postal survey. The questionnaire was circulated among general contractors, specialty contractors, construction management contractors, and design-build contractors. The surveys were aimed to be filled by the cost estimating personnel in the target organizations. Few unstructured interviews with selected respondents from the various groups of contractors were also conducted to clarify their responses, to discuss the survey results and to validate the survey. The survey response details are given in section 6.

In the final steps, based on all the gathered information, a descriptive analysis was performed as to the current cost estimating practices of construction firms in Pakistan along with identifying cost estimating needs, considerations, estimating procedures, issues that hinder the abilities of estimators and use of information technology to produce accurate cost estimates by the contracting firms in Pakistan. The analysis of results is given in section 7.

Based on the survey results and analysis, relevant conclusions and recommendations were drawn and are as given in sections 8 and 9.

## **5. Survey Design**

A structured questionnaire consisting of two parts was designed – parts A and B. As identified and explained in section 4, part A consisted of requesting respondent's personal information and company information.

Part B consisted of three sections. The first section was titled *cost estimation requirements, considerations and setup in the responding organizations.* This section contained questions about estimators and their firms, including required years of experience for estimators, language of communication between contractor and the owner or owner's representative, management level at which the firm's bidding prices are settled, and method of allocating company overhead, project overhead, and profit.

The second section was titled *cost estimation procedures and issues in the responding organizations.* In this section, the participants were asked about the methods of detailed estimating usually used, and their assessment of their own past estimates. Sixteen important information items were needed to make the detailed estimates, and 21 problems that may face estimators were listed for evaluation. The participants were asked to rate both information items and problems, according to their importance on a five-point scale (0 = very low; 1 = low; 2 = medium; 3 = high; and 4 = very high).

The third section was titled *computerized estimation process – extent of use and issues*. This section was provided to help assess whether the estimator used a computer in developing cost estimates, and the reasons if the answer was "no." If the answer was "yes," the participant was asked to state the type of estimating software used, benefits of computerized estimation, and whether the computer was being used to perform other management functions such as accounting and project scheduling.

## 6. Survey Response

### 6.1 Response Rate

The response rate for the survey is shown in Table 1. This response rate (54%) is considerably good for a construction industry questionnaire survey. In similar construction industry surveys, Farooqui et al. (2008) received a response rate of 57%, and Ahmed and Azhar (2004) received 30.4%. Baker (1998) reported that statistically reliable conclusion can be obtained from a sample size of 20 or more.

**Table 1: Breakdown of Responses**

Total questionnaires sent	Questionnaires returned incomplete	Total number of potential responses	Total valid responses received	Percentage of valid responses
85	6	79	46	54%

### 6.2 Respondent Characteristics

The respondent firms included various types of construction industry contracting firms, including general contractors (51.2%), specialty contractors (22.1%), construction management contractors (15.4%), and design-build contractors (11.3%). The average number of years in business for the responding firms was thirty (30) years. These firms were involved in various types of construction works including heavy engineering/ infrastructure construction (73.9%), commercial building construction (43.5%), industrial construction (34.8%), institutional construction (hospitals/ schools etc.) (30.4%), and residential construction (26.1%). Note that there were overlaps in their work sector shares. The areas of construction works operation included the major cities of Pakistan. All sizes of firms, in terms of number of permanent employees, were represented in the survey sample: under 50 (20.8%), 50-100 (29.2%), 100-150 (0%), 150-200 (29.2%), and over 200 (20.8%).

The respondents included estimators working with these organizations. The average total work experience of the responding personnel was almost eleven (11) years, while the average work experience related to cost estimation or cost engineering was almost eight (8) years. Almost 56% of the respondents had at least a bachelor's degree in civil engineering or related discipline.

## 7. Analysis and Discussion

The analysis of the survey is organized in three key areas as follows:

1. Cost estimation requirements, considerations and setup in contractor organizations
2. Cost estimation procedures and issues in contractor organizations
3. Computerized estimation process – extent of use and issues

In line with the format of the questionnaire, the results are reported in three sections. The companies' responses are indicated as a percentage of total responses.

## 7.1 Cost Estimation Requirements, Considerations and Setup in Contractor Organizations

In this section of the survey, the respondent contracting firms were asked about the basic cost estimation requirements, their considerations in the estimation process and their firm's cost estimation setup. The results are illustrated in the following sub-sections.

### 7.1.1 Experience Requirement for Cost Estimators

The respondents were asked about minimum experience required by firms to hire cost estimators. The results showed that almost 22% of the firms had no particular requirement of experience for hiring cost estimators, while only 26% of the firms required an experience of more than five years. Almost 69% of the organizations required at least three years of experience for estimating employment. A breakup of the results is shown in Table 2.

**Table 2: Minimum Experience Requirement for Cost Estimators**

<b>Minimum Experience Requirement for Cost Estimators</b>	<b>Response Distribution (%)</b>
No particular requirement for experience	22
1-2 years	9
3 years	30
4-5 years	13
6-7 years	17
8-9 years	0
10 years or more	9

The results show that an appreciable proportion of firms (31%) place little or no emphasis on estimator's experience during the hiring process. This may indicate that these firms do not necessarily consider experience of estimator as a significant factor contributing towards more accurate estimation. This, in a way, shows weakness of, as well as lack of adequate emphasis on the cost estimation setup of construction contracting firms.

### 7.1.2 Language Used in Developing and for Communicating Estimates

The respondents were asked about the language used in developing cost estimates. Responses indicated that almost seventy percent (69.6%) of the firms developed their cost estimates in English, while the remaining (30.4%) used both Urdu and English to develop their estimates. The firms were also asked about the official language used for communication among the stakeholders regarding estimates. Almost forty eight percent (48%) of the firms used English only as the official communicating language while the remaining fifty two percent (52%) of the firms used both Urdu and English as the official communicating language. Urdu was not being used alone for developing as well as communicating estimates, because many materials and equipment were imported from outside the country, with English names and specifications. The above inconsistency in the use of one language for developing and communicating estimates indicates a lack of formalized approach towards the cost estimating process in the industry, which may be a contributing reason leading to cost related disputes.

### 7.1.3 Management Level at which Firm's Bidding Prices are Settled

The firms were inquired as to whether project management and/ or functional management input was customarily sought while settling bid prices. Most of the firms (65.2%) were found to settle their bid prices at the top management level only without any involvement of project and/ or functional management. This lack of consideration of project technical and managerial requirements and issues shows that bid estimates are usually produced with the objective to win bids rather than to accurately

estimate the real cost of the project, since the earlier is usually the primary concern of top management. This provides a major reason of ending up with unrealistic project cost estimates, specifically in a low bid work environment like Pakistan. A breakup of the results is shown in Table 3.

**Table 3: Management Level at which Firm’s Bid Prices are Settled**

<b>Management Level</b>	<b>Percent of Responses</b>
Project management	21.3%
Functional/ Departmental management	13.5%
Top/ Executive management	65.2%

#### **7.1.4 Methods of Allocating Project and Company Overheads**

The firms were inquired about their method of allocating overheads – project and company. With respect to project overheads, the results show that most firms (69.56%) do breakup assessment for allocating the overhead, whereas the remaining firms (30.43%) use a fixed percentage of total estimated direct project cost that usually varies (according to nature of the project) between 5% to 40%. The large variation in project overhead percentage shows an evident lack of cost control mechanisms on projects.

With respect to company overheads, results indicate that more than one-third of the firms (36.85%) do breakup assessment to allocate yearly company overhead to projects. Also, an almost similar proportion of firms (35.05%) allocate these overheads to projects proportionally based on project’s monetary value and schedule (estimated time of completion) that usually varies between 2% to 5%. The remaining firms (28%) allocate these overheads equally to all projects currently in hand or are in the planning stage.

#### **7.1.5 Contingency Allocation**

To overcome the project risk, a number of firms (36.84%) allocate contingency allowance as a fixed percentage of total direct cost of project. This fixed percentage usually varies between 1% and 3%. Also a number of firms (26.32%) allocate contingency allowance as a fixed percentage of total estimated project cost, while the remaining firms do not allocate any contingency allowance for overcoming project risks. Allocating contingency as a fixed percentage in a project shows lack of usage of a structured risk management approach or rather a lack of usage of proactive risk management strategy on projects. Zero contingency allocation by a few firms indicates a lack of appreciation of the need to fund projects from reserve accounts to cater for unfavorable, unforeseen or changed conditions.

#### **7.1.6 Profit Allocation**

As far as profit allocation is concerned, most of the firms (65.2%) were found to estimate profit based on many subjective factors such as nature of the job, job need for the company, resource commitment on the job, job schedule, type and nature of client, etc. The result shows that there is a good level of understanding among the contracting firms for the consideration of the above-mentioned factors in order to achieve a successful profitable project.

### **7.2 Cost Estimation Procedures and Issues in Contractor Organizations**

In this section, the respondent firms were asked about the basic cost estimation procedures, the process they follow, information needed to develop estimates and issues and obstacles involved in the process. The results are discussed in the following sub-sections.

### 7.2.1 Methods of Detailed Estimating

The detailed estimates for lump sum projects are usually prepared using unit cost estimates (67.8% firms), which are based on material, labor and equipment prices, and man-hour production rates. Most of the remaining firms (22.4%) use schedule-based estimation performed by resource/ cost loading via computerized methods/ software (such as Microsoft Project, Primavera Project Planner). The remaining firms (9.8%) use manual procedures for developing estimates of lump-sum projects. Unit cost estimation is the usual method used by firms for unit priced projects and cost reimbursable projects (85.2% firms and 80.6% firms respectively).

Bid unbalancing concept is not mentioned to be very often utilized, while developing the detailed estimates. Also, it is rather shocking to know that the subcontractors, material suppliers and manufacturers are not usually thoroughly involved in the estimate preparation.

### 7.2.2 Ranking of Information Items for Detailed Estimates

A list of probable information items required for the development of detailed bid estimates was developed through literature review and expert opinion. The construction firms were asked to rank the degree of importance of these information items on a five point likert scale (1 = very low; 2 = low; 3 = medium; 4 = high; and 5 = very high).

The importance index of each information item was calculated using the following formula:

$$\text{Importance Index} = \frac{\sum (\text{Importance score} \times \text{Response frequency at that importance score})}{\text{Total Number of Responses}}$$

With respect to the input provided by the survey participants, the mean ranking of information items based on degree of importance is shown in Table 4, in descending order of importance.

**Table 4: Mean Rank of Information Items needed for Detailed Cost Estimates**

Rank	Information Item	Usage Index (on a scale of 5)	Rank	Information Item	Usage Index (on a scale of 5)
1	Bid documents	4.6	5	Project location	4.1
2	Material prices	4.4	10	Skilled labor availability	4.0
3	Owner requirements	4.4	11	Labor rates	3.9
4	Equipment Costs	4.3	12	Government regulations	3.7
5	Required equipment availability	4.1	13	Risk identification	3.6
5	Inflation rate	4.1	14	Labor productivity	3.5
5	Overall economic situation	4.1	15	Historical profit information	3.3
5	Project scope and definition	4.1	16	Historical data of similar work	3.2

Bid documents have come out to be the prime source of information for the preparation of detailed cost estimates. Historical data and historical profit information have been considered as the least important information items. In Pakistan, there are no published construction cost indices or average costs to help the estimator to know cost trends. Also, there is only a rare trend in the construction industry to build strong databases or historical profiles to be used as the reference for the future. Hence the above finding indicates: 1) a lack of structured database system for cost estimating, and 2) a lack of trust of organizations over their own estimation procedures since they do not consider the historical data of cost estimation as reliable. The latter is more alarming and signifies a drastic need for improvement of cost estimating practices.

### 7.2.3 Most Critical Problems Faced in Estimation

A list of potential problems in the development of detailed estimates was developed through literature review and expert opinion. The surveyed construction firms were asked to rank the severity of these potential problems on a five point likert scale (1 = very low; 2 = low; 3 = medium; 4 = high; and 5 = very high). The severity index of each potential problem item (problem severity index) was calculated using the following formula:

$$\text{Problem Severity Index} = \frac{\sum (\text{Problem severity score} \times \text{Response frequency at that severity score})}{\text{Number of Responses}}$$

The mean ranking of problems based on severity index is shown in Table 5, in descending order of severity.

**Table 5: Mean Ranking of Problems in Detailed Cost Estimations**

Rank	Estimating Problem	Problem Severity Index (on a scale of 5)
1	Tough competition	3.9
1	Unforeseeable change in material prices	3.9
1	Incomplete drawings and specifications	3.9
4	Current workload	3.8
5	Contract period	3.7
5	Difficulty of project	3.7
7	X factor (corruption, favoritism, lack of ethics, etc.)	3.6
8	Changes of owner requirements	3.5
8	Lack of familiarity with government regulations	3.5
10	Incomplete project scope definition	3.4
11	Lack of labor productivity information in Pakistan	3.3
11	Lack of experience in similar jobs	3.3
11	Inadequate estimate development time	3.3
14	Work item omission	3.2
15	Judgment errors	2.9
15	Content of arbitration clauses	2.9
15	Lack of cost data indices in Pakistan	2.9
15	Lack of historical data for similar jobs	2.9
19	Calculation errors	2.8
20	Lack of confidence in workforce	2.7
21	Portion of work to be subcontracted	2.5

Tough competition, changes in material prices, and incomplete drawings and specifications have been identified as the three most significant problems faced by cost estimators in estimation process. Tough competition calls for competitive bidding prices, which in turn call for accurate cost estimates to win jobs. Tough competition in Pakistan can be attributed to the low bid culture in the construction industry that compels contractors to produce as low estimates as possible in order to obtain the work. Fluctuating material prices is a common trend in the country owing to large dependency on imports, inconsistent government policies with respect to import restrictions and duties, as well as lack of price control. Incomplete drawings and specifications is a direct consequence of lack of focus on developing clear, complete and detailed bid documents.

### 7.2.4 Perceived Quality of Cost Estimates

A low proportion of the firms (38%) indicated that they consider their past estimates to be satisfactory. The survey results revealed that the cost estimates of these firms were more or less precise - the actual

project cost was, on average, within 5% of the total estimated cost in most cases for these firms. However, an appreciable proportion of firms (32%) found their estimates to be mostly on the low side (underestimated). In such cases, the actual project cost was found to be more than 10% of the estimated cost. Few firms (9%) indicated that they usually find their estimates over-estimated (usually in the range of 10%), while the remaining firms (21%) were unable to judge the preciseness of their estimates. The latter either indicates a lack of focus on the significance of cost estimating and control mechanism in the organizations or the lack of a good cost engineering system in the organizations. An appreciable percentage of estimates (almost 41%) are inaccurate, which may be the driving cause of many project disputes.

### **7.3 Computerized Estimation**

In this section, the state of use of computer and information technology in cost estimation process by the construction firms of Pakistan has been assessed. The survey results show that a major proportion of the estimation process in most firms (78% firms) is done via some form of computers. All of the firms that use computers (78%) primarily use spreadsheets for the estimation process, while still an appreciable proportion of firms (56.5%) also use professional scheduling software such as Microsoft Project or Primavera Project Planner for the costing process. However, a thorough assessment of the extent of usage of these scheduling software indicated that these are in most cases used for presentation purposes only. Use of over-the-counter estimating software such as Precision Estimator, Win Estimator Pro etc. is almost non-existent. Further assessment indicated that although these software are available in the market, lack of training and software installation/ usage support by the vendors is a major reason for companies not opting for these pre-fabricated cost estimation software, but rather resorting to custom-made excel spreadsheets. Lack of computing skills has been termed as the major reason for not using computerized estimation by the remaining 22% firms.

## **8. Conclusions**

The study has resulted in drawing valuable information about the cost estimation practices in the construction industry of Pakistan. The major conclusions drawn from the study are as follows.

1. There is a minimum of three to five years of cost estimation experience generally required for cost estimators in the construction industry of Pakistan. However, few firms do not necessarily consider experience of estimator as a significant factor contributing towards more accurate estimation. This, in a way, shows weakness of, as well as lack of adequate emphasis on the cost estimation setup of construction contracting firms.
2. English is being used as the primary official language both in preparation of cost estimates and in communication. However, use of both Urdu and English for developing and communicating estimates is also predominant in the industry, which indicates a lack of formalized approach towards the cost estimating process in the industry.
3. The bidding prices are mostly settled at the top management level, with little input from project and/or functional management. This shows that only business point of view of estimates (that is winning the bids only) is more influential. The result is unrealistic bids due to low bid trend in Pakistan.
4. Breakup assessment is the most utilized way to allocate project and company overheads. Project overheads usually vary according to the size and nature of the project between 5 to 40%. The large variation in project overhead percentage shows an evident lack of cost control mechanisms on projects.
5. The risk contingency percentage varies from 1% to 3% of total direct cost of the project in construction projects of Pakistan. Zero contingency allocation by a few firms indicates a lack of appreciation of the need to fund projects from reserve accounts to cater for unfavorable, unforeseen or changed conditions.

6. Profit margin is directly linked to nature of job, job need for the company, resource commitment and the type and nature of client.
7. Detailed estimates are usually prepared using unit cost estimates, which are based on material, labor and equipment prices, and man-hour production rates. Schedule-based estimation using software is also used in the industry, particularly for lump sum projects.
8. The subcontractors, material suppliers and manufacturers are not usually indicated as being involved in the estimate preparation. Also bid unbalancing concept is not very often utilized.
9. Bid documents have come out to be the prime source of information for the preparation of detailed cost estimates.
10. There is very low trend or culture of utilizing past record and data as the means for future estimating exercises. This is a direct consequence of the non-availability of commercially available cost databases. Also, reliability on the own estimation process seem to be on the lower side. A low proportion of the firms indicated that they consider their past estimates to be satisfactory.
11. Tough competition created most of the time owing to low bid culture creates a major problem in developing accurate estimates.
12. Spreadsheets, Microsoft Project and Primavera Project Planner are being used for costing purposes which is a good sign.

## **9. Recommendations**

Based on the conclusions from the study, following are major recommendation to further improve the cost estimation process and thus the accuracy of cost estimates in construction industry of Pakistan.

1. Communications between estimators and project owner, and/or the consultant, should be established or improved during the estimating process.
2. The firms require experienced cost estimators. They should also be considering the development of new and better estimators through training. This can be done by assigning a zero experience estimator with an experienced one. The training should involve the skill of using software for costing as well.
3. The settling of bidding prices should also involve major input from the engineers, project managers and other experts as well. This will result in more realistic and accurate estimates, since, the technical and managerial complexities involved in a project are better understood by the project engineers, project managers etc.
4. Allocating risk contingency percentage without prior risk analysis is a reactive approach. Proper risk analysis should be done for each project to reduce the chances of risks and thus the contingency percentage.
5. Good communication should be maintained with subcontractors and material suppliers to keep pace with market trends. The subcontractors, material suppliers and manufacturers should be thoroughly involved in the estimate preparation to prepare more accurate and realistic estimates.
6. Well-organized historical cost data should be maintained in a single suitable location accessible to cost estimators.
7. Historical records for all possible competitors should be maintained, and a bidding strategy based on available information should be developed.
8. There is a strong need of a very elaborate and broad database of past project records for the construction industry. This database could easily be developed by the collaboration of local academia and the construction industry. This will be helpful for the industry in not only providing standard estimating procedures but also providing a means, especially for new entrants in the industry, to develop precise cost estimates. In this regards, universities can provide the technical human resource and industry can come up with other required resources such as finance, access to the projects and access to their documents, etc.
9. Low bid culture should be discouraged because it has created negative competition and has resulted in cost overruns and delays in many projects. Performance based award system should be adopted for

the construction projects procurement processes. This will stress upon the contracting firms to develop more accurate estimates and for that purpose the firms will have to refine their procedures, setup and resources of cost estimation.

10. Computer estimating should be encouraged as a productivity tool in the estimating process.

## 10. References

- Ahmed, S. M., and Azhar, S. (2004). "Risk Management in the Florida Construction Industry". *Proceedings of the 2nd Latin American and Caribbean Conference for Engineering and Technology*, Miami, Florida, June 2-4.
- Akintoye, A. and Skitmore, M. (1991). "Profitability of UK construction contractors." *Construction Management and Economics*, Vol. 9 No. 3, pp 311-325.
- Al-Harbi, K. M., Johnston, D. W., and Fayadh, H.(1994). "Building construction detailed estimating practices in Saudi Arabia." *Journal of Construction Engineering and Management*, Vol. 120 No. 4, pp 774-784.
- Baker, S. W. (1997). *Risk Management in Major Projects*. Ph.D. Thesis, University of Edinburgh, UK.
- Economic Survey of Pakistan. (2006-07). Economic Review FY 2007, Government of Pakistan.
- Farooqui, R.U., Saqib, M., and Ahmed, S.M. (2008). "Assessment of Critical Skills for Project Managers in Pakistani Construction Industry." *Proceedings of the First International Conference on Construction in Developing Countries (ICCIDC-I)*, Karachi, Pakistan, August 4-5, 2008, pp 221-234.
- Hicks, J.C. (1992). "Heavy construction estimates, with and without computers." *Journal of Construction Engineering and Management*, Vol. 118 No. 3, pp 545-555.
- Kwakye, A.A. (1994). "Understanding Tendering and Estimating", Gower, London.
- Liu, L. and Zhu, K. (2007). "Improving Cost Estimates of Construction Projects Using Phased Cost Factors", *Journal of Construction Engineering and Management*, Vol. 133 No. 1, pp 91-95
- Skitmore, R.M. (1989). "Contract Bidding in Construction: Strategic Management and Modeling." Longman Scientific and Technical, Harlow, Essex.
- Smith, A.J. (1995). "Estimating, Tendering and Bidding for Construction", Macmillan, London.
- Stewart, R. D., and Stewart, A. L. (1986). *Microestimating for civil engineers*. McGraw-Hill, Inc., New York, N.Y.