CRITICAL FACTORS AFFECTING THE MARKUP DECISION IN INFRASTRUCTURE PROJECTS IN SRI LANKA

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Degree of Master of Science

Department of Building Economics

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Dissertation submitted in partial fulfilment of the requirements for the degree Master of Science in Project Management

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate, without acknowledgement, any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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I hereby acknowledge that W.R.S.C. Ranaweera has followed the dissertation process for the Master of Science in Project Management set by the Department of Building Economics under my supervision.

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Prof. (Mrs.) B.A.K.S Perera. Date of Dissertation Supervisor

ABSTRACT

Critical factors affecting markup decision in infrastructure project in Sri Lanka.

Sri Lankan construction industry is growing rapidly in current time. There is a lot of new projects available to the contractors due to the boom stage of Sri Lankan construction industry. The tender estimate is a vital path to get the projects. Markup decision is a critical step of tender estimating process. This research analyses the critical factors affecting bid markup decision in infrastructure project in Sri Lankan construction industry. This study expects to fulfill the research gap and uplift the Sri Lankan contractors' bid markup decision. The aim of this research is to identify critical factors affect bid markup decision in infrastructure projects in Sri Lanka. This research has been conducted through literature reviews, questionnaire survey and cross case analysis. The questionnaire included eighteen factors identified through literature reviews and preliminary interviews with a view to finding the critical factors which affect the bid markup decisions of Sri Lankan contractors. The analysis of data revealed that there is a nine critical factors identified as critical factors and further cross case analysis was done to identify the relationship between markup and each critical factors by selecting ten recently tendered infrastructure projects in Sri Lankan construction industry as this research is limited to infrastructure projects. These conclude that how much each critical factor affects the contractor's markup decision for their tender estimates. The study recommended that contractors give more attention to the cost estimate accuracy to make an appropriate markup the projects in a better way by avoiding cover estimate uncertainty risk into markup and train staff to estimate accurately and to hire qualified technical staff in order to obtain an accurate estimate.

Keywords: tender cost estimation, accuracy, contractors, mark up.

Dedication……...

This dissertation is lovingly dedicated to my beloved father, mother, wife & son for their Love and Supports

ACKNOWLEDGEMENTS

This dissertation is not just a single effort of mine. This is the result of an immense effort and support given by lots of others. Therefore, I would like to record my sincere thanks for those who spent their valuable time with courtesy.

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Finally, I would like to extend my gratitude towards my family members, all my colleagues, office staffmembers who stood behind me in very difficult times giving me courage. If not for you this would not have been a reality.

At the end I would like to express appreciation to my beloved wife who spent sleepless nights and was always my support in the moments when there was no one to answer my queries.

Ranaweera W.R.S.C.
June 2017

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

RII	Relative Importance Index
LKR	Sri Lankan Rupee
RIBA	Royal Institution of British Architects

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CHAPTER ONE

1 INTRODUCTION

1.1 Background

As the construction industry is an open system, which is very sensitive to change, its characterization throughout the world is determined by the operating external environment, which consists of subsystems such as economic, political, financial, legal and technological. This has led the industry to be in a challenging state in addressing the changes forced by the subsystems in an efficient and effective manner. (Rameezdeen & Silva, 2002).Further noted that the wellbeing of the national construction industry is of paramount importance for economic development and long-term growth of a country.

Mostly in Construction industry dominated by a competitive business environment that is being driven by a lowest cost mentality the pressure on contractors' markup. Shash (1993) stated that, in competitive bidding, the bidding process involves two critical decisions, bid or not to bid' and mark up size. Both the bid decision and the determination of bid price are very important to every contractor. In addition to construction industry is commonly characterized by high level of competition. Since the large majority of the contractors win jobs through the bidding process and the owners predominantly select the contractors, who offer the lowest bid price, estimating the bid price accurately is critical for winning the contract and achieving business continuity. (Gul, Seyda & Eray, 2015).

As per Akintoye and Skitmore (1990), It is extremely fragmented and highly competitive. Contractors have to bid competitively for most of their work and at the same time deal with risks and uncertainties connected with bid submission. A great deal of current information is needed together with forecasts of demand, cost, competition, etc., to enable bids to be set and adjusted to desired profit levels

In the bidding environment, contractors should win new contracts in order to achieve their business continuity. Since owners generally tend to select the contractors, who

offer the lowest bid price, estimating the bid price accuracy is critical. As per Gul, Seyda and Eray, (2015) the bid price mainly comprises the direct costs and indirect costs of the project in question. The bid mark-up consists of general overhead cost, profit, and contingency. In general, the bid mark-up is estimated as the percentage of the base on the estimators' intuitions and past experiences. While the base estimate is found to be more or less same by competitor contractors, the offered bid prices greatly differ due to the variations in the bid mark-up size estimations. Therefore, determination of the right amount of bid mark-up is very important for contractors.

Also Lee & Chang (2004), determining the right size of bid-markup is not an easy task for a contractor. The markup must be low enough to ensure a good chance of winning a contract, but high enough to realize a reasonable profit. The determination of proper markup involves the consideration of numerous factors. In the underground construction portions, the factors considered can be increased because of uncertain subsurface conditions.

Further Lee& Chang (2004) stated that the Selection of reasonable markup is complex decision process. The complexity arises from inherent characteristics to construction projects such as. Consequence of bid price is uncertain and largely number of factors to be considered to make sound decision .Also contactors' success depend on his or her ability to assign appropriate markup size brings enough jobs and profit to the company. Therefore, contractor should take strategic approach to bid markup decision.

Determination of the competitive bid price is very important to every contractor. There are various factors effect for the size of bid markup. It governs deciding of correct markup for the project, the importance of such decisions lies in the fact that, the success or failure of a contractor's business depends on the outcome derived from these decisions.

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1.2 Problem Statement

Many studies have been conducted to identify the factors that influence bidding decisions within the recent past (Cheng, Hsiang, Tsai & Do, 2011). As per Lee & Chang (2004), determining the right size of bid-markup is not an easy task for a contractor. The markup must be low enough to ensure a good chance of winning a contract, but high enough to realize a reasonable profit. The determination of proper markup involves the consideration of numerous factors. Some factors are more important and some are less important. It will be deviated according to many factors. Due to the wrong decision making of bid markup may have chance to push the contactor to a critical situation.

Hence, there is a gap in identifying factors affecting the size of bid of markup decision and level of impact of each factor in infrastructure projects in Sri Lankan Construction industry, which accentuate the need in the global industry as well as in literature. Further it would be helpful to the construction industry to decide the right size of bid markup level by keeping the contractor in win- win situation.

1.3 Aims and Objectives

The aim of this research is to find out critical factors affecting bid markup decision in infrastructure projects in Sri Lankan construction industry. To achieve this aim the following objectives would have to be considered.

1. Identifying the importance of bid markup decision
2. Identifying factors affecting bid markup decision
3. Identifying the critical factors affecting bid markup decision.
4. Investigating the relationship between markup and critical factors.

1.4 Scope and Limitation

This research was focused on infrastructure sector construction industry in Sri Lanka. This research only focuses contractors view in private and government sector.

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1.5 Methodology

1.5.1 Literature Survey and Review

A comprehensive literature survey was carried out through journals, articles, dissertations, books and the internet to obtain existing knowledge of importance of markup decision and factors affecting markup decision in construction industry in order to achieve objective one and two.

1.5.2 Preliminary Interview

Preliminary interviews were carried out as a pilot survey to verify the finding of literature survey and identify if any additional factors affecting bid markup decision in Sri Lanka which are not identified through literature review in order to assist questionnaire survey.

1.5.3 Questionnaire Survey

A comprehensive questionnaire survey was carried out to obtain critical factors and its impact level on bid markup decision in infrastructure projects in bid markup decision.

1.5.4 Cross Case Study Analysis

Cross Case Study analysis was done to identify the relationship between markup and critical factors in current Sri Lankan construction industry.

1.6 Chapter Breakdown

Follows figure 1-1 discussed about the chapter breakdown in detail.

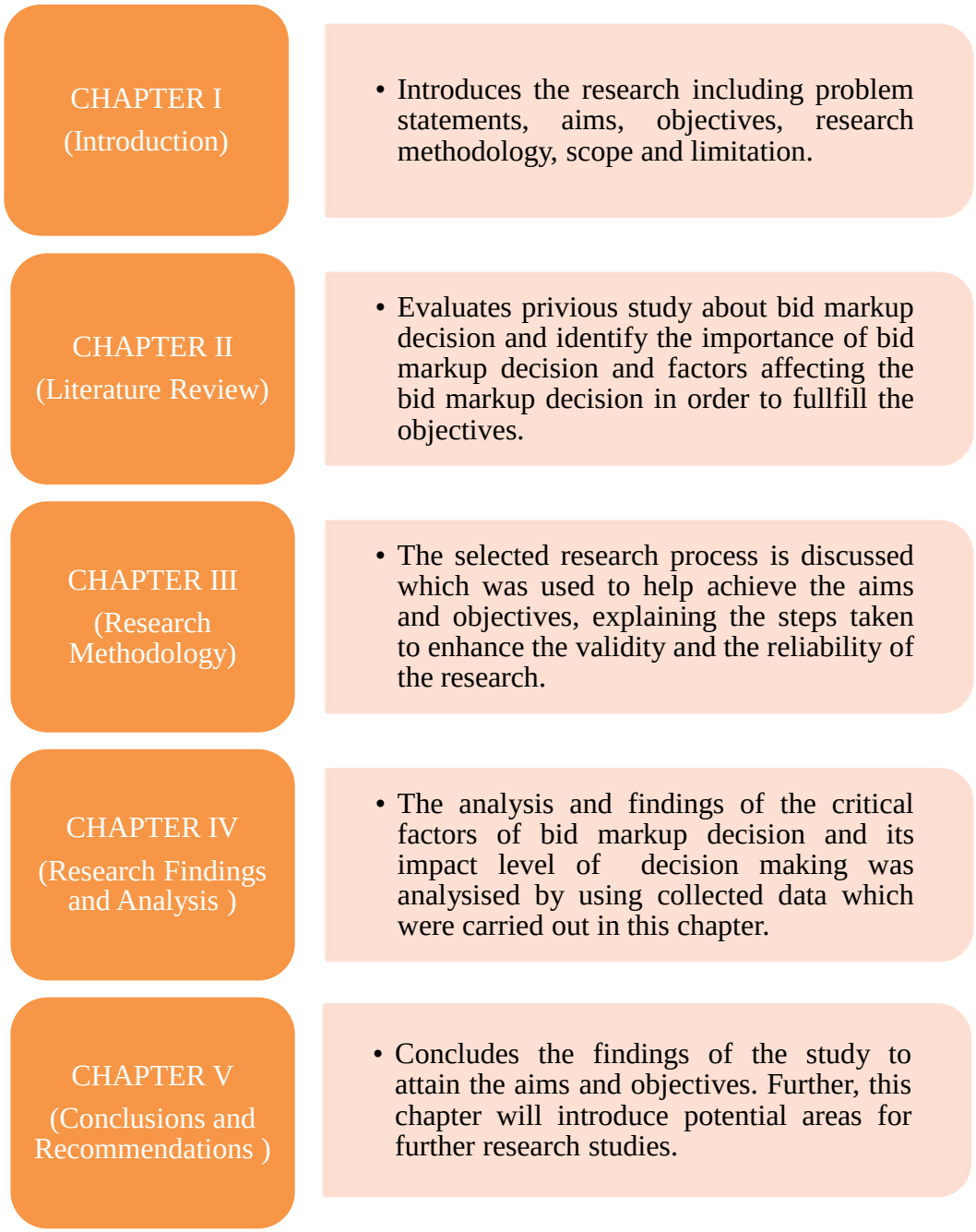

Figure 1-1 Chapter Breakdown

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CHAPTER TWO

2 LITERATURE SYNTHESIS

2.1 Introduction

A brief introduction to the research was given in Chapter one. Accordingly, this chapter aims to understand the current knowledge level regarding the research area and to establish the research problem. Therefore, this chapter is structured under following topics; construction industry, bidding, bid markup and factors affecting bid markup. Hence, the very first objective of the research is achieved by identifying type of bidding and markup. Subsequently, the second and the third objectives are covered by the topics with respective, identifying the importance of bid markup decision and identifying factors affecting bid markup decision. Finally, the research problem is established.

2.2 Construction Industry

The construction industry of any country, recognized as an economic regulator, plays a key role in its economy providing significant contribution to the national output. Its strong interdependence with other sectors of the economy has been established (Rameezdeen & Silva, 2002). Further, Valence (2010) has described the construction industry according to its characteristics as heterogeneous, widely spread industry, where no two outputs are sharing the same characteristics. In the same way, Fellows et al. (2002) illustrated the construction industry which has a large number of firms, higher amount of manpower and have derived demand. Also Rameezdeen and Silva, (2002) noted that the wellbeing of the national construction industry is of paramount importance for economic development and long-term growth of a country. As the construction industry is an open system, which is very sensitive to change, its characterization throughout the world is determined by the operating external environment, which consists of subsystems such as economic, political, financial, legal and technological. This has led the industry to be in a challenging state in addressing the changes forced by the subsystems in an efficient and effective manner.

Further Ofori, G. (1990) describes construction process as indicated in Figure 2.1.

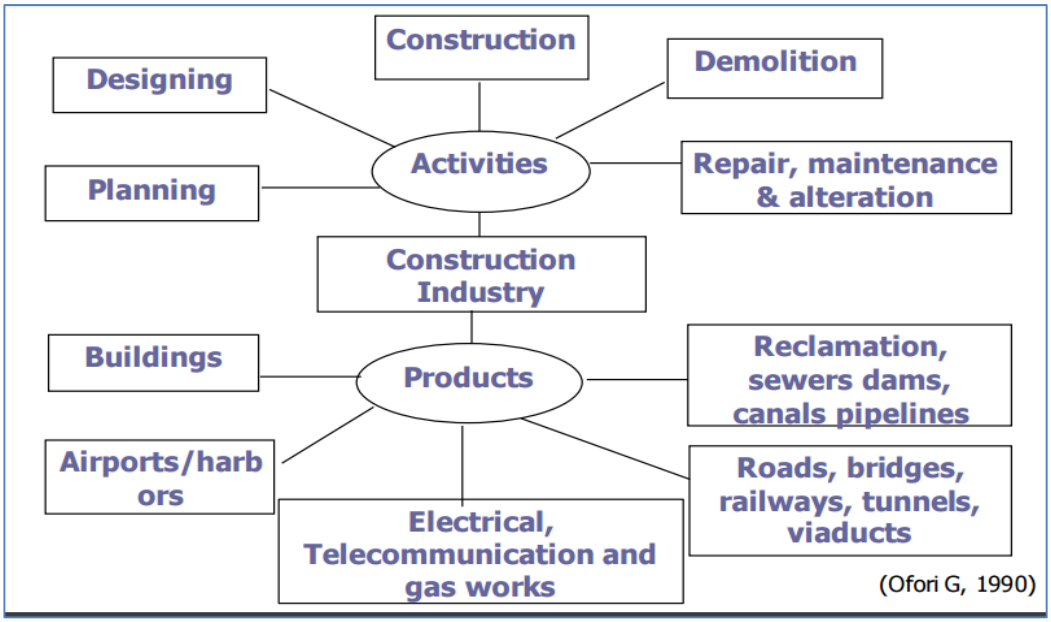

Figure 2-1 Construction Process

Source: (The construction industry – Aspect of its economic and management, 1990)

2.3 Characteristics Construction Industry

The construction industry has characteristics that are separately shared by other industries but in combination appear in construction alone (Hillebrandt, 1984). Rameezdeen (2006) noted some of unique characteristic of construction industry as follows.

- The final product is large, heavy, expensive, and spread over a large geographical area. The product is made especially to the requirement of each individual customer.
- Design is separated from construction.
- Production takes place on site itself.
- Affected by the external environment.
- Price of the product is determined in advance.

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2.4 Phases of a Construction Project

Kawakye (1997) mentioned that the construction project is highly complex in nature and has a group of activities interconnected under several phases by considering their nature. Furthermore, Anderson et al. (2006) divided the construction project into three main phases, as Pre-Construction, Construction, and Post-Construction where the sub phases of a construction project are mainly the owner's planning and budgeting phase, the design phase when the drawings and plans are created, contractor selection phase, physical construction phase, completion phase and handing over phase.

On the other hand, Kawakye (1997) mentioned that under the traditional system where the design and production functions are separated, phases of the project can be as follows,

- Conception/briefing
- Design
- Documentation
- Tendering and estimating
- Construction
- Commissioning

As per the RIBA Plan of work (2013), published by Royal institute of British Architects, The phases of construction described as follows figure 2.2.

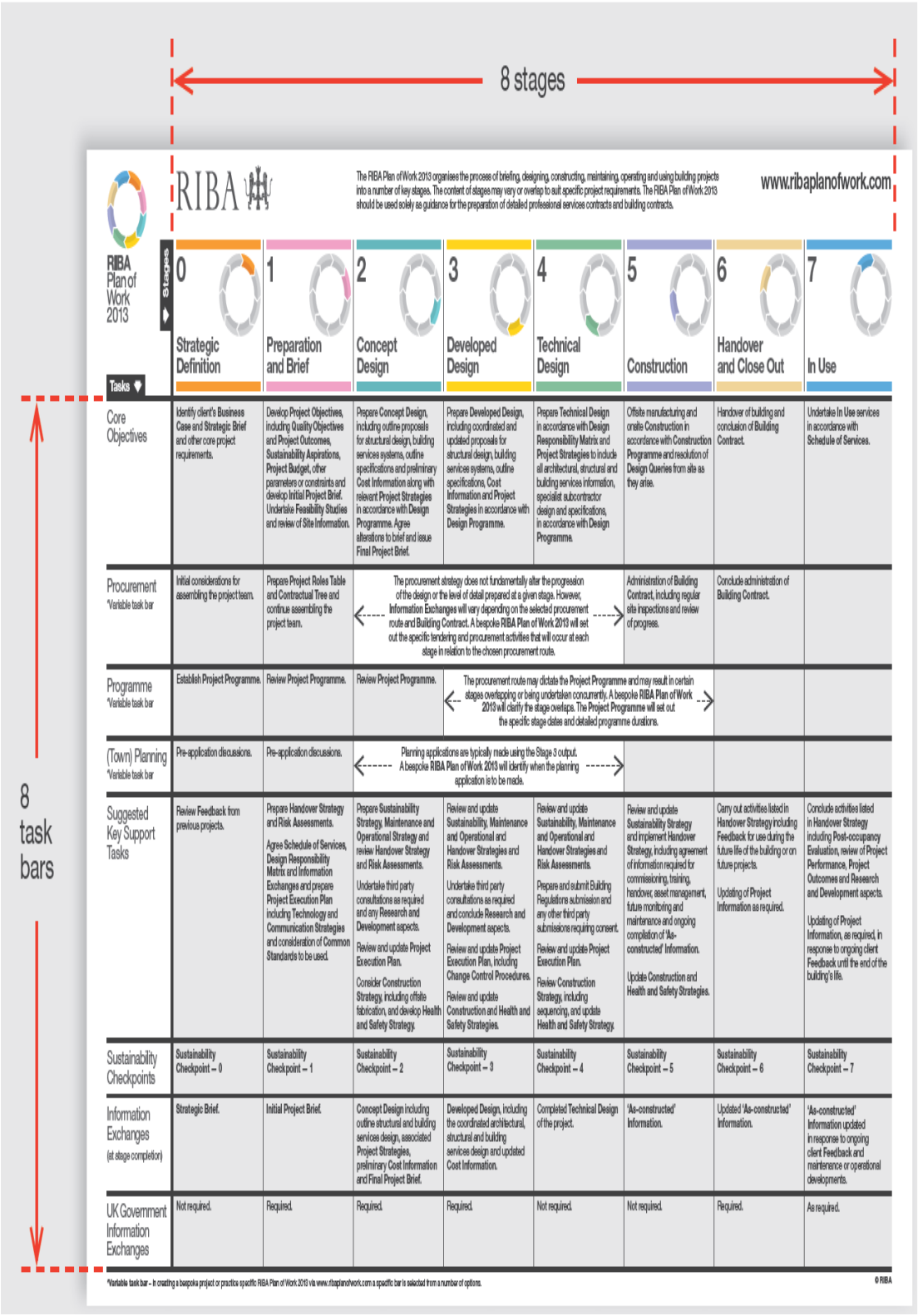

Figure 2-2 Phases in RIBA plan of work 2013

Source: RIBA plan of work 2013

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In preconstruction stage bidding is an important process to do the post construction in an effective and efficient way. RIBA plan of work says one construction project has five main stages, such as preparation, design, preconstruction, construction, use. Preparation has two stages as appraisal, design brief. Concept, design development, technical design is part of the design stage. Pre-construction has production information, tender documentation, and tender action as its part. Mobilization and construction to practical completion are the part of construction. Post practical completion stage is the use of building stage.

2.5 What is bidding?

Construction bidding is the procedure of submitting a proposal by contractors to carry out a construction project for an agreed price with the client (Zhu, 2008). Furthermore, Dagostino & Peterson (2011) stated that, Construction bidding is the activity that submits a comprehensive proposal to undertake a particular construction project along with a probable construction cost. Also it can be defined as the procedure to select a suitable contractor at a time appropriate to the circumstances and to obtain from him at the appropriate time, an acceptable tender or offer upon which a contract can be let (Eriksson & Westerberg, 2011). In addition to that, Queensland Department of Housing and Public Works (2012) stated that, there are several tendering methods used in tendering procedure and application of those methods is according to the project requirements and risks involved.

2.6 Different Bidding Arrangements

Bidding arrangements are concerned as a way of obtaining a price from a contractor (Cook, 1991). According to Shash (as cited in Ma, 2011) and Abu Shaban (2008), a construction company can either negotiate with the client or use a competitive bidding process to obtain a job. Another classification done by Liscum (2010) stated that there are two types of bidding processes as public and private in construction industry. Further, Liscum (2010) explained that the public bidding is a competitive process and the private bidding is a price driven process. Therefore, it can be

concluded that all three authors are having similar interpretation regarding the bidding arrangements.

Further, Fu, Drew and Lo (2002) suggested that competitive bidding is the most common method used in contractor selection. This preference can be occurred as the behavior of construction firms are strongly influenced by the competitive environment in which they operate (Hillebrandt et al., as cited in Oo, Drew & Lo, 2007).

- **Competitive Bidding vs. Noncompetitive Bidding**

According to Drew, Skitmore and Lo (2001), a significant amount of construction work is done through the competitive tendering. In this competitive bidding process, clients invite openly to all contractors to bid for the project and contractor can decide whether he is going to bid or not (Ma, 2011). According to Cook (1991), under the competitive bidding a number of contractors compete against each other in order to establish the most favorable bidding price. There can be more strategies to obtain a bid under competitive bidding.

Drew and Skitmore (1997) identified two strategies for contractors to use in obtaining contracts through competitive bidding. First one is steadily bidding very competitively for specific types of construction work and thereby, having a comparatively low bidding variability relative to other bidders and the second is being inconsistently competitive and having a comparatively high bidding variability relative to other bidders. There are basically two types of competitive tendering.

According to Cook (1991), open and selective tendering are the two variants of competitive tendering. Open tendering allows all the tenders to submit their bids if they comply with the requirements given in the notice while selective tendering allows preselected contractors to bid for the job (Cook, 1991). Further,the author has mentioned that noncompetitive tendering can be defined as the extreme end of the selective tendering.

On the other hand, in noncompetitive situations the client allows a single selected contractor to submit a bid and involving the negotiation work until the client and the builder agree about the amount payable to the builder (Cook, 1991).Since, both competitive and noncompetitive bidding types represent the two extreme ends of bidding, figure 2.3 compares typical characteristics of both methods according to the Builders Association of Eastern Connecticut (BAEC, 2013).Figure 2.3 illustrate character of competitive bidding and noncompetitive bidding. Builders Association of Eastern Connecticut (BAEC, 2013) tells about the features of competitive and noncompetitive bidding in figure 2.3.

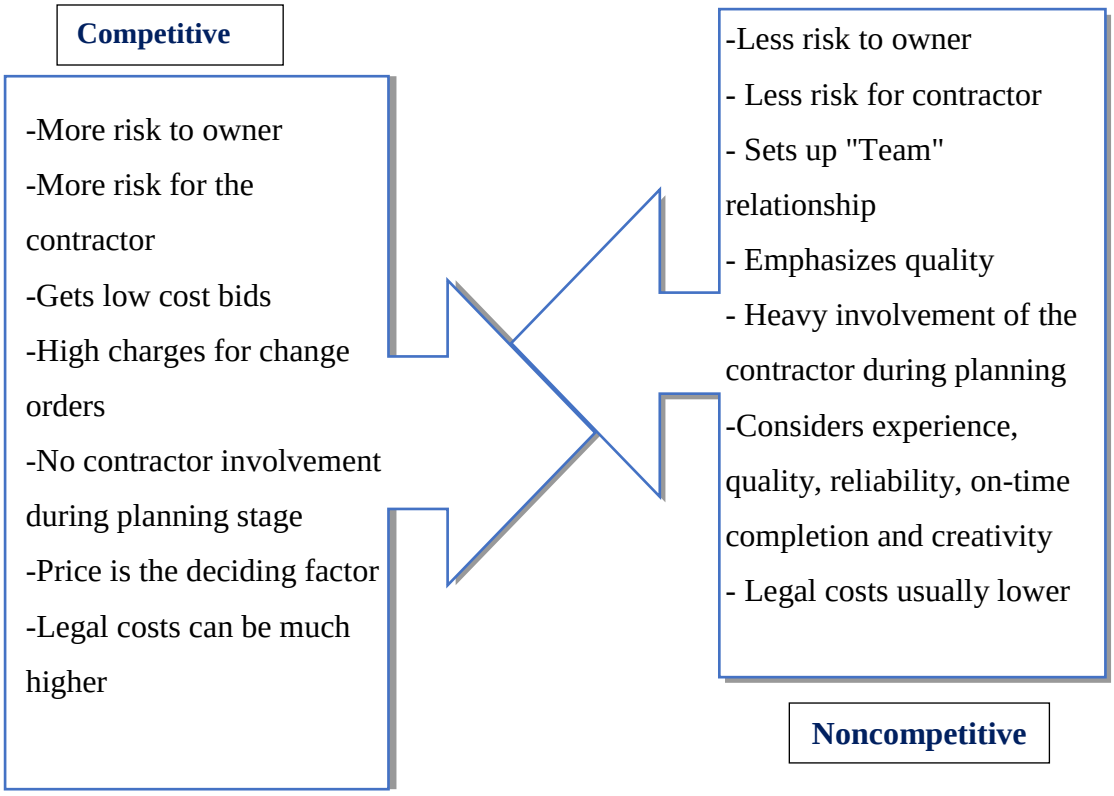


Figure 2-3 Competitive vs. Non-Competitive Bidding,

Source: Builders Association of Eastern Connecticut (BAEC, 2013)

Moreover, Cook (1991) stated that the selection of the bidding type depends on the nature of the project and the client's requirement. Since, this study has focused on

the markup decision of contractors in Sri Lanka, competitive open bidding has been concerned more in depth than negotiation. It is the fact, that the negotiation contracting is generally occupied not through an optimum markup decision making procedure but through the relationships between the client and the contractor. Further, Ma (2011) mentioned that after the company receives an invitation to bid under the competitive bidding, the company is required to decide whether to bid or not to bid for the project. If the company decides to bid for the project, it should be focused on proper bidding process including optimum markup decision.

2.7 Bidding Methods

New South Wales Government (2011) stated that, there are several tendering methods available to implement the tendering process and those methods can be described in a wide variety of ways depending on the organization, procurement system, or industry background. The following table 2.1 shows the different categorizations done by different authors.

Table 2-1 Types of Tendering Methods Review

Source: New South Wales Government (2011)

Author	Year	Categorization of tendering methods
Holt, Olomolaiye , & Harris	1995	• Open tendering • Selective Tendering • Negotiation
Yang & Wang	2003	• Open tendering • Selective Tendering • Negotiation
Murdoch & Hughes	2008	• Open tendering • One stage Selective tendering • Two Stage Selective tendering • Negotiation
Queensland Department of Housing and Public Works	2012	• Open tendering • Selective tendering
Chappell	1991	• Competition (Open and Selective) • Negotiation
New South Wales Government	2011	• Open tendering • Multi-stage tendering • Limited tendering

After considering all the different categorizations and reviewing the ideas of most of the researches which were based on this area, it is reasonable to accept the tendering methods under three distinguished types such include open tendering, selective tendering and negotiated tendering. As Adedokum, Ibinonke, and Babatunde (2013) and Chappell (1991) mentioned open tendering and selective tendering are sub methods of competitive tendering. The Figure 2.4 illustrates the tendering processes of open and selective tendering methods. Palaneeswaran and Kumaraswamy (2001) mentioned things shown in figure 2.4.

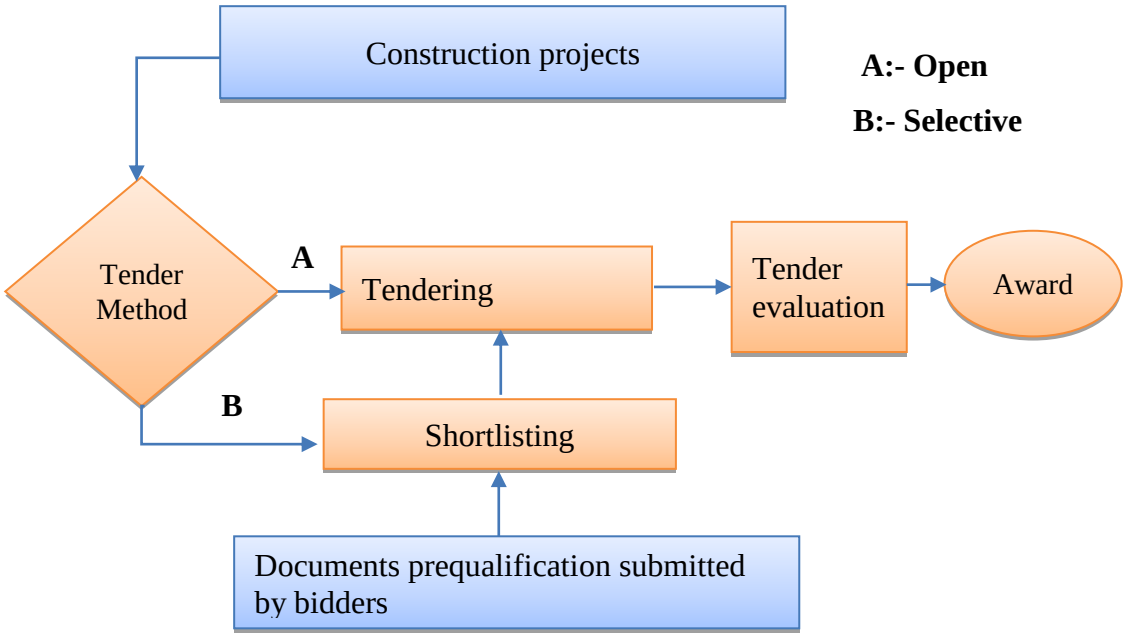


Figure 2-4 Tendering Processes of Open and Selective Tendering Methods,

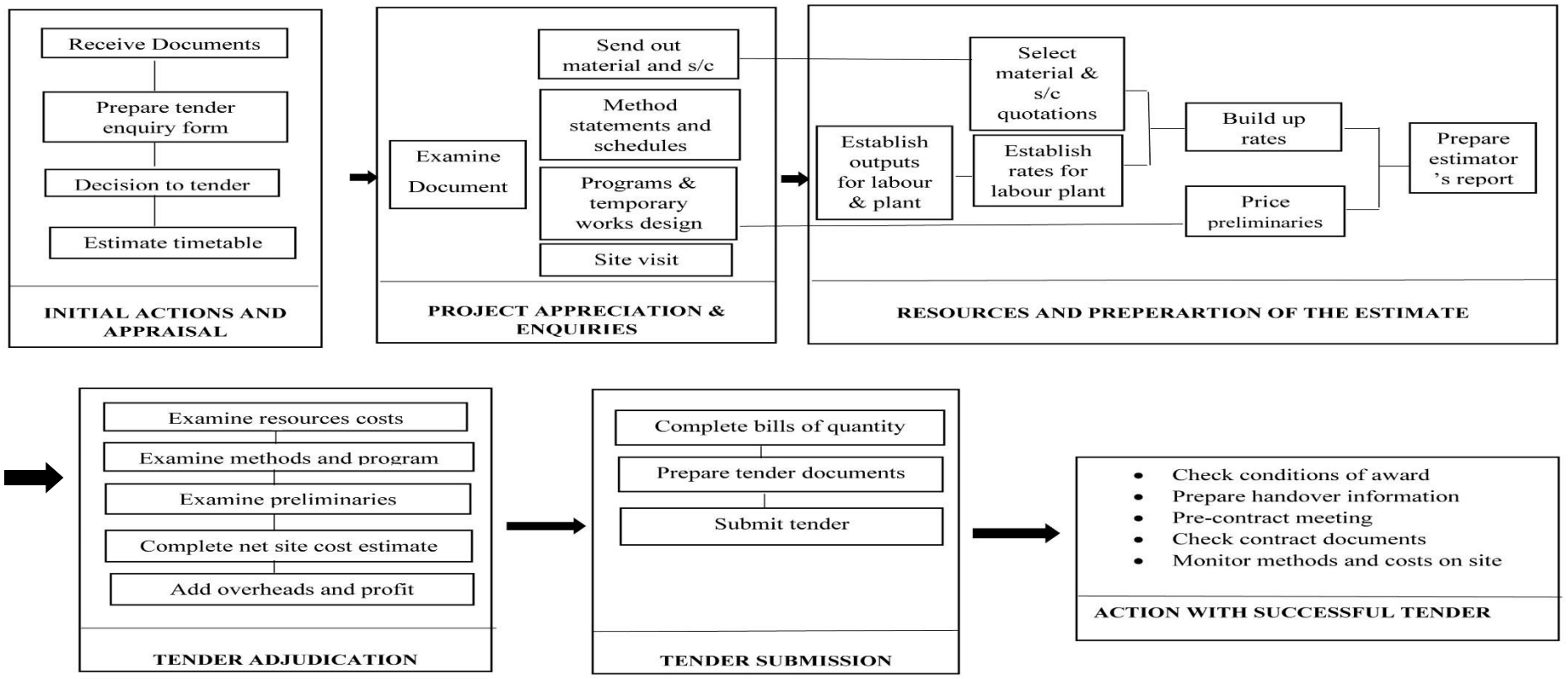
Source: Building and Environment (2001)

Further, Holt, Olomolaiye, and Harris (1996), investigated that, while considering the percentages of tendering methods used by the clients, 55% goes for selective competition and 20% for open competition. Therefore, it seems that the clients prefer the method of competition rather than going for a sole negotiated contractor.

Hatush and Skitmore (1998) mentioned that, by far the most frequently used method of selecting construction contractors is competitive bidding, in which the lowest bidder is awarded the contract. Additionally, Eriksson and Westerberg (2011) stated that Public Procurement Acts should be included in the competitive tendering methods which will result in enhancing the competition and transparency of the process. Likewise, Cheng, Wang, and Sun (2012) stated that, competitive bidding is the internationally used and verified project procurement method, which makes the construction process to be completed with high efficiency and high quality. Additionally, Palaneeswaran and Kumaraswamy (2001) described the deviation between open tendering and selective tendering as the prequalification is part of the open tendering where in selective tendering prequalification is used to shortlist the eligible bidders.

2.8 Bidding Process

Bidding process which is used to select a proper contractor can be defined not only in contractor's perspective but also in consultant's perspective (Tang, 2004). Firstly, in the view point of the consultant, bidding is a process which involves documentation regarding designing, estimating and evaluation in order to select a proper contractor (Anderson et al., 2006). Secondly, in the view point of the contractor, bidding is a process which involves deciding to bid, planning and submitting a competitive estimate to acquire the job (Lin, Lo & Yan, 2006). Though there are two main perspectives related to the bidding process, this study only considered about the bidding process in contractor's perspective as the study was aimed to address contractors' markup decision procedures. As illustrated in below figure 2.5 by Brook (2004)bid markup decision is one main part of bidding process. Hence, most favorable markup is to increase the winning chance of tender within high competitors, (Ling&Liu, 2004).



Source: Estimating and tendering for construction work,(2004)

Figure 2-5 Bidding Process

Above figure 2.5 illustrated the bidding process in the bidding. Mark up comes under tender adjudication stage, thus markup decision is an important stage in bidding process.

2.9 Importance and Benefits of Bidding

Bidding is a strategic decision that assists contractors' firms to survive within the highly unstructured construction market (Ravanshadnia, Rajaie & Abbasian (2011), Wanous, Boussabaine and Lewis (2003) stated that the survival of the contractors' firm strongly depends on successfully dealing with different bidding situations with limited time periods. In other perspective, Lin and Chen (2004) mentioned that for a contractor, it is very important to win the contract rather than just submitting a proposal. Hence, the development of successful bidding strategies is a vital task for any contracting company.

Several benefits to the contractors through continuously bidding on suitable projects under different bidding situations, such as**:**

- Establishing the reputation - If the company continuously completes construction jobs according to the requirements of the developers, the company's reputation will enhance and it will ultimately increase their business
- Increased income - Completing just a few jobs at each year can drastically increases the income of the company
- Understanding the bidding process - If a particular company continuously bidding on projects, they can be more comfortable and confident in their bidding abilities
- Improving negotiation skills - Bidding will enhance the negotiation skills of the contractor if the company bids continuously in a correct manner.

2.10 What is a Bid Markup?

As per the Andrew, McCaffer & Sherif(1995). The tender figure is combination of the direct cost estimated and markup. The markup is the amount added to the estimate to allow for company overheads, risks and profit. One cause of the markup viability is the process of assessing and allowing for these elements, which varies from company to company. Another cause of markup viability is due to the fact that the markup is based on estimated cost of project. Thus any variation or inaccuracy in estimated cost is reflected in the level of markup applied. Jha (2011) notifies that markup is a main part to determine the bid price which includes profit, contingency, allowance for risk and general overhead. It was elaborated by following figure 2.6.

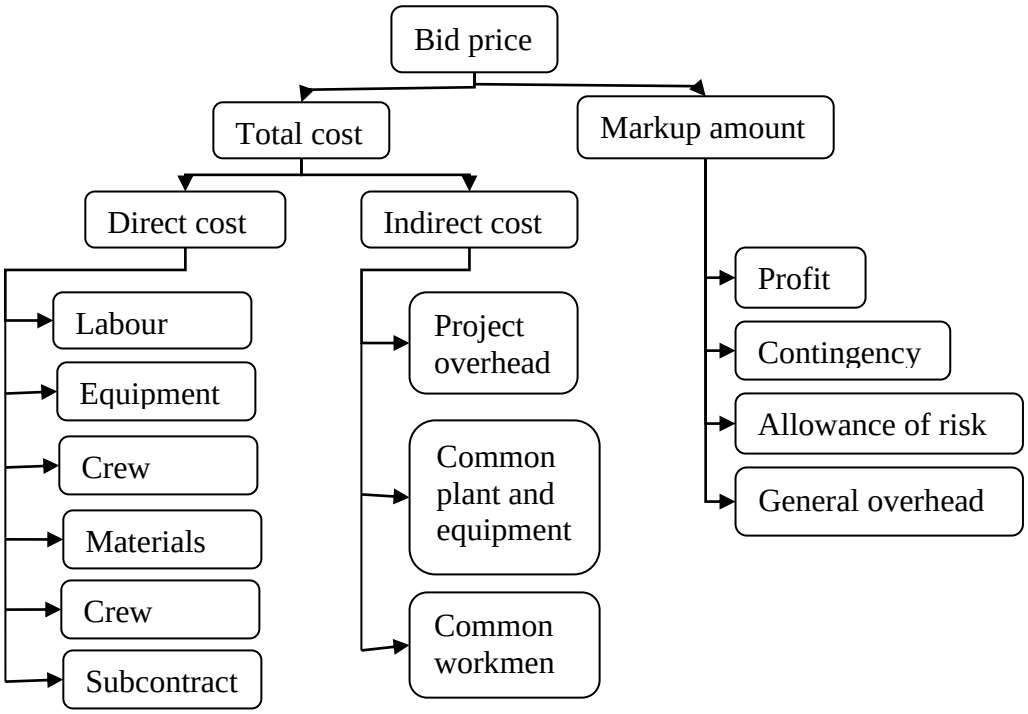


Figure 2-6 Bid Mark-up Decision

Source: Contractors estimation of cost and bidding strategy

2.11 Importance of Markup Decision

Markup decision is an important process in Estimation practice. In current era, construction industry driven by a lowest cost mentality. Because of that the pressure on contractor's markup decision is increased more than previous (Dulaimi, & Shan, 2010). Competitive bids has a nature that should make a high profit with low bid amount. There are many variables affecting the contractor's decision in how much to be bid (Dozzi, AbouRizk & Schroede, 1996). Further, there is a lot of bidding models available to contractors to determine the markup with acceptable price. Sri Lankan Contractors believe that ensuring accuracy of cost estimating does not much influence the probability of winning the job compared with determining the suitable markup. The decision level management takes grater care in markup decisions rather than the other cost estimation (Nagulan, 2001). It shows the importance of markup decisions in tender estimating.

In case of applying a different markup with a little gap in same tender, the result would be different bid prices .therefore, identifying optimum markup of bid price is crucial part of tendering (ling & Liu, 2004). Further, markup decision is a challenging job because a lot of complex and vague factors need to be consider while determining markup in tender stage. Thus, for a long time, markup percentage estimation is looked at as a kind of mysterious work mainly based on the estimator's intuition and experience. Some companies, only senior management decides on markup, in other companies, estimators and senior management are usually involved in markup decisions.

2.12 Calculation of Markup

Jha (2011) describe that Mark-up arrived from the addition of profit, contingency, allowances for risk, and general overheads. It can be expressed either, in terms of some percentage of total cost or in terms of some percentage of bid prices.

Brook (2004) defines that overheads and profit should be evaluated separately because they are calculated in different ways for different purposes. Additionally, the

term ‘overheads’ relates to off-site costs, which need to be recovered to maintain the head office and local office facilities. Items to be covered include:

- Salaries and costs to employ directors and staff;
- Rental fees, rates and maintenance of offices, stores and yards;
- Insurances;
- Fuel and power charges;
- Cars and other vehicles costs for office staff;
- Printing, stationery, postage and telephone;
- Advertising and entertainment;
- Canteen and consumables;
- Office equipment including computers;
- Finance costs and professional fees.

These charges will be found from previous project records and experience of contractors.

Further, Brook (2004) defines the profit amount is a combination of discounts and additional profit required by management. Long gone are the days when discounts could be thought of as a small reserve fund. In a competitive market all discounts are taken out before a small profit margin is added, to help in winning the work. The profit calculation is the responsibility of senior managers (and ultimately the directors). In fact it is not strictly a calculation but a view or guess about what margin would give the maximum profit for the company with the likelihood of winning the contract.

There are a lot of methods and models for the markup calculation to achieve an effective bid amount with optimum markup. It can be depending on the influence of factors which are affecting the markup decision.

2.13 Factors Affecting the Markup Decision

Chao&Kuo (2016) said that markup decision also affected by lot of factors. Further, four factors which affect bid markup decision. Such as estimated direct cost, duration, type of work, location of the project. Dozzi, Abourizk& Schroeder (1996)

studied that Project markup can be primarily categorized under environmental factors, company factors, and project factors as per given figure 2.7

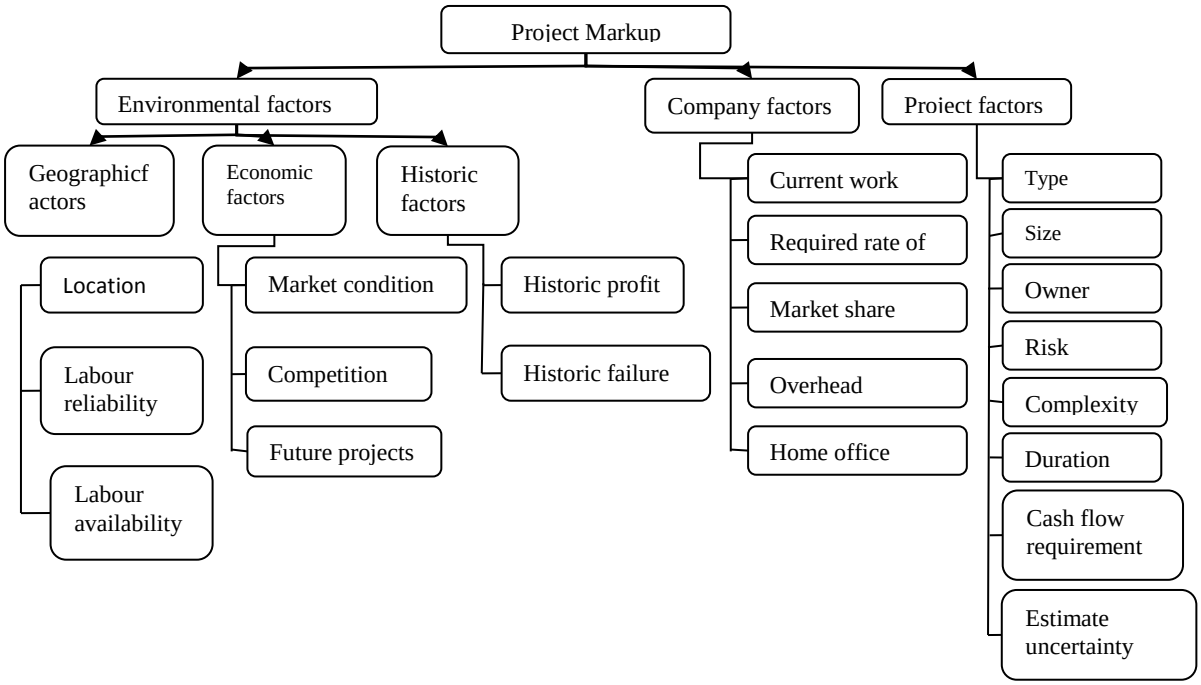


Figure 2-7 Factors Determining Project Mark-up

Source: Utility- Theory Model for Bid Markup decisions (1996)

Based on ling & Liu (2004) study, there are so many factors affecting the markup decision under different categories. Project cash flow and complexity given under Project characteristic factors. Presence of owners' special requirement and quantum of liquidated damages given under project document category. Payment record of client, size of client, type of client (public/private), Relationship and past experience with client was categorized under client characteristic. Relationship with consultant, character of consultant was identified under consultant characteristics.

Further, they notify that current workload, need for work, contractor involvement in design phase, availability of cash to carry out work, reliability of company pricing, portion of nominated subcontractor, portion of domestic sub-contractors can come under company characteristic. In the same way Identity of competitors, competiveness of other tenders was identified under tender situation.

Overall economy (availability of work), availability of labour, quality of available labour, Availability of other projects for tendering were given under economic situation

Jha (2011) specified that seventeen factors which mainly affect the bid markup decision such as,

1. Number of competitors and the intensity of competition
2. Size, cost and intensity of the project
3. Type of the project- building, infrastructure projects, etc.
4. Duration of the projects
5. Location of the project
6. Season in which the work is done
7. Degree of hazard and difficulty associated with the project
8. Name of owner/Consultant and designers, and time available for the bid preparation
9. Labour availability and productivity
10. Material availability and cost
11. Percent of the work, which is to be subcontracted and the bids of subcontractors
12. Insurance cost and fringe benefits
13. Availability of supervisory talent
14. Method of performing the work
15. Uncertainty in estimate and historic profit
16. The current and forecasted economic condition
17. The contractor's risk attitudes

Based on above literature review, factors affect the markup decision is categorized in following table 2.2, this table shows the all factors found through literature review and source of each factors as summary.

Table 2-2 Summary of Factors

No	Factors	Chao&Kuo (2016)	Dozzi, Abourizk& Schroeder (1996)	ling & Liu (2004)	Jha (2011)
01	Estimated direct cost	x			x
02	Project duration	x	x		x
03	type of work/ project type	x	x		x
04	location of the project	x	x		x
05	Labour reliability		x		x
06	Labour availability		x	x	x
07	Market condition		x		
08	Competition		x	x	x
09	Future projects		x		
10	Historic profit		x		x
11	Historic failure		x		
12	Current work load		x		
13	Required rate of return		x		
14	Market share		x		
15	Overhead recovery		x		
16	Home office work load		x		
17	Project size		x		x
18	Owner's special requirements		x	x	
19	Other risks		x		x
20	Project complexity		x	x	x
21	Cash flow requirements		x	x	
22	Estimate uncertainty		x	x	x
23	Quantum of liquidated damage			x	
24	Completeness of tender document			x	
25	Need of work			x	
26	Contractor's involvement in design phase			x	

No	Factors	Chao&Kuo (2016)	Dozzi, Abourizk& Schroeder (1996)	ling & Liu (2004)	Jha (2011)
27	Portion of nominated sub contractors			x	x
28	Portion of domestic sub-contractors			x	x
29	Competitiveness of other tenders			x	
30	Overall economy (availability of work)			x	x
31	Quality of labours			x	
32	Availability of other projects for tender			x	
33	Payment record of client			x	
34	Size of client			x	
35	Type of client (Private/public)			x	
36	Relationship and past experience with client			x	x
37	Consultant characteristic			x	x
38	Relationship with consultant			x	x
39	Character of consultant			x	x
40	Season in which the work is done				x
41	Time available for bid preparation				x
42	Material availability and cost				x
43	Insurance and fringe benefits				x
44	Availability of supervisory talent				x
45	Method of performing work				x
46	Contractors' risk attitude				x

According to ICRA Lanka (2011), the Sri Lankan construction industry is in an upward trend, due to the post-conflict scenario in the country. Hence, most of the new contractors and experienced contractors have enough jobs to bid (ICRA, 2011). Hence all the contractors are seeking more profit, determining the right size of bid-markup become very important. The markup must be low enough to ensure a good chance of winning a contract, but high enough to realize a reasonable profit. The determination of proper markup involves the consideration of numerous factors as listed above. Some factors are more important and some are less important. Further in order to find out the relationship of each factor with markup and how to apply in current scenario helps to develop the proper bid markup decision making guide line for construction industry.

2.14 Summary

Deciding right Bid markups important to construction industry which finally relates to the objectives of the construction company. By surfing the literature, the importance of the bid markup decision for the construction industry was identified. In addition to that plenty of factors identified for affecting for bid markup decision in externally and internally.

However, the literature finding reveals that there were no considerable researches done on bid markup decision in Sri Lankan construction industry. Therefore, it has been identified that there is a great need to do a research to find out the most critical factors affecting to bid markup to keep the contractor in a stable manner.

CHAPTER THREE

3 RESEARCH METHODOLOGY

3.1 Introduction

Former chapter was focused on literature review and the research problem identification. The aim of this chapter is to give an outline view of the research process that was used to achieve the aim and objectives of the current study. This chapter elaborates the research methodology using the research process under the headings of; research process, research approach, data collection and data analysis techniques.

3.2 Research Process

This research carried out the following process as illustrate on figure 3.1

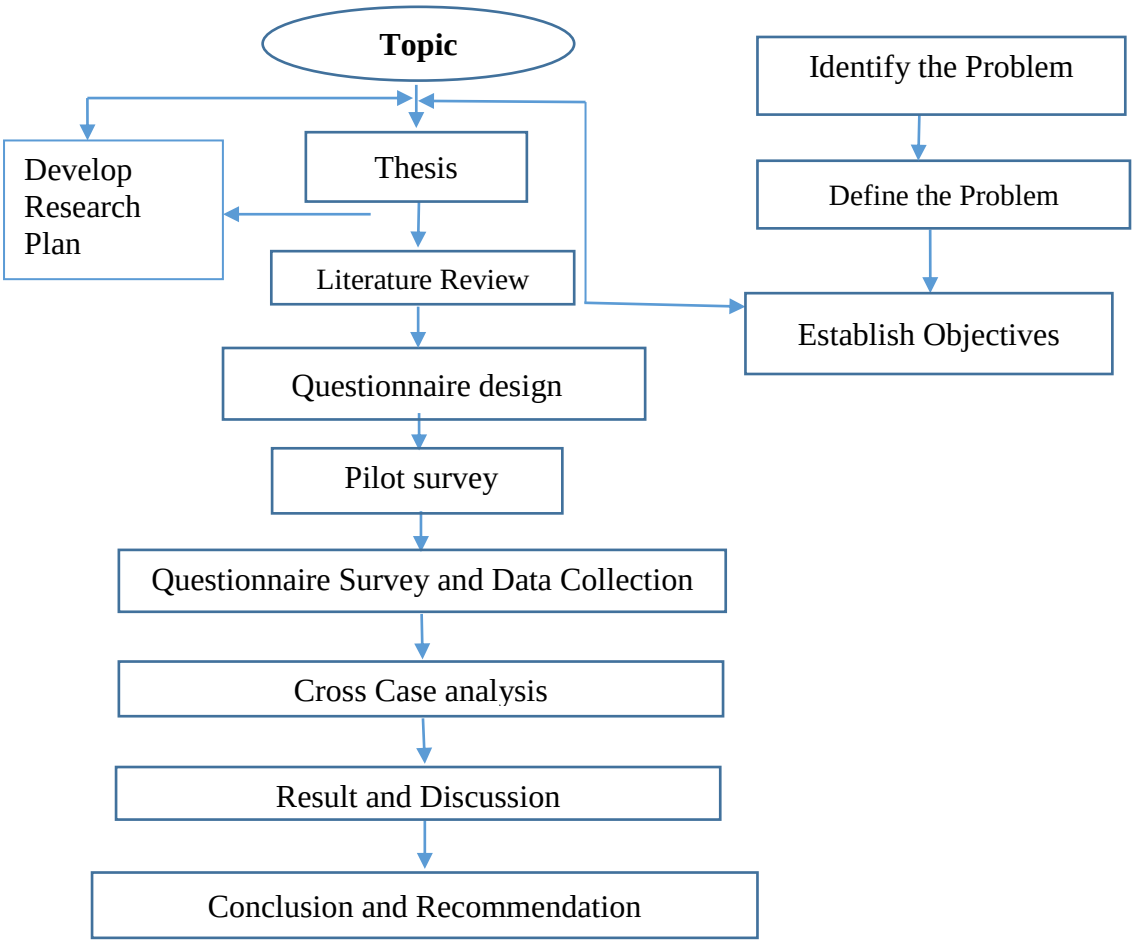


Figure 3-1 Research Process

3.3 Research approach

There are two basic approaches to carry out a research as quantitative approach and qualitative approach. Qualitative approach gathers relative information, in other words gathering answers for 'why' (ACET, 2013). Moreover, Dawson (2002) stated that qualitative research explores attitudes, behavior, experiences and attempts to get an in-depth opinion from the participants. On the other hand, the quantitative research is a process of fact-finding based on evidence or records and it is 'objective' in nature. However, the choice of an appropriate research approach among these available types depends on the nature of the study.

- **Choosing a proper approach to this research study**

This is especially true for studies involving large sample sizes and large geographic areas. Written questionnaires become even more cost effective as the number of research questions increase.

By considering the characteristics of case studies and experiments it is clear that it is appropriate to carry out this research by using a case study to investigate relationship with critical factors. On the other hand characteristics of this research mostly suited with the characteristics of a survey research. According to Mugunthan (2012) the following reasons justify the suitability.

- Surveys are relatively inexpensive and its central question is what, why and how is it happening?
- Surveys are useful in describing the characteristics of a large population. No other method of observation can provide this general capability. So it provides more accurate result in this research.
- Consequently, very large samples are feasible, making the results statistically significant even when analyzing multiple variables.
- Many questions can be asked about the Estimating practices topic giving considerable flexibility to the analysis.

- There is flexibility at the Question creation phase in deciding how the questions will be administered: as face-to-face interviews, by telephone, as group administered written or oral survey, or by electronic means.

Therefore, quantitative approach selected as the best technique rather than going for a case study or any other techniques for identify the critical factors among the factors which were identified in literature and preliminary survey. After that case study technique used to identify the relationship between bid markup and critical factors.

According to the objectives of the research, objective one and two covered under literature review. To identify the satisfaction level of current bid markup, critical factors and its impact on bid markup decision quantitative research approach was followed with issuing questionnaire among the samples. Since, the area of bid markup decision was not much covered under local literature, pilot survey was carried out to validate the findings and check reliability of findings to the Sri Lankan construction industry. Then critical factors were identified through questionnaire survey and relationship between critical factors and bid markup was identified by cross case analysis. In a nut shell, it can be highlighted that this research has followed mix approach with Quantitative approach consisted with detail Questionnaire survey and Qualitative approach with cross case analysis.

3.4 Research Techniques

Research techniques consist of both data collection and data analysis techniques as described below.

3.4.1 Data Collection

According to Tan, Robert and James (2002), commonly used data collection techniques are interviews, questionnaires, document surveys, observation and participation. A detailed survey including questionnaire survey, and semi structured interview (expert interview) was conducted in this research to collect data from the industry.

3.4.2 Questionnaire Survey

The detailed questionnaire survey was conducted to identify the critical factor which affects the Sri Lankan construction industry bid markup decision and impacts of those factors in bid markup decision by ranking its impact 1-5. Questionnaire was prepared by using the findings of the literature review and was distributed among the Estimators and senior managers who take markup decision. In addition to that, through the questionnaire survey satisfaction level of current bid markup also identified.

3.4.3 Literature Survey

A literature survey has been undertaken, in order to identify, "*Importance of bid markup decision"* and to "*Identify the factors affecting the bid markup decision"*. The literature survey was carried out by mainly referring different journal articles. However, other books, research papers, unpublished theses also were referred.

3.4.4 Preliminary Survey

A preliminary study provides a trial run for the questionnaire, which involves testing the wording of questions, identifying ambiguous questions, testing the techniques that used to collect data, and measuring the effectiveness of standard invitation to respondents (Naoum, 2013). All questionnaires should initially be piloted; completed by small sample of respondents (Fellows & Liu, 1997). In this study also the preliminary survey was used for above mentioned purposes.

3.4.5 Sampling

Sampling can be defined as the method of selecting a representative sample from a population. However, selecting most appropriate sample for the study is quite difficult (Tan, Robert & James 2002). The ultimate goal of a survey is to provide representative information about a group from which the sample was drawn. The size of the sample is an important factor that affects the accuracy of the survey. Accuracy of the data largely depends on the way the sample is selected. At the beginning of this research the scope has been narrowed down to the Road and infrastructure projects in Sri Lanka. Further as the sample size of this category is considerably

large, the random sampling is the most appropriate method for this research. The population of the research is estimators, senior managers who work in contracting firms in Sri Lanka. 100 participants were involved to collect the required data through the questionnaire survey.

Samples for the expert interview (Preliminary survey) were selected from contractors in Sri Lankan construction industry based on the experience, knowledge, position and reputation.

3.4.6 Case Study

Kothari (2004) elaborates case study method as a qualitative analysis which vigilant and comprehensive observations given to a situation, an individual or an institution. The limited number of projects for in a contracting firm in Sri Lanka urges the necessity of in-depth study on the case studies. Ten case studies were possible to be conducted in attaining necessary data, within the limited resources and time framework available. One of the main objectives of carrying out case study analysis was to validate the Questionnaire survey findings done at the early stage of data collection. There is no fixed number of cases for a study, yet it is better to go for the multi- case studies than a single study (Yin, 2003). The selection of cases was done based on infrastructure project bid result of last 3 years. Hence, one case from different types of infrastructure projects in different location was selected for this study.

3.5 Data Analysis Techniques

There are many statistical methods for analysis collected data. As per the need of this research Relative Importance Index method is easily understandable and suits for this. The requirement of this analysis is to find out the most critical factor by using the respondent given weightage for each factor, RII is well suited for this in a convenient way. Further, cross case analysis was done by manual without using NVIVO. Because here no need to analyse interviewees opinion, here only to identify the relationship of mark-up and factors in selected projects..5.1 Relative Importance Index (RII)

Relative Importance Index (RII) is one of the most widely used measures to determine the relative significance of the attributes (Doloi, 2008).

The RII was evaluated using the following expression:

$$RII = \frac{\sum(Wn)}{NxA}$$

Relative importance index (RII)

Where,

W - *Rating of each Factor given by respondent*

n - *Frequency of Responses*

N - *Total number of responses*

A - *Highest Weight*

Based on the analysis, critical factor was identified

3.5.2 Cross Case Analysis

Cross-case analysis is a qualitative methodology widely used in Social Science. However, systematic and rigorous analysis techniques that consistently produce objective and reliable findings need to be identified. A cross-case analysis of 10 recent projects in infrastructure category was undertaken to validate the Questionnaire survey findings done at the early stage of data collection. Here, analysis is done manually.

3.6 Write up

The writing up of the dissertation was progressively developed from time to time, instead of waiting until the end of the data analysis process. Further, it was started with descriptive writing and was led to narrow chapter that provides conclusions and suggestions for construction industry.

3.7 Summary

This chapter discussed briefly about the significance of the study, research approach, research process, data collection, data analysis, proposes critical factors and its applicability in bid-markup decision for Sri Lankan construction industry. The process of developing this research and the features were explained briefly in this chapter. By using the collected data through the Literature survey and pilot survey, the questionnaire was developed and questionnaire survey was carried out to attain the third objectives. Finally cross case analysis done for checking the applicability of each critical factor in current Sri Lankan construction industry.

CHAPTER FOUR

4 RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

This Chapter presents the major findings of the research with the decisive objective of finding out the critical factors which affect bid markup decision and based on that suggest the model for bid markup decision in Sri Lankan construction industry. The results have been deduced from a field survey consisting of fifty five questionnaires from contractors who work in Sri Lankan construction industry. The opinion of the factors affecting the bid markup decision are obtained from contractors to facilitate them to mark the significant level of factors in bid markup decision. This analysis illustrates the details about the preliminary survey, respondent's profiles and all the necessary information about the respondents. This chapter mainly focuses on finding out the critical factors which influence the contractor's bid markup decision which have been identified through the questionnaire survey, to achieve the objective number three. This analysis is designed in order to investigate relationship between bid markup decision and critical factors in achieving objective four.

4.2 Preliminary Survey

The preliminary survey was undertaken to ensure the opinions of the contractor regarding factors affecting the contractor's bid markup decision. Questionnaire for finding out the critical factors which affect the contractor's estimation practice was constructed based on a comprehensive literature review and semi-structured face-to-face interviews which are conducted with the professionals from construction organizations.

Experts were requested to shortlist the factors to make questionnaire in the way to achieve the objectives. They were modified to merge with factors and eliminate most of the factors based on its low significance and non-suitability for Sri Lankan construction industry based on their knowledge and experience.

Table 4-1 Respondents Detail of Preliminary Survey Interviews

Organization	**Designation**	**Profession**	**Years of experience**
Contractor	Senior Vice President	Engineer	20 -25 Years
Consultant	Managing Director	Quantity Surveyor	20 -25 Years
Contractor	Chief Quantity Surveyor	Quantity Surveyor	15 -20 Years
Contractor	Contract Manager	Quantity Surveyor	15 -20 Years
Contractor	Chief Engineer	Engineer	20 -25 Years

A total of 46 factors which affect the bid markup decision in construction industry that were identified and reported in previous studies were considered in this research. To reflect the nature of the Sri Lankan construction industry better and in order to achieve suitable factors to suggest the model four of them were merged with another factor and two factors newly added. 18 factors were finally selected for questionnaire survey by avoiding other factors as advised by experts who participated in a preliminary survey.

The given Table 4.2 illustrates the findings from the literature review and the preliminary survey.

Table 4 2 Result of Preliminary Survey

No	**Factors found out from literature**	**Source**	**Results from interview**	**Factors selected by questionnaire survey**	**Comment by interviewees**
1	Estimated direct cost	Literature	Applicable	Estimated direct cost	5 experts accepted
2	Project duration	Literature	Applicable	Project duration	4 experts accepted
3	type of work/ project type	Literature	Applicable	type of work/ project type	3 experts accepted

No	Factors found out from literature	Source	Results from interview	Factors selected by questionnaire survey	Comment by interviewees
4	location of the project	Literature	Applicable	location of the project	3 experts accepted
5	Labour reliability	Literature	Not applicable	-	No one accepted
6	Labour availability	Literature	Applicable	Labour availability	3 expert accepted
7	Market condition	Literature	Not applicable	-	In can be covered by other factors – accepted by 5 experts
8	Competition	Literature	Applicable	Competition	5 experts accepted
9	Future projects	Literature	Applicable	Future projects	3 expert accepted
10	Historic profit	Literature	Applicable	Historic profit	3 expert accepted
11	Historic failure	Literature	Applicable	Historic failure	3 expert accepted
12	Current work load	Literature	Applicable	Current work load	4 experts accepted
13	Required rate of return	Literature	Not applicable	-	1 expert accepted
14	Market share	Literature	Not applicable	-	No one accepted
15	Overhead recovery	Literature	Not applicable	-	2 expert accepted
16	Home office work load	Literature	Not applicable	-	1 expert accepted

No	Factors found out from literature	Source	Result from interview	Factors selected by questionnaire survey	Comment by interviewees
15	Overhead recovery	Literature	Not applicable	-	2 expert accepted
16	Home office work load	Literature	Not applicable	-	1 expert accepted
17	Project size	Literature	Merged with type of work/ project type	-	5 experts accepted
18	Owner's special requirements	Literature	Not applicable	-	2 expert accepted
19	Other risk	Literature	Not applicable	-	2 expert accepted
20	Project complexity	Literature	Merged with type of work/ project type	-	5 experts accepted
21	Cash flow requirements	Literature	Not applicable	-	2 expert accepted
22	Estimate uncertainty	Literature	Applicable	Estimate uncertainty	5 experts accepted
23	Quantum of liquidated damage	Literature	Not applicable	-	1 expert accepted
24	Completeness of tender document	Literature	Merged with Estimate uncertainty	-	5 experts accepted
25	Need of work	Literature	Applicable	Need of work	5 experts accepted
26	Contractor involvement in design phase	Literature	Not applicable	-	No one accepted
27	Portion of nominated sub-contractors	Literature	Not applicable	-	No one accepted

No	Factors found out from literature	Source	Result from interview	Factors selected by questionnaire survey	Comment by interviewees
28	Portion of domestic sub-contractors	Literature	Not applicable	-	2 expert accepted
29	Competitiveness of other tenders	Literature	Merged with competition	-	5 experts accepted
30	Overall economy (availability of work)	Literature	Applicable	Overall economy	4 experts accepted
31	Quality of labours	Literature	Not applicable	-	No one accepted
32	Availability of other projects for tender	Literature	Not applicable	-	No one accepted
33	Payment record of client	Literature	Not applicable	-	1 expert accepted
34	Size of client	Literature	Not applicable	-	2 expert accepted
35	Type of client (Private/public)	Literature	Not applicable	-	2 expert accepted
36	Relationship and past experience with client	Literature	Applicable	Relationship and past experience with client	4 experts accepted
37	Consultant characteristic	Literature	Not applicable	-	No one accepted3
38	Relationship with consultant	Literature	Not applicable	-	No one accepted
39	Character of consultant	Literature	Not applicable	-	No one accepted

No	Factors found out from literature	Source	Result from interview	Factors selected by questionnaire survey	Comment by interviewees
40	Season in which the work is done	Literature	Not applicable	-	1 expert accepted
41	Time available for bid preparation	Literature	Applicable	Time available for bid preparation	3 expert accepted
42	Material availability and cost	Literature	Not applicable	-	No one accepted
43	Insurance and fringe benefits	Literature	Not applicable	-	No one accepted
44	Availability of supervisory talent	Literature	Not applicable	-	No one accepted
45	Method of performing work	Literature	Not applicable	-	No one accepted
46	Contractors risk attitude	Literature	Applicable	Contractors risk attitude	5 experts accepted
47	Engineer's estimate	Preliminary survey	Added	Engineer's estimate	Proposed by 1expert and accepted by other all
48	Number of bidders	Preliminary survey	Added	Number of bidders	Proposed by 1expert and accepted by other all

Here, factors suggested by more than 3 experts will be considered for questionnaire survey.

As per the Table 4.2, factors that affect the bid markup decision are identified and some factors are merged and removed for the questionnaire survey purpose to achieve the critical factor to suggest the model for bid markup decision.

Finally, eighteen factors were selected for the questionnaire survey.

Here the Engineer's estimate and the number of bidders were selected through the preliminary interview. The three experts insisted to include above two items for questionnaire survey due to relevance of biding markup decision in Sri Lankan industry.

4.3 Analysis of Questionnaire Survey

4.3.1 Organizational Profiles

This section mainly is designed to provide general information about the respondents in terms of the major type of work involved, position and experience of the respondent, the number of projects that the organization prepared for the tender cost estimate within one year , how many tenders have been won per year and satisfaction level of current markup decision.

4.3.2 Comparison of Responses

A total of 100 questionnaires were distributed among randomly selected professionals in contracting firms. However, a total number of 55 responds were returned out of 100 questionnaires. It is represented that 55 % of the selected population responded to the survey and 45% of them were not responded as shown in Figure 4.1

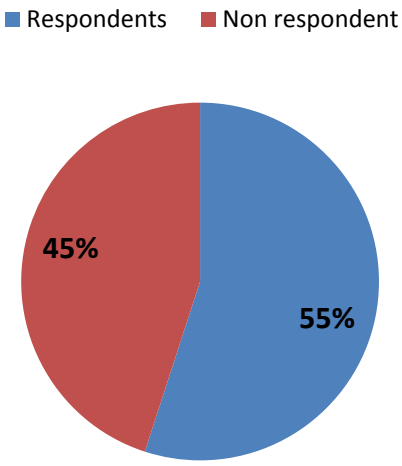


Figure 4-1 Respondent Detail

4.3.3 Type of Works

Figure 4.2 shows that respondent firms details. There are a number of private and government Contractor firms in Sri Lanka. Among those, the most popular and experienced organizations were selected for this current researches shown as follows.

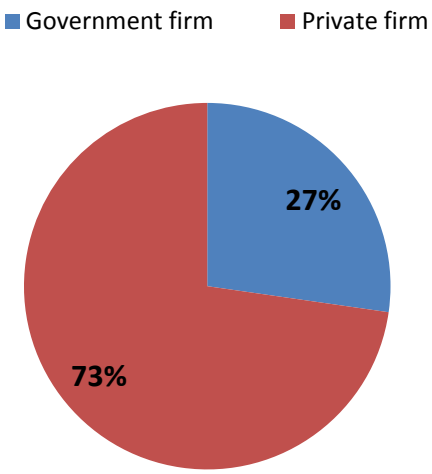


Figure 4-2 Percentage of Targeted Respondents Group

4.3.4 Designation of Respondent

Table 4.3 shows that 23% (13) of respondents are engineers and 77% (42) of the respondents are Quantity Surveyors. It can be seen that most of the respondents have key positions that ensure the quality of data.

f – Frequency, %-Percentage

Table 4-2 Designation of Respondent

Designation of Respondent	**Contractor**	
	f	*%*
Engineer	13	23%
Quantity Surveyor	42	77%
Total	55	100%

4.3.5 Respondents' years of experience

Table 4.4 shows that 27.5% (11) contractors' respondents and 40% (14) of the consultants' respondents (33.33% from the total sample) have years of experience Less than 5 years. 27.5% (11) of contractors' respondents and 25.71% (9) of the consultants' respondents (26.67% from the total sample) have years of experience between 5 -10 years. 25% (10) contractors' respondents and 8.57% (3) of the consultants' respondents (17.33% from the total sample) have years of experience between 11 - 15 years. 20% (8) of the contractors' respondents and 25.72% (9) consultants' respondents (22.67% from the total sample) have years of experience more than 15 years.

Table 4-3 Respondent's Years of Experience

Years of Experience	**Contractor**	
	f	*%*
5 - 10 Years	11	20%
10 - 15 Years	25	46%
16 - 20 Years	10	18%
More than 20 Years	9	16%
Total	55	100%

These results illustrate that, approximately, more than half of the samples, (80 %) contractors have an experience more than 10 years, besides, and 20% of the respondents have experience within 5-10 years. These results also provide a level of satisfaction that the obtained data reflect what it was designed for. Those respondents have good designation in their organizations to provide an accurate and precise data.

4.3.6 Satisfaction with Current Bid Markup

There were 5% (3) of respondents who were “Very Satisfied” and 33% (18) of respondents were “Satisfied” with the Current bid markup decision. While 47% (26) of respondents were “Neutral” and 15% (8) of the contractors have indicated that they were “Not satisfied”. At the same time there were no respondents indicated that they were “Extremely not satisfied” with the current markup decision, as shown in Table 4.5.

Table 4-4 Satisfaction with the Current markup decision

Level of Satisfaction	**Contractor**	
	f	%
Very Satisfied	3	5%
Satisfied	18	33%
Neutral	26	47%
Not Satisfied	8	15%
Total	55	100%

In the survey most of the respondents were at neutral level satisfaction with their estimate. They even not accepted that they were satisfied. Only 38% were in a satisfaction level with their estimate including 5% of very satisfied level of people. Others were neutral or not satisfied. 47% were neutral and 15% accepted that they were not satisfied.

Thus, there is a need to understand the need of a proper way to decide markup, determining markup is a main part of the estimate. This study gives the guideline for the bid markup decision. Therefore this research will help to improve the satisfaction level of tender estimate by increasing this markup decision as reasonable.

4.3.7 Estimating Unit

Table 4.6 shows that 100% (40) of the Contractors have cost estimating unit, 15% (6) of the contractors have less than 3 persons in their estimating unit, 37.5% (15) contractors have 3 – 4 members in their estimation unit.47.5% (19) contractors have 4 or more members in their estimation unit as shown in Figure 4.3.

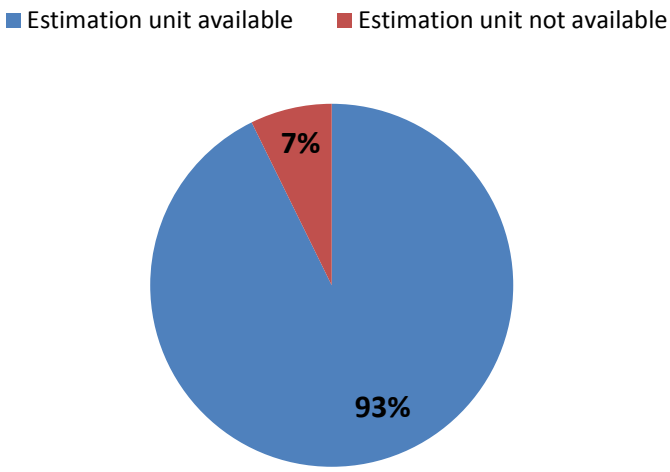


Figure 4-3 Estimation Unit Availability in Contracting Firms

4.4 Critical Factors Affecting Bid Markup Decision

Statistical analysis is carried out to identify the critical factors affecting the bid markup decision of Sri Lankan contractors in order to fulfill the objective number two. The given critical factors were identified and proposed through the literature survey and preliminary interviews, under these proposed factors there are eighteen factors (18).They have been provided for the survey, the survey covered two types of respondents groups namely: contractors from government firms and contractors from private firms. The contractors have been given the questionnaire to identify the critical factors which affect their bid markup decision while estimating, 55 contractors responded in the survey out of 100 contractors.

Based on their given significance level of each factor, Critical factor was identified by ranking all factors by using RII statistical analysis method. The following table shows analysis result.

Table 4-5 Critical Factors Affecting Bid Markup Decision

Item no	Factors	RII value	Rank
1	**Estimated direct cost**	**0.913**	**1**
2	**Competition**	**0.869**	**2**
3	**Type of work/ project type**	**0.844**	**3**
4	**Project duration**	**0.838**	**4**
5	**Engineer estimate**	**0.829**	**5**
6	**location of the project**	**0.815**	**6**
7	**Estimate uncertainty**	**0.800**	**7**
8	**Number of bidders**	**0.767**	**8**
9	**Need of work**	**0.760**	**9**
10	Current work load	0.698	10
11	Future projects	0.691	11
12	Overall economy (availability of work)	0.684	12
13	Contractors risk attitude	0.680	13
14	Historic failure	0.680	13
15	Relationship and past experience with client	0.669	15
16	Labour availability	0.658	16
17	Historic profit	0.600	17
18	Time available for bid preparation	0.520	18

The above Table 4.6 indicates that factors and its RII values found out by the survey. Out of eighteen factors nine factors have RII values more than 0.750. It shows that this factor has been exclusively recommended by the respondents as good critical factors which affect Sri Lankan contractors' bid markup decision. The selected factors are as follows in Figure 4.4.

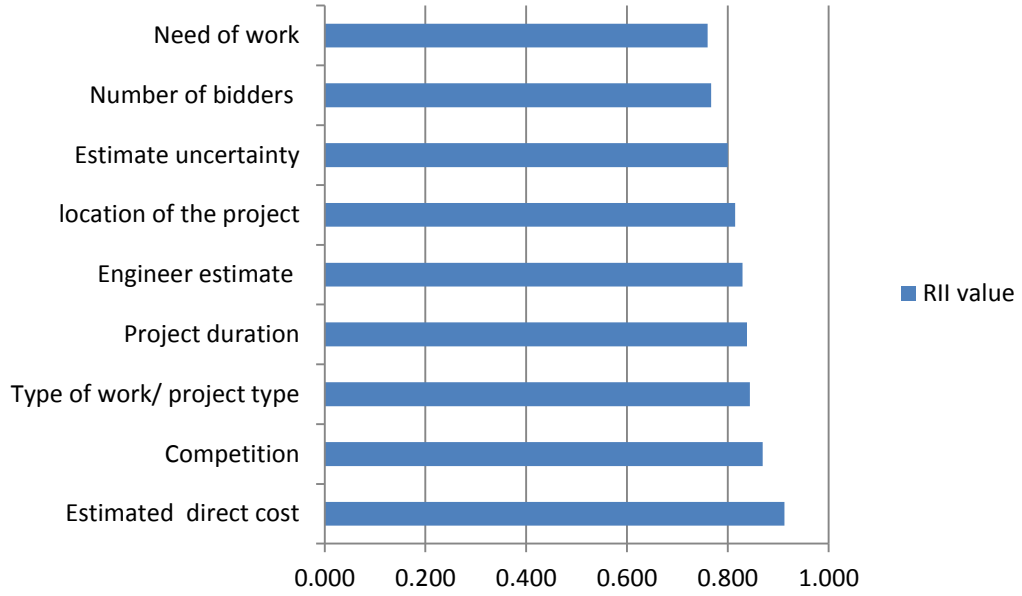


Figure 4-4 Critical Factors and its RII Values

4.4.1 Estimated Direct Cost

As per the ranking of RII "Estimated direct cost" was ranked in the first position by the respondents as the most imperative step of the selected best estimating practice with very high relative importance index of (0.905). Direct costs are directly attributable to the object. It directly involved efforts or expenses for the cost object are the direct costs. Final tender sum will be the direct cost plus markup. According to the total amount of direct cost generate the idea of the size of the project. Bidder can get the idea about actual cost of construction in details. Using that he may have a chance to reduce markup level to win the tender. It reveals that the first and foremost thing for a contractor is to consider their bid markup decision. So it gets higher RII value and becomes one of critical factors. Therefore, most of the contractor decide their markup range based on the direct cost of the estimation.

4.4.2 Competition

"Competition" was ranked as second critical factor with RII value 0.869. The competition can be defined in several methods. As per Cambridge Dictionary competition can be defined as a situation in which someone is trying to win

something or be more successful than someone. In bidding it is dictated that number and nature of competitors for the bid will decide the markup range as a vital range. In general the contractor identified number and nature of other participating bidders in a pre-bid meeting. Company decides the markup by depending on the number and the nature of competitors participating with them for the particular tender. The company decides whether bid can be got by reducing markup or not based on their competition level.

4.4.3 Type of Work / Project Type

"Type of work / project type" took place as third with RII value 0.865.It explains the nature of the project and activities involved. If the work is more complex it may cause for higher markup. But if contractor is experience in work is in a similar nature, it may cause to lower the markup. It represents the importance of project type in bid markup decision. Companies have a wide range of markup according the project type (Road projects, Building projects, irrigation projects, etc.) depend on their resource availability of those type projects, expertly and complexity of project. So Project type becomes one of critical factors when deciding the markup.

4.4.4 Project Duration

As per the respondents result "Project duration" took the place four by getting RII value 0.855. Different projects have different durations it depends on the size and complexity of the project. Based on duration project overhead may vary. It shows that estimators put markup based on project duration to cover the risks available through the long duration such as inflation, external environmental changes (Political, changes in litigation).So Project type becomes one of critical factors when deciding the markup.

4.4.5 Engineer Estimate

The "Engineer estimate" got the fifth place with RII value 0.836. As per engineer estimate of the project its bid markup decision differs. The Engineer estimate is a cost of a construction job is the probable cost of that job as computed from plans and

specifications. For a good estimate the actual cost of the proposed work after completion should not differ by more than 5 to 10 % from its approximate cost estimate, provided there are no unusual, unforeseen circumstances.. The Engineer estimate prepared by the Engineer/Consultant and it includes the markups. Generally most of bid document reveals the amount of engineer's estimates to get the realistic bid price. So the bidder can get the idea of engineer's budget for the project. It helps to decide markup by keeping the engineer estimate as a bench mark. So it takes a vital role in bid markup decision.

4.4.6 Location of the Project

"Location of the project" found as the sixth important factor with RII value 0.825. If it is a long distance unfamiliar area, risk related to the project is high, according to the location the bidder is able to understand material or labour availability, distance, transport difficulties, cultural problems and so on. It will result a higher or lower direct cost, therefore, intend to cover the risk they add their markup in a high range with their direct estimate cost. Thus, "location of project gets the sixth place in critical factor order.

4.4.7 Estimation Uncertainty

The "Estimation Uncertainty" is considered as the seventh critical factor with RII value 0.807. Normally the markup is decided with the intension of covering the uncertainty of estimate. The uncertainty born due to incompleteness of the bid document, amount of higher value of provisional sums, missing details and so on. If the estimate is accurate with a low markup range can get the tender and expected profit also achieved easily. So if it is accurate the estimate markup will be reasonable, if not estimators put high markup to cover the risk arrived from inaccurate estimate.

4.4.8 Number of Bidders

In the eighth place "number of bidders" took place with RII value 0.800. The Contractor will know the number bidders in pre bid meeting. Company decides

markup based on the number of bidders for the particular bid. If the number of bidders is low they may increase their markup because of the probability of winning is high in low number of bidders.

4.4.9 Need of Works

Need of work takes ninth place with RII value 0.760. bid markup will adjust by the need of the project . Some type of the project required for the contractor to get the grade and improve their pre-qualification of similar experience. So they try to get that project while giving less markup without high profit. So it is also an important factor while deciding markup. In a similar way if the contractor feels that getting the particular tender is not that much important they may put reasonable or high markup. Because of these aspects "need of work" becomes one of critical factors that affect the bid markup decision.

Further, Current work load, Future project, overall economy (availability of work in the construction industry at the time period), Contractors risk attitude, Historic failure, Relationship of past experience with client, Labour availability, Historic profit, Time available for bid preparation are the factors got the rank from ten to eighteen with RII value respectively.691,0.684,0.680,0.680,0.669,0.658,0.600,0.520. Even those factors got RII value more than 0.500 in this research. It validates the research further.

When we consider the current work load and future projects, the construction company decides that whether the particular pricing tender is important or not to them or not based on the current work load of company. It means current number of Project Company has availability of future projects. Based on the important markup will be vary. Overall economy means the availability of new projects in the country, if new projects will come more in future, companies do not focus on the particular tender by reducing its markup. Contractors risk attitude is high they will not cover all their cost under their markup. So their markup may be lower than other companies. The Contractor decides the markup based on their past project lessons learned and experience. Thus historic failure is an important role to the contractors.

Relationship of past projects with the client is an important factor; companies decide the markup based on relationship of the client. Labour availability is an important issue in current construction industry. If the company hasn't enough labour to the particular tender, to cover the risk companies put high markup. Historic profit of companies influence contractors to maintain same or decide the profit as per their historic data. Time available for bid preparation is another case that estimators put high markup and keep them in a safe side.

As per the data analysed result the most affecting factors for bid markup presented as follows in Figure 4.5

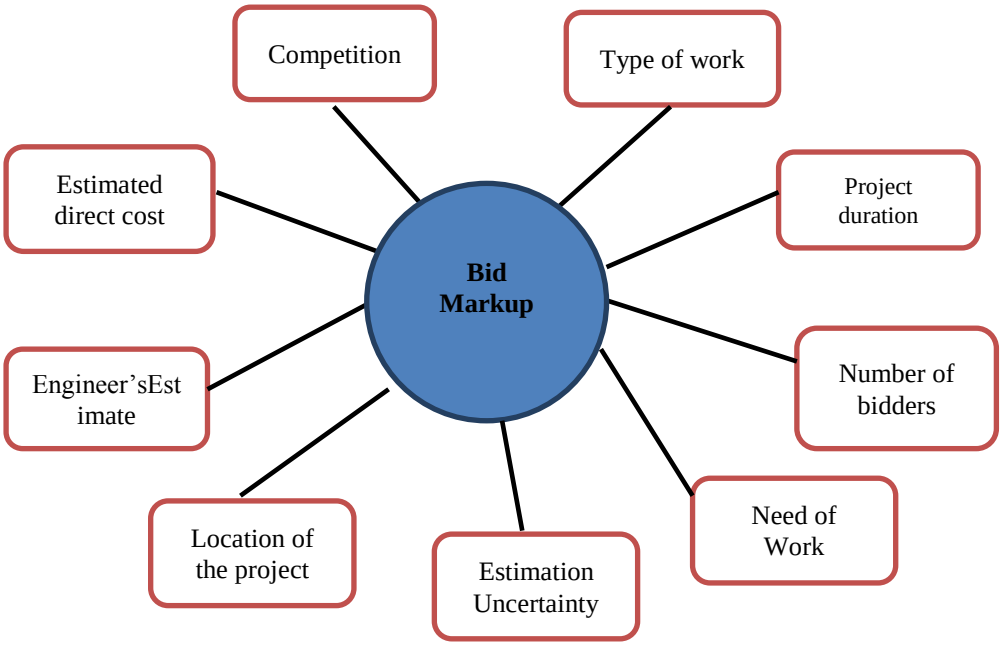


Figure 4-5Critical Factors in Bid Markup Decision

4.5 Case Studies

These case studies consisted of the all necessary information about the selected bidding project and discuss the application of selected critical factors in practical scenario. The 10 numbers of case studies were selected in infrastructure sector and present all necessary information about the project and the analysis of the application of selected critical factors in calculation of bid markup.

4.5.1 Overview of the Cases

The case studies were conducted for the purpose of discussing the applicability of selected factors in bid markup decision as described in Chapter 3. Ten numbers bidding completed road projects were selected comparing Earth work, flexible pavement, drains, culverts, bridges and ancillaries. All related data for bid markup decision were extracted and presented in a proper manner. The brief description of the cases is as follows

Case 01

Case Identification: P-01		
Role in Contract :	Contractor ✔	Sub-Contractor ☐
Project Category : Road & Highway		
Location :	Colombo	***Project Duration :*** 18 Months
Type of Contact :	Measure & Pay	***Bidding year :*** 2016
Bid Value : LKR	1,858 million	***Markup Percentage :18%***
Brief Description : The work involved the rehabilitation and improvements together with widening and reconstruction of road including of sub base, aggregate base course, shoulder construction, binder course, wearing course, drainage, culverts, bridges and incidental works construction of road works and related incidental works.		

Case 02

Case Identification: P-02			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category :Road & Highway			
Location :	Colombo	***Project Duration :***07 Months	
Type of Contact :	Measure & Pay	***Bidding Year :*** 2016	
Bid Value : LKR	441 million	***Markup Percentage :21%***	
Brief Description : The work involved the rehabilitation and improvements together with widening and reconstruction of road including of sub base, aggregate base course, shoulder construction, binder course, wearing course, drainage, culverts and incidental works construction of road works and related incidental works.			

Case 03

Case Identification: P-03			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category :Road & Highway			
Location :	Colombo	***Project Duration :***18 Months	
Type of Contact :	Measure & Pay	***Bidding Year :***2015	
Bid Value : LKR	1,262 million	***Markup Percentage :23%***	
Brief Description : The work involved the rehabilitation and improvements together with widening and reconstruction of road including of sub base, aggregate base course, shoulder construction, binder course, wearing course, drainage, culverts and incidental works construction of road works and related incidental works			

Case 04

Case Identification: P-04			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category :Road & Highway			
Location :	Kaluthara	***Project Duration :***18 Months	
Type of Contact :	Measure & Pay	***Bidding Year :***2015	
Bid Value : LKR	1,222 million	***Markup Percentage :24%***	
Brief Description : The work involved the rehabilitation and improvements together with widening and reconstruction of road including of sub base, aggregate base course, shoulder construction, binder course, wearing course, drainage, culverts, bridges and incidental works construction of road works and related incidental works.			

Case 05

Case Identification: P-05			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category :Road & Highway			
Location :	Mathale	***Project Duration :***24 Months	
Type of Contact :	Measure & Pay	***Bidding Year :***2015	
Bid Value : LKR	2,879 million	***Markup Percentage :18%***	
Brief Description : The work involved the rehabilitation and improvements together with widening and reconstruction of road including of sub base, aggregate base course, shoulder construction, binder course, wearing course, drainage, culverts, bridges and incidental works construction of road works and related incidental works.			

Case 06

Case Identification: P-06			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category : Road & Highway			
Location :	Polonnaruwa	***Project Duration :*** 12 Months	
Type of Contact :	Measure & Pay	***Bidding Year :*** 2016	
Bid Value : LKR	393 million	***Markup Percentage :28%***	
Brief Description : The work involved the rehabilitation and improvements together with widening and reconstruction of road including of sub base, aggregate base course, shoulder construction, binder course, wearing course, drainage, culverts, bridges and incidental works construction of road works and related incidental works.			

Case 07

Case Identification: P-07			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category : Irrigation			
Location :	Galle	***Project Duration :*** 30 Months	
Type of Contact :	Measure & Pay	***Bidding Year :*** 2015	
Bid Value : LKR	1,253 million	***Markup Percentage :25%***	
Brief Description : The work involved in this project is rehabilitation and improvement works consist of dredging the canal where necessary including earth excavation and rock excavation, constructing gabion walls to the canal, desilting the canal up to required level, constructing new structures, improvements and repairing for the existing structures, and turfing for the canal banks.			

Case 08

Case Identification: P-08			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category :Irrigation			
Location :	Mathale	***Project Duration :***24 Months	
Type of Contact :	Measure & Pay	***Bidding Year :***2016	
Bid Value : LKR	320 million	***Markup Percentage :27%***	
Brief Description : Rehabilitation and Improvement works consisting of dredging the canal where necessary including earth excavation and rock excavation, widening the canal to the required standard, desilting the canal up to required level, introducing new structures, improvements and repairing for the existing structures, hydro mechanical works and turfing for the canal banks. In addition construction of gabion walls and canal lining shall be done.			

Case 09

Case Identification: P-09			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category :Water Supply			
Location :	Polonnaruwa	***Project Duration :***12 Months	
Type of Contact :	Measure & Pay	***Bidding Year :***2015	
Bid Value :LKR	987 million	***Markup Percentage :30%***	
Brief Description : The work involved in this project is pipe laying of pumping mains main in Raw Water Supply .Major work consisted of Laying of HDPE& DI pipes to the lines and grades by open trench method as per LSS designs and drawings, including installation of valves for the areas (Air Valves, Washout valves etc) and construction of bridge and culvert crossings.			

Case 10

Case Identification: P-10			
Role in Contract :	Contractor ✔	Sub-Contractor ☐	
Project Category : Water Supply			
Location :	Rathnapura	***Project Duration :*** 18 Months	
Type of Contact :	Measure & Pay	***Bidding Year :*** 2016	
Bid Value : LKR	1,717 million	***Markup Percentage :23%***	

Brief Description :
The work involved in this project is pipe laying of pumping mains main in Raw Water Supply .Major work consisted of Laying of HDPE& DI pipes to the lines and grades by open trench method as per LSS designs and drawings, including installation of valves for the areas (Air Valves, Washout valves etc) and construction of bridge and culvert crossings

4.5.2 Analysis of the Relationship of Bid Markup and Critical Factors

Based on the above ten selected cases following relationship was found between markup and critical factors arrived from the survey. Here, each factor related to markup in each ten selected projects. Flowing tables and graphs show those findings.

4.5.2.1 Estimated Direct Cost

Comparison made between direct costs against the bid markup of each selected 10 case studies project to find out the relationship between markups vs. direct cost as shown below.

Table 4-6 Direct Cost vs. Bid Markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Direct cost(RsMn)	1524	348	972	929	2361	283	940	234	691	1322
02	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%

Above table shows the bid markup changes with estimated direct cost. The graph shows how markup changes with the estimate direct cost.

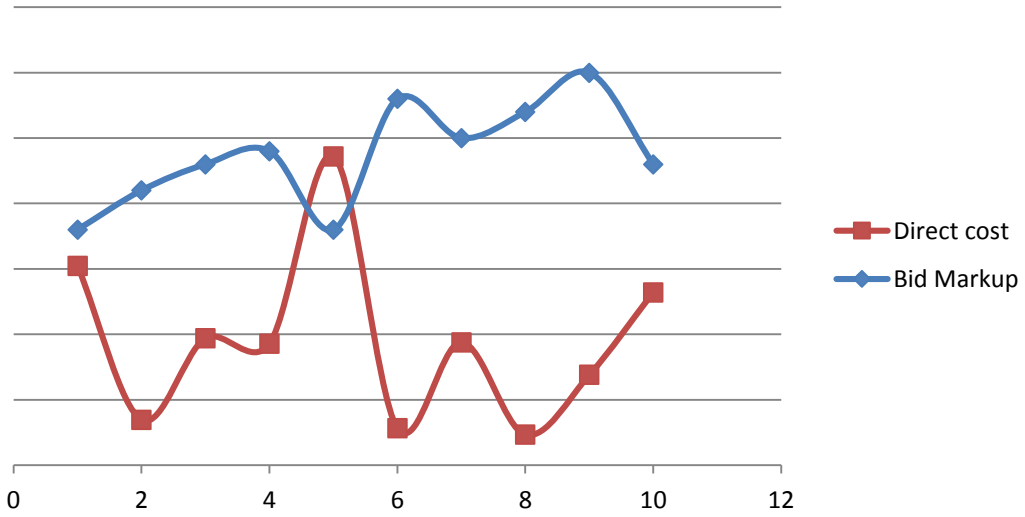


Figure 4-6 Direct Cost vs. Bid Markup

It clearly shows that when the estimate direct cost increases, markup percentage gets low due to keeping the overall bid amount in a reasonable range. Thus, the result of questionnaire survey applicable was verified here. But in some extensions, there may be slight change in the way of the graph. Because there is a lot of factors affecting the bid markup other than estimated direct cost. In general the project which has higher values of direct cost, markup will be comparatively low because overhead percentage is comparatively less in a bigger project. Therefore, in this case analysis we can compare the overall view for the applicability verification.

4.5.2.2 Competition

Comparison made between the competitions against the bid markup of each selected 10 case studies project to find out the relationship between markups vs. competitions as shown below. The table below illustrates that how the markup varies with competitions of each ten projects which were selected for the case study.

Table 4-7 Competition vs. Bid markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%
02	Competition	H	L	H	H	H	L	A	L	A	H
H - High A -Average L - Low											

The above table shows the competition (competitiveness of other contractors) and the bid markup decision. In the pre bid meeting or site visit, the experienced bidder, can predict who will be the main competitors of the bid. Accordingly markup will be adjusted. When the competition is high our bid markup is goes down in order to win the bid. But here it does not happen in each project. But in some projects it happened. Because there is an influence of other factors may highly influence while deciding the mark up. But in an overall view it seems that when competition is low, markup percentage will go high.

4.5.2.3 Project Type

Comparison made between project types against the markup of each selected 10 case studies projects to find out the relationship between markups vs. Project type as shown below. The table below illustrates that how the markup varies with project type of each ten project which were selected for the case study.

Table 4-8 Project type vs. Bid Markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%
02	Project Type	R	R	R	R	R	R	IR	IR	WS	WS
R - Roads IR - Irrigation WS - Water Supply											

As per finding from questionnaire, the project type gets a vital place in critical factors. Above table shows the change of markup as per the type of the project. Companies select the markup as per the company capacity in each project. Irrigation projects and water supply projects have high markup than road projects among those 10 projects selected for case study.

4.5.2.4 Duration

Comparison made between duration against the bid markup of each selected 10 case studies project to find out the relationship between markups vs. duration as shown below. The table below illustrates that how the markup varies with duration of the each ten projects which were selected for the case study.

Table 4-9 Duration vs. Markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%
02	Duration (Month)	18	7	18	18	24	12	30	24	12	18

This table represents that the bid markup changes with Project duration. Project duration is one of the factors which affects the bid markup. Following graph also represents the overall view of how bid markup differs with project duration. Through that we can ensure that project duration is also one of the main factors which affect the bid markup decision.

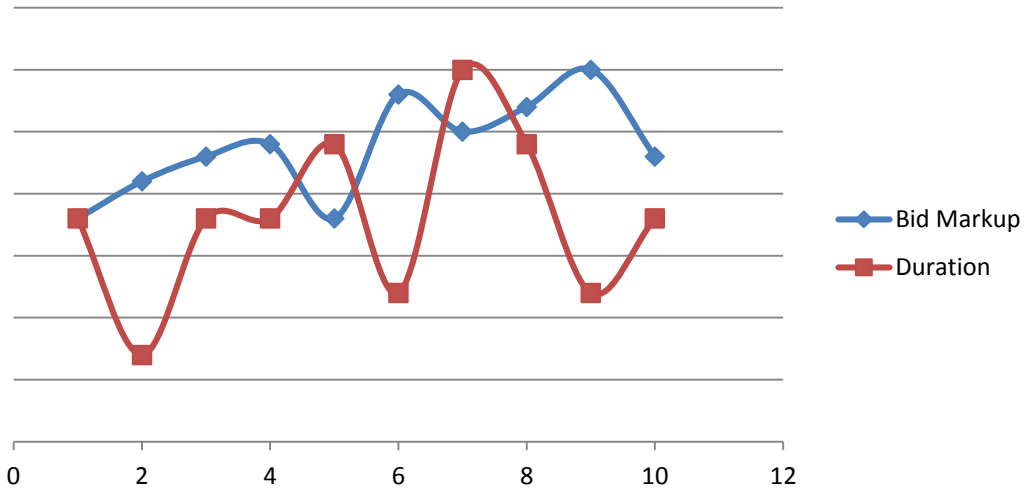


Figure 4-7 Duration vs. Bid Markup

When duration goes high bid markup goes low, in the same way bid markup goes up when duration goes down.

4.5.2.5 Engineer's Estimate

Comparison made between the engineers' estimates against the bid markup of each selected 10 case studies project to find out the relationship between markups vs. engineers' estimates as shown below.

Table 4-10 Engineer estimate vs. Bid Markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%
02	Engineer Estimate (RsMn)	1780	440	1150	1320	2750	250	980	200	900	1650

Following graph shows that the trend of the engineer estimate and markup for each selected ten projects.

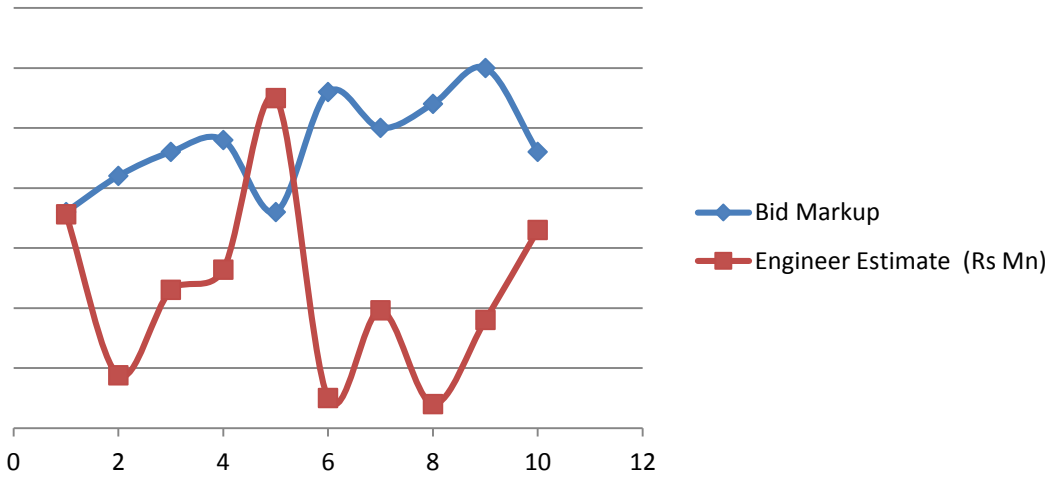


Figure 4-8 Bid markup vs. Engineer Estimate

This shows that the bid markup goes down while project engineer estimate goes up. And it's goes up while engineer estimate goes down. It ensures that there is a relationship with engineer estimate and bid markup decision. By using Engineer Estimate, the bidder has an initial idea about the size of the project. In addition to that by the experienced bidder has an idea about the range deviation of winning price against the engineer's estimate. Accordingly markup will be adjusted. Thus it can be validate the finding from the questionnaire.

4.5.2.6 Location

Comparison made between locations against the bid markup of each selected 10 case studies project to find out the relationship between markups vs. location as below.

Table 4-11 Location vs. Bid Markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%
02	Distance from Colombo (Km)	6	4	19	48	175	230	123	225	229	92

Above table shows the bid markup and location of each ten selected projects. Location represented by the distance of the project location form Colombo.

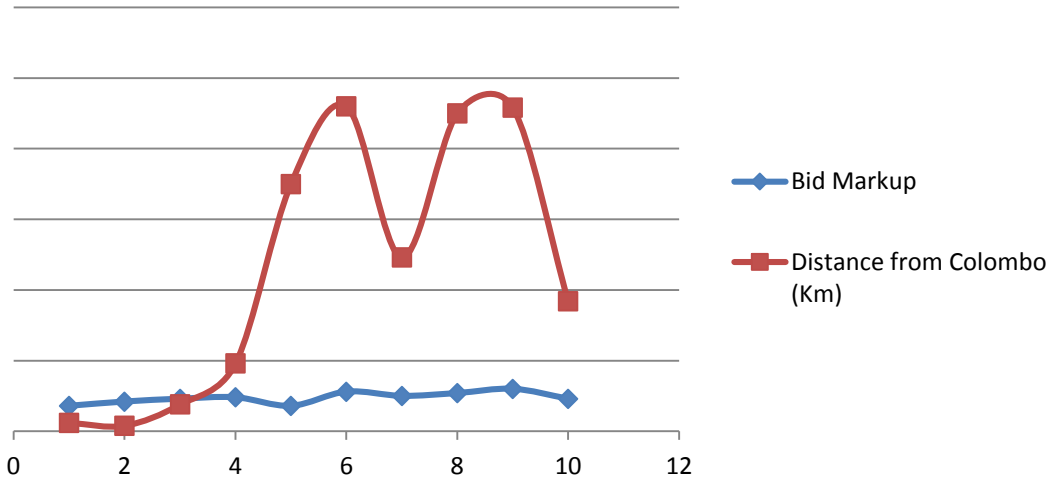


Figure 4-9 Location vs. Bid Markup

It seems, in an overall view when distance is low, there is a considerable down trend in a bid markup. But location is not the only one factor which influences bid markup decision. Therefore, we can't expect the direct relationship between one factor and the bid markup decision. Anyhow there is a relationship and it can be ensured in a overall view. Generally if the project is near Colombo, markup will be less due to availability of resources and all requirements. But if the bidder is mobilized in a specific area outside Colombo, he may catch low markup for the bids in that area.

4.5.2.7 Estimate Uncertainty

Comparison made between Estimate uncertainties against the bid markup of each selected 10 case studies projects to find out the relationship between markups vs. Estimate uncertainty. Estimate uncertainty is one of the critical factors which is influencing in bid markup as per the finding through the data collection. Following table shows the relationship with estimate uncertainty and bid markup.

Table 4-12 Estimate Uncertainty vs. Bid Markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%
02	Estimation Uncertainty	1%	2%	3%	3%	3%	5%	4%	4%	4%	2%

As per the above table, whenever estimator felt that his estimate is not accurate or the most of details are missing, incompleteness of tender document there is a possibility to add that uncertainty percentage into markup percentage in order to cover the risk of estimate uncertainty.

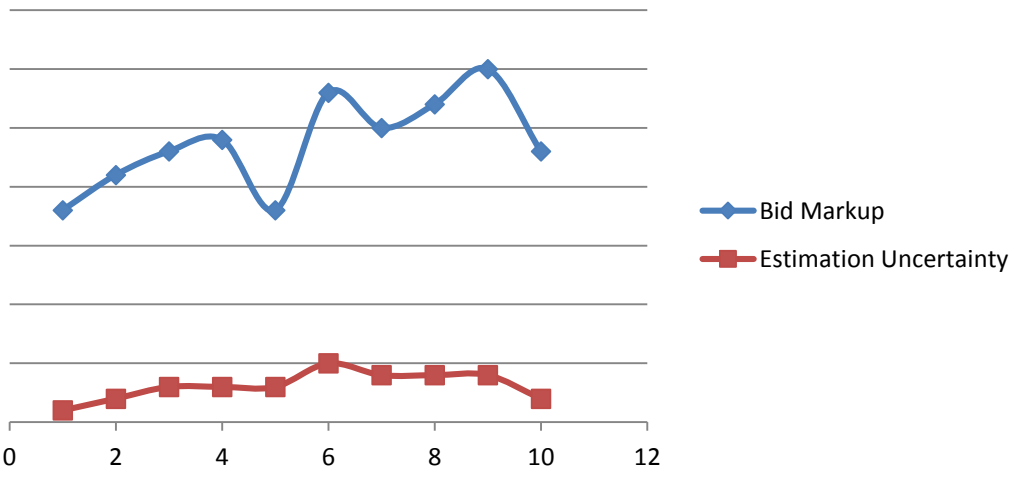


Figure 4-10 Estimate Uncertainty vs. Bid Markup

Above graph clearly illustrates that how bid markup decision changes with the estimate uncertainty for each project. Therefore, there is a positive relationship between estimate uncertainty and bid markup decision. As an example the Project P-06 and P – 9 most of the details are missing in the tender stage. Also the BOQ contains more lump sum items. So the need to allow some percentage of uncertainty for the markup.

4.5.2.8 Number of Bidders

Comparison made between numbers of bidders against the bid markup of each selected 10 case studies projects to find out the relationship between markups vs. the number of bidders as follows. The number of bidders critically influence of companies bid markup decision is one of finding through data collection. In order to verify its applicability ten projects were selected.

Table 4-13 Number of Bidders vs. Bid Markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%
02	Number of bidders	10	15	12	8	11	9	6	8	9	10

Based on above data, following graph formed to understand about the trend easily between bid markup and number of bidders.

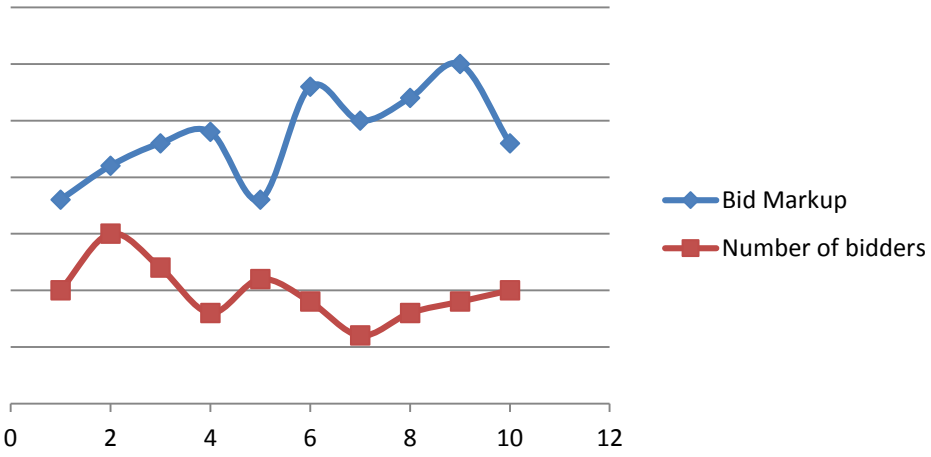


Figure 4-11 Number of Bidders vs. Bid Markup

It seems whenever the number of bidders increases, the markup percentage is going down to get the optimum chance to get the tender. If the number of bidders is low for the particular project companies are not concerned to reduce bid markup that much. Thus, there is a negative relationship between bid markup and the number of bidder.

4.5.2.9 Need of Work

Comparison made between need of work against the bid markup of each selected 10 case studies projects to find out the relationship between markups vs. need of work as shown below. Need of work is an important factor to determine the markup. There are some situations to get the tender for the particular reason with low profit. Thus, when it comes under high need project that markup will be low. The following table shows the markup and need of the project for the selected ten projects for the case study.

Table 4-14 Need of Work vs. Bid Markup

Item No	Description	Cases									
		P -01	P -02	P -03	P -04	P -05	P -06	P -07	P -08	P -09	P -10
01	Bid Markup	18%	21%	23%	24%	18%	28%	25%	27%	30%	23%
02	Need of work	H	L	H	A	H	L	H	L	A	A
H - High A -average L - Low											

Above table shows that, in an overall view when we need the project more, our markup gets low. But if some unavoidable other factors influence the markup, due to its impact it may be considerably high even its need.

4.5.3 Summary of Findings

The relationship of identified critical factored with bid markup in selected projects summarized as follows.

Table 4-156 Summary of findings

No	Critical factors affect the bid markup decision	Relationship with markup in selected projects in a overall view
01	Estimated direct cost	Strong negative relationship with markup
02	Competition	Strong negative relationship with markup
03	Type of work/ project type	Positive relationship with markup
04	Project duration	Negative relationship with markup
05	Engineer estimate	Negative relationship with markup
06	location of the project	Slightly negative relationship with markup
07	Estimate uncertainty	Strong positive relationship with markup
08	Number of bidders	Strong negative relationship with markup
09	Need of work	Negative relationship with markup

As per above comparison, it shows that, all identified critical factors have a strong relationship with bid markup. Even there is a minor deviation with few projects considered for case study, a part of that, in an overall view that relationship can be seen. Bid markup has a negative relationship with project direct cost as well as competition among the bidders. Project type has positive relationship with bid markup in case of its complexity. Duration and Engineer estimate have a negative relationship with bid markup in an overall view. For instance, due to other factors influence the relationship varied. Location also has inverse relationship with bid markup. Estimate uncertainty has more strong straight relationship with bid markup even other factors influence it. The number of bidders and need of work has downbeat relationship with bid markup.

4.6 Summary

This Chapter is mainly focused on finding out the most critical factors affecting to bid markup decision and applicability of critical factors in actual construction projects. Quantitative analysis was done with the use of RII method with the satisfaction given by the selected respondents to find out the most significance factors affecting the bid markup decision. As a Qualitative part, 10 case studies were selected in infrastructure sector and discuss the applicability and validate the fond significance factors through the quantitative analysis. From the graphs and tables clearly illustrate the behavior of each selected critical factor in different type of situation. It will provide the guide line for each estimator in construction industry when decide the bid markup. Bidders have to consider relationship of each critical factor with bid markup while determining their bid markup for their estimate which is identified through case studies. Project direct cost, competition, duration, Engineer estimate, location, number of bidders, the need of work has negative relationship with bid markup. Project type and estimate uncertainty have positive relationship with bid markup.

CHAPTER FIVE

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The preceding chapter analyzed and discussed the findings through the study. Nevertheless, this chapter is focused on drawing out conclusions and recommendations from the analysis and the discussion performed in the previous chapter.

5.2 Conclusions

This was conducted to determine critical factors which affect the bid markup decision and relationship between identified factors and markup in Sri Lankan construction industry. For this research two types of contractors sample groups were selected, which are namely contractors from private sector and contractors from government sector. The study was conducted through questionnaire survey and case study. In order to achieve the objective, a mixture of qualitative and quantitative approaches were used.

The first objective "define that what bid markup decision is '" was achieved through the literature review. This is an important objective for continuing the research further. The second objective was identified through literature review and preliminary interviews. Third and fourth objectives of this research were attained through the questionnaire survey and case study.

The second objective was "Identify the factors which is affecting the bid markup decision of contractors in Sri Lanka". Through the literature survey and preliminary interview this objective was achieved. In case of preliminary survey, five experts in Sri Lankan construction industry were selected in the contractor and consultant field who are in a good position with good knowledge and experience.

Third objective of this study was to find out the critical factor from the selected factors which affect the bid markup decision critically. RII statistical analysis

technique was used to achieve the third objective. Questionnaire survey was carried out to find the critical factors which are considered by contractors affecting the bid markup decision in Sri Lankan construction industry. Nine factors were identified as critical factors which are got the RII value more than 0.750. The identified factors are estimated direct cost, competition, type of work / project type, project duration, engineer estimate, location of the project, estimation Uncertainty, the number of bidders, and the need of works. The reason for selecting as significant and it importance narrowly discussed in the analysis chapter.

Identify the relationship between identified critical factors and bid markup in current Sri Lankan industry is the fourth and final objective. To fulfill the objective number four, cross case study analysis method was used. Ten recently tendered projects were selected to verify the applicability of selected critical factors.

The view of contractors and case study result were almost same as the overall result .This shows that identified nine critical factors critically affect the bid markup decision in the industry. Thus, contractors should consider these factors as a vital part of their markup decision.

5.3 Recommendations

This research recommends that contractors should give more attention to all the factors proposed in this research as critical factors affecting contractors' bid markup decision in Sri Lankan construction industry. Contractors should monitor the performance of their estimates in terms of accuracy and hire qualified technical staff to obtain accurate estimates. Clear identification of project requirements is essential before the start of the estimating process. Contractors and consultants should make sure the accuracy and reliability of cost information, also obtain accurate information from manufacturers and suppliers pertaining to the costs of procured materials and systems. This accuracy will reduce the mark up of contractors in order to avoid the percentage of the markup to avoid the risk due to estimate uncertainty.

The research recommended that training programmes and seminars on tender cost estimates in an accurate way and consider the critical factors while determine

markup for the development of construction industry and avoid unnecessary increase in tender sum due to inappropriate markup. Further, this study recommends that both government and private organizations need to follow the training programmes conducted by regulatory body.

The study revealed that providing standard time limit for estimation could make the contractors to follow the best estimation practice to increase the accuracy of estimate. Thus, markup can be reduced unnecessary cost expense of client will be reduced. However, for an immediate work, it is difficult to work in accordance with the standard time limit. Therefore, the regulatory bodies need to establish standard time limits in relation to project definition

Finally, the findings of this study will help contractors and consultants to focus on the main causes affecting the bid markup decision and develop effective strategies and solutions to achieve accurate cost estimate and get the reasonable markup which give benefit to contractor and consultant .

The research finding including critical factors and its behaviors in practical construction scenario provide the pure guideline for the construction industry when decide the markup in bidding stage.

5.4 Further Research

- This research was carried out to identify the critical factors of bid markup decision and its applicability in industry. Therefore, the propose model for the bid markup decision was suggested as a further research.

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APPENDICES

- APPENDIX A – Preliminary Interview Guideline
- APPENDIX B – Questionnaire
- APPENDIX C – Case study interview guide line

APPENDIX – A
PRELIMINARY INTERVIEW GUIDELINE

Name: …….

Organization: …….

Designation: …….

The following factors were identified as factors affecting the bid markup decision through literature review. Please comment on this and add if any additional factors which are not here. Selected factors will be used in the questionnaire survey to find critical factors to propose guidelines to Sri Lankan contractors**.**

No	**Factors**	**Expert comment about factors for the questionnaire survey to propose guidelines**
01	Estimated direct cost	
02	Project duration	
03	Type of work/ project type	
04	Location of the project	
05	Labour reliability	
06	Labour availability	
07	Market condition	
08	Competition	
09	Future projects	
10	Historic profit	
11	Historic failure	
12	Current workload	
13	Required rate of return	
14	Market share	
15	Overhead recovery	
16	Home office work load	
17	Project size	
18	Owner's special requirements	
19	Other risk	

No	Factors	Expert comment about factors for the questionnaire survey to propose guidelines
20	Project complexity	
21	Cash flow requirements	
22	Estimate uncertainty	
23	Quantum of liquidated damage	
24	Completeness of the tender document	
25	Need of work	
26	Contractor involvement in design phase	
27	Portion of nominated sub contractors	
28	Portion of domestic sub-contractors	
29	Competitiveness of other tenders	
30	Overall economy (availability of work)	
31	Quality of labours	
32	Availability of other projects for the tender	
33	Payment record of client	
34	Size of client	
35	Type of client (Private/public)	
36	Relationship and past experience with client	
37	Consultant characteristics	
38	Relationship with consultant	
39	Character of consultant	

No	Factors	Expert comment about factors for the questionnaire survey to propose guidelines
40	Season in which the work is done	
41	Time available for bid preparation	
42	Material availability and cost	
43	Insurance and fringe benefits	
44	Availability of supervisory talent	
45	Method of performing work	
46	Contractors risk attitude	

Additional opinion of experts about the research and factors:

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APPENDIX – B
QUESTIONNAIRE

CRITICAL FACTORS AFFECTING THE MARKUP DECISION IN INFRASTRUCTURE PROJECTS IN SRILANKA

Dear Sir/ Madam,

To start, I would like to present my appreciation and thanks to you for spending of your time and effort to complete this questionnaire.

This questionnaire's aims are to identify the model to determine the bid markup in construction projects in Sri Lanka. This is a part of partial fulfillment of the requirements for Master of Science in Project management from University of Moratuwa, Sri Lanka. We hope that the result of this questionnaire will improve the ability of Contractors in their bid markup decision.

Information in the questionnaire:

The information collected through the questionnaire will be used for academic research and it will be treated with complete confidentiality.

Content of questionnaire:

This questionnaire is divided into two sections as:-

Section (1): Respondents' general information.

Section (2): Contractors' estimation practice.

The Objectives of the research are as follows:

1. Identifying the importance of bid markup decision
2. Identifying factors affecting bid markup decision
3. Identifying the critical factors affecting bid markup decision.
4. Investigating the relationship between markup and critical factors.

Yours faithfully
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Section One	**Respondents' General information**

1.1.Name of the Organization (optional):

1.2.Name of the Respondent (optional) :

1.3 Type of Works

☐ Contractor (Private) ☐ Contractor (Government)

1.4 Position

☐Project Manager ☐Managing Director ☐ Engineer ☐ Quantity Surveyor
☐Other (Mention please) ……..

1.5 Years of experience in the field

☐5-10 years ☐11-15 years ☐ 16-20 years ☐More than 20 years

1.6 Are you satisfied with the current bid markup decision?

☐Very satisfied ☐Satisfied ☐Neutral ☐Not satisfied ☐extremely not satisfied

1.7 Is there an estimating unit in your organization /firm? ☐Yes ☐No

1.8 Who takes bid markup decision in your Organization: ……

1.9 How many bids do you estimate per year: ……

1.10 How many bids do you win per year: ……

Section Two	Critical Factors Affecting The Markup Decision In Infrastructure Projects In Sri Lanka

From the literature and preliminary survey, it was found that, following the factors mainly influence on bid markup decision in Sri Lankan construction industry. Please express your opinion about how the degree of importance of these factors in your current Markup decision.

Please mark the level of importance of the steps in your current estimation practice in Sri Lanka on the scale 1- 5. Under the Two categories as follows

1. **Significance of Factors affecting bid markup decision**

5-Very Important	4 – Important	3 – Somewhat Important	2 – Less Important	1 - Not important

No:	Factors affecting the bid markup decisions	Significant Level of factors				
		1	2	3	4	5
1	Estimated direct cost					
2	Project duration					
3	Type of work/ project type					
4	Location of the project					
5	Labour availability					
6	Competition					
7	Future projects					

No:	Factors affecting the bid markup decisions	Significant Level of factors				
		1	2	3	4	5
8	Historic profit					
9	Historic failure					
10	Current workload					
11	Engineer estimate					
12	Estimate uncertainty					
13	Need of work					
14	Number of bidders					
15	Overall economy (availability of work)					
16	Relationship and past experience with client					
17	Time available for bid preparation					
18	Contractors' risk attitude					
	Please specify if anything you want to mention and rank it below					

Thank you

APPENDIX – C
CASE STUDY DATA SHEET

Name: ……

Organization: ……..

Designation: ……

Case Identification:			
Role in Contract :	Contractor ☐	Sub-Contractor ☐	
Project Category :			
Location :		***Project Duration :***	
Type of Contact :		***Bidding Year :***	
Bid Value : LKR		***Markup Percentage :***	
Brief Description :			

- Number of Bidders:
- Competition Level in this Project : Low ☐ Average ☐ Medium ☐
- Need of work of this Project: Low ☐ Average ☐ Medium ☐
- Estimate Uncertainty: 1% ☐
  2% ☐
  3% ☐
  4% ☐
  5% ☐