FACTORS AFFECTING CONSTRUCTION COSTS IN SRI LANKA

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ABSTRACT

This study identifies severe cost factors that define the construction project cost in order to reduce costs and cost overruns in public sector building projects. A comprehensive literature survey was followed by two rounds of Delphi surveys to extract a set of exclusive cost factors and their levels of importance with the participation of a panel of 30 experts. Severity index (to rank the cost factors according to the importance), correlation analysis (to check the agreement between the parties), cross tabulation (to identify the linear relationships between the collected data) and hypothesis testing (to prove the agreements between the parties and to check the confident levels) were used to analyse the data.

According to the research study findings, 44 cost defining factors were identified for the public sector building projects. Further, the differences in perspectives upon significance of cost factors by the direct stakeholders of construction industry were also identified. Most significant cost factors were identified as; cost of materials, size of the projects, projects planning and the complexity of projects. Further, factors were categorised in to the five main categories. Construction parties' related factors contributed to the construction costs by 25%. Financial factors contributed to the costs by 21%. Construction item related factors contributed to the costs by 20%. Environmental factors contributed to the 18% while political factors affecting to construction costs by 19%. Most significant cost factors of each category were identified separately and a guideline was formed to help minimize building construction cost in Sri Lanka leading to a better sustainable construction practice.

Keywords: *Building Projects; Direct Stakeholders; Public Sector.*

1. INTRODUCTION

Poor cost performance in construction projects has become a major concern for both contractors and clients (Saleh, 2008). A clearer understanding of the cost determinants (Akintola, 2010; Alahakoon, 2012; Thanushan, 2012) is vital to achieve the desired level of accuracy of anticipated labour costs, material costs, plant and equipments in total cost estimation. The estimator need to be able to examine these factors and subsequently estimate, plan for, and mitigate the adverse effects of these factors on the project cost. Further accuracy of cost estimate will greatly affect the ability to deliver on time and within the budget (Hawang, Zhao, and Ng, 2013). Further, it has been observed that most accurate estimate leads to highest value for money to the construction client. However Hammed, Ismail, and Mohd, (2011) stated that cost overrun is observed as one of the most frequently occurring issues in construction projects worldwide and need to be studied more to alleviate this issue in the future. This trend is more severe in developing countries where these overruns sometimes exceeds 100% of the anticipated cost of the project.

The high demand for building construction coupled with tight monetary supply in public sector is stressing the construction industry to minimise costs in a country like Sri Lanka. The problem of high construction costs in all aspects of construction is becoming obvious. Consequently, substantial cost overruns are being observed in projects. This substantial increases in costs as compared to initial estimates, has brought about loss of client confidence in consultants, added investment risks, builders to add low profit margins, inability to deliver value to clients, and disinvestment in the construction industry. Therefore there is a need for a scientific study to be carried out to identity factors affecting to the construction cost in Sri Lanka in order to identify true construction costs. In the Sri Lankan context many researchers have been conducted on "construction cost factors for road constructions projects" as a whole. However a building project consideration has not been done. This research investigates possible

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ways and means to address the problem of "Identifying what are the factors affecting to building construction costs in public sector". Therefore the aim of the study is to identify the ways and means to reduce construction cost in public sector construction projects with the objectives as to, identify cost effective factors that are considered by estimators, identify reasons for cost overrun factors in building construction project, determine constructions costs factors severity ranking according to contractors, consultants and client and to derive a guideline on minimising building construction cost in Sri Lanka.

2. LITERATURE REVIEW

2.1. A RECENT PICTURE OF SRI LANKAN CONSTRUCTION INDUSTRY IN AN ECONOMISTS PERSPECTIVE

In Sri Lanka, as of most developing countries, the construction industry plays a dominant role in the economic activities of the country. According to Central Bank (2012) the construction industry accounts for about eleven percent of the nation's capital investment and nine percent of the Gross Domestic Product (GDP). Furthermore, the construction industry is said to have contributed about half of the total stock of fixed capital investment in the Sri Lankan economy (Central Bank Report, 2012). Husseini (1991) pointed out the industry also generates employment opportunities, which is only second to the government in providing the employment for labour.

Especially at the post war context, construction industry was at a boom in its economic cycle where, the country's economy also was experiencing a healthy run. However, when reaching the year 2011, the industry was pushed towards a recession and its effects were felt in all spheres of national economy (ICRA Management Consulting Services, 2011). Consequently, the state governments resorted to take foreign loans as a quick solution to the problem of lack of funds. However, some of the measures taken by government in order to revitalise the economy have further aggravated the situation. One obvious implication of this development is that the cost of imported raw materials and subsequently of the finished products has substantially increased (ICRA Management Consulting Services, 2011). These substantial increases were reported by Alahakoon (2012) have obvious negative implications for the major players and the industry; undermining the viability and sustainability of the industry.

Stakeholders to any industry are a group or individual who can affect or is affected by achieving the industry's objectives. The role of stakeholders as major players in industry dynamics are widely recognised and recorded. This pluralistic view of the identity of those who have an investment and an interest in an industry extends well beyond the traditional concept of "shareholders" to include client, consultant, builders, material suppliers, trade unions, communities, government agencies, etc. (Kasimu, 2012). The interest, influence and importance of various stakeholders in an industry could vary. Further, stakeholders can be categorised in to two groups as direct and indirect stakeholders. Direct stakeholders are having a major role in defining the construction cost of project with regard to a construction project.

2.2. SIGNIFICANCE OF IDENTIFICATION OF COST ESTIMATION AND OVERRUN FACTORS IN CONSTRUCTION PROJECT - BROADER VIEW

Cost estimation is particularly difficult in the construction industry, often leading to considerable cost changes that are explained by large uncertainties and uniqueness of projects (Barker, 2008). One might expect that cost changes have that same probability as completing the project below the cost estimate. According to the Jayasena (2006) selection of proper method of procurement is mostly affecting to the estimation of cost as well as final project cost. Although Kasimu (2012) identified lack of cost control in all of the project development phases can contribute to cost control problems, of particular interest is the time the client makes the decision to build. In the traditional method, this is often made towards the end of the design phase. Accurate budget estimates are critical to the initial decision to build process for the construction projects (Ameh, Soyingbe, and Odusami, 2010). According to the Oladapo (2007), Akpan and Igwe (2001) Project cost changes can be caused by rising costs from the initial stages of project to the final completion of project. Flyvbjerg, Holm and Buhl (2002) discussed that for the client, accurate cost estimates are vital for business decisions on strategies for asset development, potential

project screening, and resource commitments for existing and proposed project developments. Accurate estimates are critical to the initial decision-to-build process for the construction of capital projects.

2.3 CONSTRUCTION COST FACTORS

Okpala (1988) investigated the causes of high costs of construction in developing countries and identified a total of 27 factors causing cost overruns and delays from the research. Okpala (1988) indicated twenty variables that could cause delays and cost overruns and seven other variables that could result in the escalation of construction costs without necessarily causing delay. Ismail, Aftab, and Ahmad, (2012) emphasised the effect of the economic situations of developing countries on the contractor's performance. Because of high competition between contractors, they accept very low margins of profits. In a study of the construction industry in developing countries like Nigeria, Omoregie and Radfort (2006) sampled the opinions of contractors, consultants and clients and they discovered 15 factors responsible for project delays and construction cost escalation. In another study, Elinwa and Silas (1993) identified 31 essential factors causing high cost of buildings with fraudulent practices and kickbacks ranked most important factor in developing countries. Frimpong, Oluwoye and Crawford (2003), in a review of developing countries, identified some factors as underlying causes of delay and cost over runs in construction projects. Furthermore, a study of the relative weight of ten major causes of business failure in the United States of America revealed construction cost related factors as mostly contributing to business failure (Kangari, 1989). In another new study in Nigeria, Kasimu (2012) has identified 41 cost factors while categorising to major five sections such as financial factors, factors related to the construction parties, factors related to the construction items, environmental factors and political factors.

In considering all the studies mentioned above, following forty one factors were identified as factors affecting construction costs via the literature survey. According to Kasimu (2012) factors affecting the construction costs can be categorised under following five main categories as mapped in Figure 1.

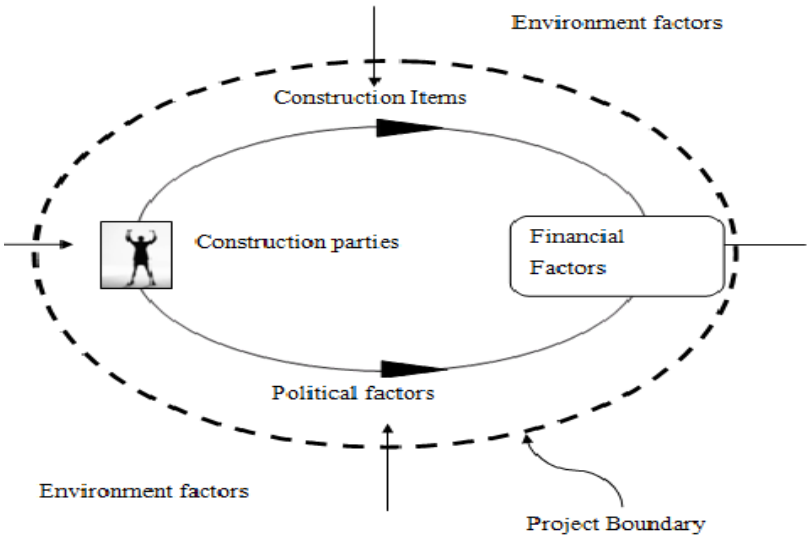

Figure 1: Major Factors Affecting Construction Cost
Source: Kasimu (2012)

Each of all factors categorised according to the Kasimu (2012) shows the relationships of all factors to the each factor. It shows the external factors are affecting to the all other factors significantly to the project boundary. Other factors are affecting to the most changes of the financial factors as a whole inside the project boundary. Table 1 summarise the identified different sub factors under each of the main five factors.

Table 1: Summary of Construction Cost Factors

Environmental Factors	Factors Related to Construction Parties	Factors Related to Construction Items	Financial Factors	Political Factors
Level of Competition	Project Planning	Cost of Material	Fluctuation of Prices of Materials	Supplier Manipulation
Complexity of Projects	Contract Management	Cost of Machinery	Project Financing and Payments	Fraudulent Practices and Kick Backs
Economic Condition	Long Period between Design and Time of Tendering	Transportation Cost	Mode of Financing, Bonds and Payments	
Project Location	Cost of Labour	Duration of Contract Period	Wrong Estimation Methods	
Social and Cultural Impacts	Contract Procedure	Additional Work	Inflation Pressure	
Number of Construction Going on At Same Time in the Western Province	Lack of Coordination and Allocation of Responsibilities between Designers and Contractors	Size of the Project	Insurance Cost	
Effects of Weather	Relationship between Management and Labour	Equipment Maintenance Cost	Currency Exchange	
Effects of Weather	Government Policies (Rules and Regulations)	Design Changes		
Number of Competitors	Poor Financial Control on Site	Waste on Site		
	Bureaucracy in Tendering Methods	Inadequate Production of Raw Materials by Country		
	Inadequate Labour Availability			
	Previous Experience of the Contract			
	Disputes on Site			
	Labour Nationality			
	Absence of Construction Cost Data			

Source: Kasimu (2012)

2.4. WAYS OF MINIMISING CONSTRUCTION COST

There are several ways in which cost of construction can be minimised. Fisk (1997) reveals two cost reduction measures. The first is the application of a value engineering concept, which aims at a careful analysis of each function and the elimination or modification of anything that adds to the project cost without adding to its functional capabilities. The second is to provide comprehensive and error free designs and specifications to avoid misinterpretations by the contractor or delay due to missing details. According to Cooke and Williams (2003) elimination or minimisation of design and specification, delivery delays and site wastes through formulation and implementation of effective material policy and material management may lead to cost reductions. In addition, Ashworth (1996) observed that profitable firms may be generating their revenues from the elimination of waste at both professional and trade practice levels.

Cost reduction measures also include: establishing firmly the requirements and features of the project at the onset before getting started; preparing the project team to do its best by getting members to sign off on capabilities and responsibilities; staying diligent about keeping the project the project on the right path through contract clauses that disallow significant changes once the project is underway; effective

human resource management through effective motivation; and project tracking involving discerning early what area or paths are leading to dead ends and applying early corrective actions.

3. METHODOLOGY

A comprehensive literature survey was carried out by referring to published books, journals and articles to obtain existing knowledge on identify the construction costs factors affecting the costs of construction projects. According to the identified cost factors, a questionnaire survey was carried out according to the Delphi technique to obtain views among the construction professionals in public sector upon the factors affecting construction costs. Two Delphi rounds were conducted using questionnaires and ranking of the identified factors were done by using the severity index accordingly from contractors, consultant and clients viewpoints. The weighted mean, standard deviation, standard error of mean and coefficient of variation are used to aid the researcher in interpretation of the information. By the correlation coefficient, the extent to which two variables are linearly related to each other is measured. Three methods were used to determine association among the parties included in this study. These are the Spearmen Correlation, Rank Agreement Factor and the Kendall's Coefficient of Concordance. Cross tabulation involves placing the survey data into tabular form, from that the functional relationship of these data can be described therefore Cross tabulation of the Experience of Responders and Average percentage agreement for the cost categories were conducted. Finally in order to lay the groundwork for costs estimation accuracy, this study sought to discover the major variables affecting construction costs of building project and via ranking.

4. FINDINGS AND ANALYSIS

4.1. RESULTS OF DELPHI ROUND ONE

Principle of the first round of the Delphi methodology is to extort and recognise the factors which influence the construction costs in building projects. The round one was carried out from beginning to end using an open ended questionnaire and interviews among the selected expert panel. In this round 33 questionnaires were disseminated and 30 of them were collected in that time. In this round expert panel was given the factors, which are generally affecting Construction costs as the theory suggests. Expert panel was asked to identify the factors which are important in terms of construction costs in public projects. Further the panel was asked to suggest any other factors which are appropriate to be considered. Respondents have suggested Soil and land stability, Inadequate Specification, Delay in payment and Difficulties in importing materials as some additional factors, which are important to consider as factors affecting construction costs in building projects in public sector addition to the criteria provided. These factors were to be considered to the second Delphi round of the survey. Consequently 44 factors are the factors which have been considered in the second round excluding the factor Labour Nationality which has received 46.67% in the initial Delphi round.

4.2. RESULTS OF DELPHI ROUND TWO

The second round of Delphi method was mainly concerned about identifying significance of factors. Therefore severity index was used to rank the construction costs factors according to the costs significance. Cost of material was taken the highest severity index (84%) out of the other factors. Out of the 44 factors 5 factors were recorded with a Severity Index result more than the 70%. Further, 29 factors were recorded more than 50% of Severity Index value while 14 factors recorded lower than 50% of Severity Index value. Waste in site was recorded the least Severity index out of all 44 factors. Order of factors is shown in Table 2.

Table 2: Rankings of Construction Cost Factors

	Factor	Severity Index
1	Cost of Material	84
2	Size of the Project	77
3	Project Planning	76
4	Complexity of Projects	73
5	Previous Experience of the Contract	72
6	Contract Management	71
7	Economic Condition	69
8	Poor Financial Control on Site	68
9	Lack of Coordination and Allocation of Responsibilities between Designers and Contractors	67
10	Wrong Estimation Methods	67
11	Inadequate Specification	66
12	Level of Competition.	65
13	Relationship between Management and Labour	64
14	Project Financing and Payments	63
15	Number of competitors	62
16	Soil and Land Stability	62
17	Delay in Payment	61
18	Inflation Pressure	59
19	Cost of Labour	58
20	Design Changes	57
21	Fraudulent Practices and Kick Backs	56
22	Difficulties in Importing Materials	56
23	Fluctuation of Prices of Materials	55
24	Duration of Contract Period	54
25	Disputes on Site	53
26	Supplier Manipulation	53
27	Cost of Machinery	52
28	Inadequate Labour Availability	51
29	Absence of Construction Cost Data.	50
30	Contract Procedure	49
31	Mode of Financing, Bonds and Payments	49
32	Government Policies (Rules and Regulations)	48
33	Long Period between Design and Time of Tendering	45
34	Bureaucracy in Tendering Methods	45
35	Project Location	43
36	Additional Work	43
37	Number of Construction Going on at Same Time in the Western Province	42
38	Effects of Weather	41
39	Inadequate Production of Raw Materials by the Country	39
40	Equipment Maintenance Cost	38
41	Transportation Cost	37
42	Social and Cultural Impacts	33
43	Currency Exchange	32
44	Waste on Site	26

According to the first round, 44 factors were used to the second round and statistical techniques were used to the further analysis. According to the results of second round cost of material was recorded the highest mean value with least coefficient of variance (27.04%). However, eight factors were recorded between 30% - 40% of the coefficient of variance showing the higher agreement within the expert panel. 21 factors were recorded the below than 50% of the coefficient of variance showing the relatively high

agreement between the expert panel. Further, the results of second round as showing the good ranking agreement between the tree groups.

Consultant - client (r_s = 0.75); Contractor - Client (r_s = 0.76); Consultant - Contractor (r_s = 0.81)

Cross tabulation contribute to place the survey data into tabular form to describe the functional relationship of collected data. The cross tabulation shows in Table 3 compares the tested group with their public sector experience.

46.67% - over 10 years of experience; 66.67% - over 5 year experience; 30% - over 15 year of experience

The hypothesis is to be tested whether consultants, contractors and clients are generally agreed on the rank of severity of cost factors. The two tailed ($\alpha = 0.05$) t - test is suitable for this study.

Null Hypothesis H0 : $\rho = 0$ (There is no agreement between severity ranks of cost factors and there is no correlation of responses)

Alternative Hypothesis H1 : $\rho \neq 0$ (There is agreement between severity ranks of cost factors and there is correlation of responses)

SPSS computer software was used to calculate "t" value and the result of test hypothesis is as follows;

Table 3: Test Statistics Data

95% CI test statistic, T-Test of statistics = 0 (vs. not = 0), Degree of Freedom = 42 (44-2)		
$T_{0.05}$(42)	2.018	
T-Cal	For Contractor - Consultant	8.09
	For Contractor - Client	8.95
	For Consultant - Client	8.35

Therefore, the null hypothesis is rejected. According to test there is a relationship between the rankings. Therefore there to a 95% CI it can be concluded hat parties are agree on the severity of the factors and all parties were trustworthy in their responses.

4.3. LEVEL OF INFLUENCE ON THE FACTORS OF CONSTRUCTION COSTS

Accoring to the Kasimu (2012) cost of materials and insufficient time was the top cost significant factors. However, when considering top five costs factors as the research findings most of significant factors are agreed by Kangari (1989), Kasimu (2012), and Frimpong, Oluwoye and Crawford (2003). There are five important factors highly highlighted by the expert panel showing the high severity index. They are;

Table 3: Five Most Cost Significance Factors

Column Reference	Rank of Factors	Construction Cost Factors	Severity Index
9	1	Cost of materials	84%
18	2	Size of the projects	77%
19	3	Projects planning	76%
2	4	Complexity of projects	73%
30	5	Previous experience of the contract	72%

Cost of material is highly emphasised as a cost factor for the building construction costs. According to the Kasimu (2012) costs of material price will depend upon the fluctuation of material, absence of or shortage of funds to afford materials, high transportation costs, high taxes charge by government, materials shortage in religion. Further, Kasimu (2012), highlighted that size of project and insufficient planning lead to costs overruns. However the size of the project and project planning were found in this study as next most important factors showing the very close severity index and same ranking agreement. Top most important cost factors have shown a close high severity index over the other cost factors.

The factors recognised as least important factors in cost of construction are currency exchange and waste on site however the Kasimu (2012) agreed with findings. Moreover, Kasimu (2012) discussed that currency exchange as least construction cost factor. However, currency exchange affects directly other factors such as transportation costs and material prices when projects have special features like BOI approval. The top least five important cost factors as ranked by experts are shown in Table 4.

Table 4: Five Least Cost Significance Factors

Column Reference	Rank of factors	Construction Cost Factors	Severity Index
15	40	Equipment maintenance cost	38%
11	41	Transportation cost	37%
5	42	Social and cultural impacts	33%
39	43	Currency exchange	32%
17	44	Waste on Site	26%

According to the Kasimu (2012), Potts (2002), Kangari (1989), Elinwa and Silas (1992), and Frimpong, Oluwoye and Crawford (2003) agreed about the all cost factors identified by expert survey. Total of 44 factors were identified as construction costs factors concluded for Sri Lankan Context. Most of factors caused due to human nature. However, there were two factors identified as natural costs factors as effects of weather (Severity index 41%) and soil and land stability (Severity index 62%). Ranking of all factors implied that most of human related factors are contributed to the construction costs.

4.4. MAJOR FINDINGS IN RESEARCH

Factors of Construction costs were categorised in to five major groups. According to the Kasimu (2012) in developing countries, considerable percentage of 19% - 30% costs factors was contributed from the *group of construction parties,* 14% - 22% from *group of environmental* and 20% *of political factors,* 16%-20% *from financial factors, 20% - 23% from* construction item factors, . According to the research study cost contribution in Sri Lankan construction industry is about 25%. Hence this group of factors were identified as biggest impact on construction costs rather than the other groups. ; Environmental factors (18%), financial factors (21%), Construction item factors (20%) and Political factors (16%). However combination of environment factors and financial factors shown 39% similarly the construction parties and political group contribution to the construction costs. Construction party's related, financial factors and construction item related groups were contributed to the more than 64% of construction costs while political and construction item related groups showing 36% of the construction costs significantly.

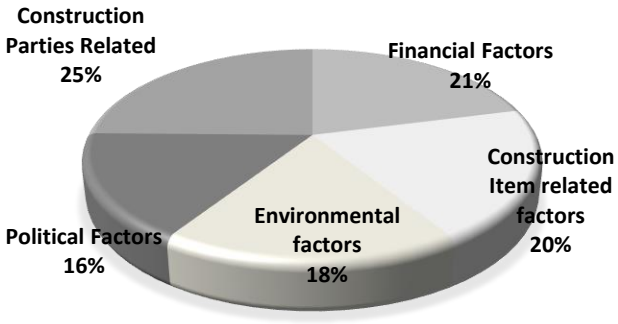

Figure 2: Groups Cost Distribution Over the Total Construction Costs

The research study shows a general good agreement level in raking of the factors affecting construction costs. However, highest ranking agreement is between the consultant and client over with contractors.

Contractors have ranked the critical factors affecting construction costs as; *(18) Size of project, (9) cost of material, (19) project planning, (20) contract management, (37) wrong estimation methods*. Consultants have ranking the cost factors ranking; *(9) cost of material, (18) size of the project, (37) wrong estimation method, (19) project planning and (3) economic condition*. Finally client have rank the factors affecting to construction costs; *(9) Cost of materials, (3) economic conditions, (19) project*

planning, (27) poor financial control on site, (30) previous experience of the contract. The five least important factors agreed by the experts; *(40) equipment maintenance costs, (42) social and cultural impact, (45) currency exchange and (45) waste on site.*

The cross tabulation results show and compare the experience of the tested groups of experts. About 65% of the experts that were analysed belong to the over five years and about 30% of the experts having more than the 15 years of the experience. About 46.67% experts having more than the ten years experience. According to the Kasimu (2012), there was good agreement between the groups while proofing that the Kendall's rank correlation is 0.93 showed the grate agreement between the groups of consultant, contractor and client. Most of the costs factors based on *parties related* are critically influence the construction costs by 25% with respect to the other categories in Sri Lanka. Consultants and clients believe that costs of building material are extremely server factor for construction costs. Environmental factors affects to the construction costs by 18% while political factors influencing the construction costs by 16% in the Sri Lanka. When considering the Sri Lankan context also *political influence* on the construction costs is considerable. Financial factors affect to the construction costs in 21% and item related factors affects in 20%.

5. CONCLUSIONS

Construction sector is a major industry which significantly contributes to the country's economy. Wrong or inadequate identification of construction cost factors usually course to a project failure. Therefore, identification of factors that define the construction cost is an important research area in current practice. Especially for public clients it is critically important to identify the factors that define costs for their projects to give good value for people's money in the country. Hence, this research study focused to address the problem of reducing the construction costs in public sector projects. The attempts were made to identify and analyse the factors which are critically influencing in the construction costs in public sector building projects.

This research study was based on the Delphi methodology to extort a set of exceptional factors which are influencing construction costs and to determine the level of importance of each factor for the public sector. The initial identification of the influencing factors affecting to construction costs, was carried out through a comprehensive literature survey. All together 41 construction costs factors were identified for the first round of Delphi method and out of 41 factors 40 factors were identified to be considered in public sector costs factors and 4 new factors were identified to be considered. Level of importance of each costs factor was analysed through the results of the second of Delphi rounds. According to the results 44 factors were identified as significant costs factors for the public sector.

Construction industry is specific and uniquely characterised. Since, the costs of a construction project is highly related to five most costs significant factors as agreed by construction professionals as cost of materials**,** size of the projects, projects planning, complexity of projects and previous experience of the contract.

Research concluded that identified the most costs significance factors for the factors affecting to construction costs in public sector projects. Basically construction costs of building projects are ascertain by the tendering procedure according to the government rules and regulations. In the public sector projects, costs identification can be done effectively in pre and post contract stages. Therefore, identification of costs factors in the each stage is very important to reduce the construction costs and avoid future costs overruns. In this research found out that several factors could be identified in the pre contract stages as costs factors. Hence, adaption of identified costs factors to the projects is a responsibility of the projects team in initially stages. However, most of cost factors could be foreseen by the pre contract stages. According to the top 20 cost factors identified, showed that 80% - 60% of the cost significant factors could be foreseeable by the project team in the pre contract stages. Therefore, proper investigation and understanding will result to give good value to the public money.

When considering the post contract stage, project team could be foreseeable risks of cost increasing in the projects. Hence, project team should be take actions to identify costs factors which can be course to the costs overruns. When considering the top 20 cost factors, 20% - 40% of cost factors belong to the post contract activities in the post contract stage itself. Hence identified costs factors in the research, is

more important to the project team in controlling and identifying the possible costs in pre and post contact stages which would lead for a better sustainable construction practice.

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