FACTORS AFFECTING THE CONTINGENCY BUDGET OF BRIDGE PROJECTS

Niluksha Dushmanthi Madduma Liyanage

09 8868

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Department of Civil Engineering

University of Moratuwa

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DECLARATION

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N.D.M. Liyanage

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The above candidate has carried out research for the Dissertation under my supervision.

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Dr. L.L. Ekanayake

DEDICATION

Dedicated to

My beloved parents,

Sister, Brother and Husband.

ABSTRACT

Cost overrun in any sector brings bad image to the organisation and unrest to the professionals. The cost overrun can be resulted either due to risk events or non risk events. Possible non risk events in bridge projects are the scope changes, design changes, quantity increase and variations. However those non risk events produce a justification to the additional cost incurred and it enhance the value of the project adding more properties.

On the other hand risk events take place unexpectedly and it wastes the project money and degrades the value of the project. Therefore in order to absorb this risk cost, without making any burden to the project, conventionally it is practicing to allocate contingency budget.

However still the most road and bridge contracts do not meet set cost targets as a result of improper assessment of risk factors inherent in construction. The majority of time and cost overruns are attributable to either unforeseen or foreseen events for which uncertainties were not properly accommodated. The Sri Lankan practice is to add a 10% contingency sum in bill quantities to cover the risks or uncertainties. However, even with the presence of this contingency allocation, cost overruns still prevail in the industry.

Identification of the root causes for the contingency budget overrun and presenting preventive strategies for the small bridge contracts cover the research topic.

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N.D.M. Liyanage

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ABBREVIATIONS AND ACRONYMS

BOQ	-	Bill of Quantities
CAPC	-	Cabinet Appointed Procurement Committee
CE	-	Chief Engineer
DPC	-	Department Procurement Committee
EE	-	Executive Engineer
EOT	-	Extension of Time
GOSL	-	Government of Sri Lanka
HD	-	Head of the Department
ICTAD	-	Institute of Construction Training and Development
MOU	-	Memorandum of Understanding
MPC	-	Ministry Procurement Committee
PD	-	Provincial Director / Project Director
PMBOK	-	Project Management Body of Knowledge
RDA	-	Road Development Authority
SBD	-	Standard Bidding document
TEC	-	Technical Evaluation Committee
VO	-	Variation Orders

CHAPTER 1: INTRODUCTION

Risk is inherent in all human endeavours, including construction activities, and the risk elements involved are diverse and varied (Odeyinka 2000). Risk in construction can be described as exposure of construction activities to economic loss due to foreseen or unforeseen events for which uncertainty was not properly accommodated. It has been pointed out that construction projects are full of risks and include those that may relate to external commercial factors, design, construction and operation (Ashworth 2002). Too often, these risks are not dealt with satisfactorily and the industry has suffered poor performance as a result (Tah 2000).

Most of road and bridge contracts are not meeting set cost targets as a result of improper assessment of risk factors inherent in construction. The majority of time and cost overruns are attributable to either foreseen or unforeseen events for which uncertainties were not properly accommodated (Perry 1985). The Sri Lankan practice is to add a 10% contingency sum in bill quantities to cover the risks or uncertainties. However, there is no proper definition or practice for contingency expenses in the road sector. Therefore contingency allocation is used to cover the cost overrun which ever take place first.

1.1 Background

Economic development of any country directly relies on the efficiency of the transportation system. For most countries, the road infrastructure is major if not the most expensive national and public asset. Since road transportation is the primary mode of transportation in Sri Lanka, it is very vital that the road network is adequately developed to promote efficient transport of people and goods.

The Road Development Authority being the principal highway authority has a responsibility to provide a road network to meet the social aspirations of the people in terms of mobility and safety, since the people at large depend on the public transportation for their travel needs.

Therefore, it is the responsibility of the Road Development Authority to ensure that the entire rehabilitation project undertaken should be completed within the prescribed

period of time and budget in order to assure improved riding quality to cater to uninterrupted public availability.

The Road Development Authority carries out a considerably large amount of the road and bridge projects in the country with domestic funds as well as the foreign funds. Mega scale projects managed by the Project Management Unit which is under the Ministry of highways and these projects are run with the intervention of the foreign countries. However, most of roads and bridge constructions running through the country are medium and small scale projects which provide access between residential areas and industrial zones, and quantity wise almost more than 50% of financing for these projects is done by the domestic funding. (Table 1) Therefore effective and successful implementation of above projects is a very contemporary requirement of the country.

At different stages of project implementation, there are different types of risk. At the feasibility and inception stages, for instance, the client might not have decided exactly on the depth of piling for foundations. Such matters will represent an uncertainty from the estimator's point of view.

The traditional practice in Sri Lanka is to add a 10% contingency sum to the Bill of Quantities of the road or bridge contract, since NPA guidelines recommend a maximum 10% of contract amount as contingency budget for road and bridge projects.

Table 1 : Domestic and foreign funds received to the RDA

	Fund Source	2008 (Mn)	2009 (Mn)	2010 (Mn)
1	Domestic Fund	30,186.6	37,783.9	50,518.4
2	Foreign Aid Grant	2,069.9	2,530.0	1,060.0
3	Foreign Aid Loan	16,980.6	26,332.2	24,726.8
4	Reimbursable Foreign Loan	3,448.1	1,746.0	39.0
5	Foreign Aide (Not Classified)	14,987.7	23,992.5	23,783.5
	Total	**67,672.6**	**92,384.5**	**100,127.6**

Source : Appropriate Account 2010, Ministry of Highwas

1.2 Problem Definition

As per the researches (Nawfall, 1997) as well as through the experience, it has found that there exist cost overrun in road and bridge projects of the Sri Lanka. Therefore Sri Lankan road sector suffered heavily due to delays and criticisms on cost overruns. Therefore professionals get the blame at the end due to the unsuccessful completion of the projects. Also this brings a bad image to the organization, since Road Development Authority expenses are covered only through the treasury funds.

Cost overrun can be resulted due to risk events as well as the non-risk events.
Scope changes, design changes, variations and quantity increases come in to the account of non-risk events. The cost overruns due to these non-risk events are justifiable and perhaps these events enhance the value of the projects.

On the other hand the cost overrun incurred due to risk events make a burden to the projects and these events degrade the value of the projects. Hence it is very much vital in managing these risks with a proper understanding and a control.

However, even presently there exists a practice of allocation 10% from the initial contract amount as the contingency budget to manage these risk events. Since the prevalence of this contingency allocation, risk events will contribute to the cost overrun, only if the risk cost exceeds the 10 % from the initial contract amount.

However, there are situations that cost overrun going beyond the 10% of initial contract amount and the reason for this might be either inadequate contingency allocation or inappropriate utilization of the contingency allocation.

Therefore, at presently it is very necessary to study, analyze and understand the reasons behind this problem, and thereby identify the probable modification to the existing practice.

1.3 Objectives

Therefore, this research study is carried out to achieve the following objectives, by focusing on the risk management of the road and bridge sector as the main research areas.

- Find out the factors which affect on the contingency allocation
- Evaluate the adequacy of the contingency allocation to manage risk
- Preventive measures for contingency overruns

1.4 Scope

Initially scope was to evaluate the contingency budget to road and bridge projects. However there is a vast coverage in road construction due to different surfacing types, ground improvement techniques and bases etc. Therefore, scope was restricted only for the bridge projects since; both together will not produce a focused output at the end.

Under consideration of the above, this research has been undertaken to evaluate the different risk factors, contributing to the contingency allocation of completed small bridge projects which cost below 25 Million Sri Lankan Rupees. The research is done from a client's point of view for the domestic funding projects. Since the selected cost category is between 10 Million - 100 Million range, the relevant Condition of Contract is the SBD1 published by ICTAD, Sri Lanka.

1.5 Methodology

The available literature was reviewed to identify the elements of the contingency budget. Then the data was collected from records available in the RDA for small bridge projects, to identify the risk and non-risk cost overrun portion and thereafter risk portion was evaluated to find out the adequacy of the contingency allocation.

This method comes under the descriptive research method, since the main goal of this type of research is to describe the data and characteristics of what is being studied. This involves collecting quantitative information, then organising the information, tabulating and describing the qualitative information.

1.6 Main Findings

There is no proper definition for the contingency allocation in the road sector. Contingency allocation is being used for cope with the scope changes, design changes and extra works. In some cases contingency allocation used to cover the price escalation. The practise is to spending the contingency allocation to cover up the cost overrun events which ever come first.

The research reveals that there exists cost overrun in small bridge projects, which consist of non-contingency overrun and price escalation. However, there is no physical contingency overrun for the small bridge projects.

1.7 Guide to the Report

The report consists of six chapters and four appendices.

Chapter 01:-

Introduction to road and bridge projects of Sri Lanka, Contingency budget and the Road Development Authority.

Chapter 02:-

This contains the information obtained from the literature review pertaining to the factors leading to cost overrun, and contingency budget of the construction industry. In addition the Sri Lankan background in contingency allocation and its limitations have been summarized

Chapter 03:-

Suitability of the selected methodology has been discussed and available bridges coming under the contract amount Rs. 25 Mn have been listed. In addition the flow chart and selection criteria of critical projects have been presented.

Chapter 04:-

The detail on three selected critical cases is presented in this chapter.

Chapter 05:-

The detail analysis on three critical cases is presented in this chapter. Further, main risk factors, which influence the contingency budget and the causes behind those factors, have been discussed.

Chapter 06:-

The preventive measures to be taken to minimise the risk factors, thereby to control contingency budget exceedance.

CHAPTER 2: LITERATURE REVIEW

2.1 Background

The universal objective of construction projects is to complete the project on time and within the budget while meeting established quality requirements and other specifications. The increasing complexity of infrastructure projects and the environment within which they are constructed place greater demands on construction managers to deliver projects on time with budget and high quality (Enshassi, Al-Najjar and Kumaraswamy 2009)

As a client organization, the RDA taking the risk that projects will not get built on schedule, that those will not get built for what has budgeted, and that those will not be of the quality expected.

As mentioned in the PMBOK (Project Management Institute 2004) project risk has its origins in the uncertainty that is present in all projects. Known risks are those that have been identified and analyzed, and it may be possible to plan for those risks using the processes of project management. However, unknown risks are not that easy to avoid, cannot be managed proactively and a prudent response by the project team can allocate general contingency against such risks, as well as against any known risks for which it may not be cost effective or possible to develop a proactive response.

A research study has been done to identify the key factors that lead to cost overrun in foreign funded road and bridge projects of Sri Lanka, utilizing the documentary records available in the RDA (Nawfal 1997).

The key factors are,

- Price fluctuation
- Currency fluctuation
- Claims
- Variation orders
- Dispute Settlement awards
- Compensation and cost arising from increase in quantities.

In addition to the above key factors, it has found 23 principal common causes of claims in RDA contracts of foreign funded projects.

1. Inadequate time provision to prepare tender documents.
2. Incomplete work descriptions
3. Inadequate site investigation
4. Inadequate contract documents
5. Post tender correspondence and negotiation
6. Cost of testing
7. Bore hole and exploratory excavation
8. Delays in the relocation of services
9. Delays in land acquisition
10. Lack of co-ordination with other organizations.
11. Lack of knowledge in interpretation of terms of the contracts
12. Delays in providing facilities for the engineers
13. Late issue of drawings and instruments
14. Missing setting out details
15. Delays in advance payments
16. Late issue of interim certificate
17. Late payment of certificates
18. Inadequate contract monitoring and management.
19. Civil disruptions
20. Delays in locating suitable naturally occurring material
21. Effect of subsequent legislation
22. Inherent characteristics of contractor
23. Mismanagement of advance payment

Risk factors identified, which lead to cost overrun have been categorized as follows (Dada and Jagboro 2007)

1. Physical risk factors
2. Environmental risk factors
3. Design risk factors
4. Logistics risk factors

5. Financial risk factors
6. Legal risk factors
7. Political risk factors
8. Operational risk factors
9. Time schedule slippage

However, the main risk factors identified are financial and political influence among the above. Here a model has developed by relating the variation between the initial contract estimate and the actual project cost to the risk variables. From the analysis, the percentages of project cost overrun due to the impact of risk were established for each procurement method investigated (Table 2). The research recommends that contingency addition should be equal to the cost overrun amount, since the objective of contingency allocation is to excessive expenditure coverage.

Table 2 : Contingency percentages for different procurement method

Procurement Method	Contingency %
Management Procurement Method	30 %
Traditional Method	16 %
Design and Build	9 %
Management Construction	25 %
Direct Labour	13 %

Hence, for the Nigerian construction industry, a 16% contingency allocation is recommended, since cost overrun factors coincide with contingency risk factors, as identified by the researcher.

Delays and cost increases in the construction of private residential projects in Kuwait has been studied (Koushki 2005). The amount of time delays and cost increases was greater when the total cost of a residential project was higher. A major factor

contributing to the time and cost increase was the inadequacy of money and time allocated to the design phase.

However the three main cases for above cost overrun were

1. Poor contract management ,
2. Material related problems
3. Owners' financial constraints.

26 factors have been identified that cause cost overruns in construction of ground water projects in Ghana (Frimpongs 2003). According to the contractors and consultants, monthly payments difficulties was the most important cost overruns factor, while owners ranked poor contractor management as the most important factor. Despite some difference in viewpoints among the three groups surveyed, there is a high degree of agreement among them with respect to their ranking of the factors. The overall ranking results indicate that the three groups felt that the major factors that can cause excessive ground water project cost overruns in developing countries are

1. Poor contractor management
2. Monthly payment difficulties
3. Material Procurement
4. Poor technical performances and
5. Escalation of material prices

It has studied the factors influencing construction time and cost overruns for high rise projects in Indonesia (Kaming 1997) where 31 project managers working in high rise buildings were surveyed and pointed out that the major factors influencing cost overrun were

1. material cost increase due to inflation
2. Inaccurate material estimating and
3. Degree of project complexity

The main cost overrun factors identified for construction projects in the Gaza Strip (Enshassi, Al-Najjar and Kumaraswamy 2009) are

1. Increment of material prices due to continuous border closures
2. Delay in construction, supply of raw materials and equipment by contractors
3. Fluctuations in the cost of building materials
4. Project materials monopoly by some suppliers
5. Unsettlement of the local currency in relation to dollar value
6. Low commitment of donor to compensate any bad result that may come from the bad economic and political situation
7. Donor policy in biding tender to the lowest price one
8. Design changes
9. Extra works at owners request
10. Resource constraint
11. Funds and associated auxiliaries not being ready
12. Lack of cost planning monitoring during pre and post contract stages
13. Improvements to standard drawings during construction stage
14. Inadequate review for drawings and contract documents
15. Contractual claims such as extension of time with cost claims
16. Inaccurate quantity take off
17. Technical incompetence, poor organizational structure and failures of the enterprise
18. Lack of cost reports during construction stage
19. Inadequate project preparation planning and implementation
20. Delays in issuing information to the contractor during construction stage
21. Lack of co-ordination at design phase
22. Change in the scope of the project, in government policies
23. Some tendering manoeuvres by contractors, such as front loading of rates
24. Incomplete design at the time of tender
25. Bad allocation of labour inside the site
26. Delays in decision making by government, failure of specific co-ordinating
27. Delay in costing variations and additional works
28. Lack of experience of project type

29. Re measurement of provisional works
30. Wrong/Inappropriate choice of site
31. Omissions and errors in the bills of quantities
32. Delay in handing over of projects
33. Absence of managerial programs that help in saving materials inside the site
34. Indecision by the supervising team in dealing with the contractors queries resulting in delays
35. Lack of experience of local regulation
36. Change in owner's brief
37. Inability of the contractor to adopted properly to the project environment
38. Labour unrest
39. Lack of attracting skilful technicians for work
40. Lack of experience of technical consultants, inadequacy of foreign collaboration agreements, monopoly of technology
41. Unpredictable weather conditions
42. Long period of the project maintenance period
43. Over time work hours of supervising engineer are paid by the engineer.

The magnitude of average schedule slippage due to variations was reported as 18% (Kumaraswamy, Millar D and Yogeswaran 1998). The deviation (variation) cost amounted to an average of 14% of the total cost of the project (Zeitoun and Oberlender 1993). Although there have been cases where variation cost accounted for as high as 100% of the budgeted funds, the industry norm was about 10%. The impact of variations varies from one project to another. However it is generally accepted that variations can affect construction projects with unpalatable consequences in time and cost (Hester, Kuruprenas and Chang 1991).

2.2 Risk Management

As per the PMBOK guide, project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses and monitoring and control of a project. Most of these processes are updated throughout

the project. The objectives of risk management are to increase the probability and impact of positive events and decrease the probability and impact of events adverse to the project.

The project risk management processes include the following.

1. Risk Management Planning
2. Risk Identification
3. Qualitative Risk Analysis
4. Quantitative Risk Analysis
5. Risk Response Planning
6. Risk Monitoring and Control

2.3 Contingency Budget

The purpose of the project contingency allocation is to generate a reserve of funds sufficient to assure successful completion of the project on time and within total budget through minimization of the cost overrun risk factors.

The contingency sum, usually expressed as a percentage mark-up on the base estimate, is used in an attempt to allow for the unexpected. Construction and development is fraught with difficulty, and the basic notion of risk analysis is that it is useful to at least make an attempt to identify these risky items and attach some financial value to them.

These amounts can then be added to a project budget as items of possible expenditure. The intention is that project budget becomes a more realistic representation of the client's likely outlay.

However, there are several weaknesses inherent in using a contingency amount as per the (Thompson and Perry 1992)

The percentage figure is, most likely, arbitrarily arrived at and not appropriate for the specific project.

- There is a tendency to double – count risk because some estimators are inclined to include contingencies in their best estimate.

- A percentage addition still results in a single figure prediction of estimated cost, implying a degree of certainty that is simply not justified.
- The percentage added indicates the potential for detrimental or downside risk, it does not indicate any potential for cost reduction, and may therefore hide poor management of the execution of the project.
- Because the percentage allows for all risk in terms of a cost contingency, it tends to direct attention away from time performance and quality risks.
- It does not encourage creativity in estimating practice, allowing it to become routine and mundane, which can propagate over sights.

2.4 National Procurement Agency Guidelines

These guide lines provide instruction of contingency amount allocations on GOSL funded projects. The relevant clauses are as follows.

Variation Orders – Works

Clause 8.13.1

The condition of contract will normally empower the employer to vary the form, quality or quantity of the work to be executed at any time during the progress of the work and provide the basis for such variation and valuation of such variations within approved limits.

Clause 8.13.2

A contract variation order is used to obtain approval to order variations and, more particularly to obtain authorization to incur the financial effects of them.

Approving Authority for Aggregate Variations not exceeding the Contingency Provision (Clause 8.13.3)

Contract variation orders may be authorized by the Head of Department/Project Director provided that the net sum of the variation and any previous variation does not exceed the amount of the contingency provision provided in the approved contract budget. Contingency provision generally should not exceed ten percent (10%) of the estimated contract amount.

Approving Authority when Contingency provision is exceeded (Clause 8.13.4)

When the approved contingency provision is exceeded or where there is no contingency provision, the contract variation order should be submitted for approval to the appropriate level of authority given in the Procurement Manual.

2.5 National Procurement Agency Procurement Manual

Corresponding reference of Procurement Manual, 2006 on Variation to Contracts is as follows.

Clause 8.13.4

The variation to contracts during the implementation stage causes a very high burden on the Procurement Entity and the Government. If the contribution from the variation to the final contract sum is high it will dilute the procurement process that was carried out when awarding the contract.

Therefore the procurement entity must ensure that all professional and human efforts are taken to minimize this situation. Variations are mainly due to change of scope and quantity variations.

To minimise variations due to change of scope, the procurement entity should get a comprehensive briefing from the persons who are involved in design, whether they are internal or external consultants before inviting bids. In case the aggregate

variation exceeds the contingency amount, and the procurement entity requires approval for the varied amount, the procurement entity is required to certify that the contract award or the persons who have involved in design would have foreseen. In the latter case the approving authority may require to obtain a statement from such persons and procurement entity mist forward the same.

To minimize variations due to inaccurate quantities or omissions in the BOQ, it is recommended that before the start of preparation of bidding documents, PE should obtain a certificate from the persons who have prepared the BOQ that a second person has checked the BOQ for its accuracy and completeness.

Despite all above, if the aggregate amount of the variations (due to quantity changes and extra works orders issued), is within the contingency provision (which should be 10% maximum) the HD/PD may approve the change order.

Otherwise, the HD/PD should take necessary steps to revise the TCE.

If the aggregate amount of variation as computed above is still within the 5% limit of the original TCE, the CAO, if he is satisfied with the variation and by obtaining the assistance of a TEC appointed by him may approve the variation.

If the aggregate amount of variation as computed above is more than or equal to 5% of the original TCE, and if the CAO is satisfied with the variation, the variation should be approved by the appropriate PC assisted by the appropriate TEC. For this purpose the appropriate committees should decide on the basis of revised TCE and not necessarily the committees that handled the original procurement.

2.6 Practice of the Road Development Authority

Taking the Sri Lanka road and bridge construction industry, the RDA handles most of such contracts as the client on behalf of the government. Under the RDA, in addition to government funding, various types of donor agencies are operating such as, the Asian Development Bank (ADB), World Bank (WB), Overseas Economic Corporate Fund (OECF), Japanese Funding Agency (JAICA), Kuwait Funding (KF) etc.

Government funds are received by the RDA from the yearly allocation by the Government for rehabilitation and construction of national roads and bridges in Sri Lanka. These funds are released considering the requirement of the 10 provinces operating under the Provincial Directors. At the provincial set up, the Director Maintenance, Management and Construction distributes the allocation to each Provincial Director and thereafter the Provincial Director will allocate the received funds to the respective Chief Engineers of the district under him, and Chief Engineers will distribute received allocation to the respective Executive Engineers of the division and project engineers.

While commencing construction work, if the construction cost exceeds the original contract amount, while being within the contingency allocation, then the Director MMC can approve to continue the works with the excess amount through the Provincial Director.

In addition to that, if the prevailing excessive amount is greater than the contingency portion, but less than 10% of original contract amount, then it should get the approval of the Director General, through the Director MMC.

Further, if the excess amount within 10% to 15%, then the Secretary of the Ministry of Highways can approve it. (Either through MPC assisted by TEC or without MPC)

In addition to that, if the prevailing excessive amount is greater than 15% of original contract amount, then it should get approval through MPC assisted by a TEC.

2.7 Variations

Variations are the major component which contributes to the contingency budget of RDA road and bridge projects.

A variation is any deviation from an agreed well defined scope and schedule. Stated differently, this is a change in any modification to the contractual guidance provided to the contractor by the owner or owner's representative. This includes changes to plans, specifications or any other contract documents. Variations in construction projects can cause substantial adjustment to the contract duration, total direct or

indirect cost or both. The magnitude of average schedule slippage due to variations was reported as 18% (Kumaraswamy, Millar D and Yogeswaran 1998) the deviation (variation) cost amounted to an average of 14% of the total cost of the project (Zeitoun and Oberlender 1993). Although there have been cases where the variation cost accounted for as high as 100% of the budgeted funds, the industry norm was about 10%. The impact of variations varies from one project to another. However, it is generally accepted that variations can affect construction projects with unpalatable consequences in time and cost (Hester, Kuruprenas and Chang 1991).

2.8 Condition of Contract for Cost Control

In addition to the procurement guide lines and procurement manual published by the NPA, for Rs.10 – 100 million GOSL funded projects should follow the guidance and instructions of Standard Bidding Document 1, published by ICTAD.

The Condition of Contract (SBD1 2007) was studied in detail to identify cost exceedance situations. The relevant clauses most likely to give rise to the cost claims were as follows.

Clause 37 Bills of Quantities

37.1 The bills of quantities shall contain items for construction installation, testing, and commissioning work to be done by the contractor

37.2 The bill of quantities is used to calculate the initial contract price. The contractor is paid for the quantity of the work done at the rate specified in the bills of quantities for each item.

Clause 38 Changes in the Quantities

38.1 If the final quantity of the work done differs from the quantity in the BOQ for the particular item by more than 25% , provided the change exceeds 1% of the initial

contract price , the engineer shall re examine the rate based on market conditions and adjust the rate to allow for the changed quantity exceeding the 25%.

38.2 The engineer shall not adjust rates arising from changes in quantities if thereby the initial contract price is exceeded except the prior approval of the employer.

38.3 If requested by the engineer, the contractor shall provide the engineer with a detailed cost breakdown of any rate in the BOQ.

Clause 39 Variations

39.1 Variations may be initiated b the engineer at any time prior to issuing the certificate of completion for the works, either by an instruction or by a request for the contractor to submit a proposal.

39.2 Variation may be ordered by the engineer provided the cumulative value of ail such variations issued does not exceed a sum specified in the contract data. Any variation ordered above this limit would need the prior approval of the employer.

39.3 The contractor shall execute and be bound by each variation, unless the contractor promptly gives notice to the engineer with supporting documents to establish that he cannot obtain the necessary equipment, materials, plant & temporary works or any of them as appropriate, require for the variation. Upon receiving this notice, the engineer shall reconfirm, vary or cancel the instruction.

39.4 Each variation may include:

a) Changes to the quantities of an item of work included in the contract

b) Changes to the quality and other characteristics of any item of work

c) Changes to the levels, positions and dimensions of any part of the works

d) Omissions of any work other than work intended to be carried out by others.

e) Any additional work , plant, material or services necessary for the works including any associate tests on completion, boreholes and other testing and exploratory work: or

39.5 The contractor shall not make any alteration and /or modification of the permanent works, unless and until the engineer instructs or approves a variation.

39.6 All variations shall be included in updated programmes produced by the contractor.

Clause 40 Payment for Variations

40.1 The contractor shall provide the engineer with a quoted for carrying out the variation when requested to do so by the engineer within 07 days or such extended time given by the engineer. The engineer shall assess the quotation before the variation is ordered, taking in to consideration the provision given in the contract data.

Clause 43 Payments

43.1 Payments shall be adjusted for deductions for advance payments and retention. The employer shall pay the contractor the amounts certified by the engineer within 14 days of the date of each certificate. If the employer makes a late payment the contractor shall be paid interest on the late payment in the next payment. Interest shall be calculated from the date when the late payment is made at the prevailing rate of interest of 1% over the lending rate of the central bank to commercial banks.

43.2 If an amount certified is increased in a later certificate or as a result of a recommendation by the adjudicator or an arbitrator, the contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.

43.3 Unless otherwise stated, all payments and deductions will be paid in Sri Lanka Rupees.

43.4 Items of the works for which no rate or price has been entered in will not be paid for by the employer and shall be deemed covered by other rates and prices in the contract.

Clause 44 Compensation Events

44.1 The followings are the compensation events.

a. The employer does not give access to a part of the site by the site possession date stated in the contract data.

b. The employer modifies the schedule of other contractors in a way that affects the work of the contractor under the contract.

c. Other contractors, public authorities, utilities, or the employer does not work within the dates and other constraints stated in the contract, and they cause delay or extra cost to the contractor.

d. The engineer orders a delay or does not issue drawings, specifications or instructions required for execution of the works on time.

e. Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the latter of acceptance from the information issued to bidders (including the site investigation reports), from information available publicly and from a visual inspection of the site.

f. The engineer gives an instruction for dealing with an unforeseen condition, caused by the employer or additional work required for safety or other reasons.

g. The advance payment is delayed.

h. The effects of the contractor of any of the employer's risks.

i. The engineer unreasonably delays issuing a certificate of completion.

j. The engineer instructs the contractor to uncover or to carry-out additional tests upon work, which is then found to have no defects.

k. Other compensation events described in the contract or determined by the engineer shall apply.

44.2 If a compensation event would cause additional cost or would prevent the work being completed before the intended completion date, the contract price shall be increased and/or the intended completion date shall be

extended. The engineer shall decide whether and by how much the contract price shall be increased and whether and by how much the intended completion date shall be extended.

CHAPTER 3: METHODOLOGY

In attempting to respond to the above research objectives and aims, this research project employed an inductive qualitative research methodology through a combination of critical literature review and a process of case study survey.
A case study is a research methodology common in research field. It is based on an in depth investigation of a single, inductive group or event. Rather than using samples and following a rigid protocol to examine a limited number of variables, case study methods involve an in-depth, longitudinal (over a long period of time) examination of a single instance or event.

The term "case study" has multiple meanings. It can be used to describe a unit of analysis or to describe a research method. A case study is generally accepted as a qualitative research method (Alavi and Carlson 1992): (Orlikowski and Baroudi 1991) and according to (Saunders, Lewis and Thornhill 2000) it is an approach particularly suited to generate answers to the questions "why", "how" and "what".

An inductive approach starts with a question or "problem statement" (Glesne and Peshkin 1992) followed by conclusions that are generated from the existing data. Research using this approach is particularly concerned with context in which such events take place: therefore, the study of a small sample of subjects may be more appropriate than a large number (Easterby-Smith 2002).

Thus, it is hoped that the selection of a meaningful and representative sample of case studies may provide a good basis for a good critical analysis that may result in generalisable understandings (Bhandari, Nunes and Annansingh 2005). Furthermore, as stated by (Saunders, Lewis and Thornhill 2000) inductive research allows a more flexible approach, as changes, instance and sample, can be made as the research progresses. Based on these arguments, the methodological framework in Figure 01 was adapted from (Bhandari, Nunes and Annansingh 2005). This framework encompasses the following four inductive steps and is based on the framework proposed by (Yin 1984).

1) Performing a literature review on risk factors and risk causes was carried in order to provide a theoretical background to the study and establishing an initial proposition of main categories of risk in bridge projects for further exploratory and critical analysis.
2) Establishing an appropriate set of case studies was selected on the basis of its validity, descriptive value and reliability
3) Performing an analysis of individual case studies to provide a response to the research question and to establish the risk identification.
4) Producing a synthesis of the different case studies to provide a response to the research question and to establish the risk identification ontology.

3.1 Case Selection

When selecting the cases for study, information – oriented bridge projects were used, as opposed to random sampling. This is because an average case is often not the richest in information. Extreme or typical cases reveal more information because they activate more basic mechanism and more actors in the situation studied. In addition, from both an understanding – oriented and an action – oriented perspective, it is often more important to clarify the deeper causes behind a given problem and how frequently they occur. Random samples emphasizing representativeness will seldom be able to produce this kind of insight: it is more appropriate to select a few cases, chosen for their validity, but this is not always the case.

The approach adopted in this research is the study of the documentary records and information of completed bridge projects available in RDA, and identify the high risk projects. The strategy is to study and analyse cases of financially unsuccessful bridge projects of initial contract amount below 25 million rupees. The additional quality criteria for the selection of case studies include the following characteristics.

- Clear and descriptive
- Focus on failure description
- Findings are unbiased

3.2 Evaluation of the Selected Methodology

The study is based on some previous understanding of the nature of the research problem. That most road and bridge projects encountering the cost overruns due to risk or non risk factors.

Here the main aim is to identify the major risk factors which cause cost overrun and allocate the contingency amount to suit the potential risk factors, if the prevailing percentage figure is inadequate.

In these kinds of descriptive research, accuracy is very important. If the study does not present a precise measurement of the cost overrun, it will mislead the managers who are making the contingency budgeting and other decisions based on this study.

Therefore the method adopted is the directly take out the data from the available records rather than for Questionnaire survey, Interview or any other research methods.

3.3 Methodology

Most recently completed and records available bridge projects in RDA (Table 3) were studied, which have an initial contract amount below 25 million rupees and follows the procedure given in the flow chart (Figure 1).The data gathered for the purpose is given in the Appendices A

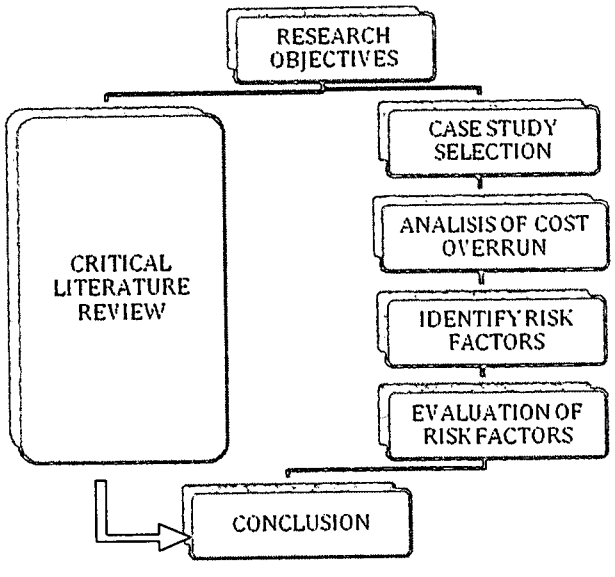

Figure 1 : Flow chart

Table 3 : Records of small bridge projects of GOSL funding

No:	Contract No	Project Name	Contract Amount (Mn)	Completed		Cost Overrun
				No	Yes	
1	RDA/MMC/BD/02	Widening of bridge No:2/2 on Hendala Hunupitiya Road	91.49		√	√
2	RDA/MMC/BD/05	Reconstruction of bridge No:5/1 on Hendala Uswetakeiyawa Road	42.09	√		
3	RDA/MMC/BD/06	Reconstruction of bridge No:25/6 on Wanduramba Ethumale Yakkatuwa Road	18.08		√	-
4	RDA/MMC/BD/07	Construction of bridge No:25/3 on Galle Udugama Road	15.84		√	-
5	RDA/MMC/BD/08	Reconstruction of bridge No:31/4 on Galle Deniyaya Madampe Road	20.63		√	√
6	RDA/MMC/BD/10	Construction of suspension bridge across Ma-Oya at Waddeniya	22.61		√	-
7	RDA/MMC/BD/17	Reconstruction of bridge No:2/1 on Narahenpita Nawala Nugegoda Road	66.75		√	
8	RDA/MMC/BD/21	Widening and Redecking of bridge No:5/3 on Jaela Ekala Gampaha Road	21.34	√		
9	RDA/MMC/BD/22	Widening of bridge No:7/1 on Hendala Uswetakeiyawa Road	Not commenced	√		
10	RDA/MMC/BD/30	Widening and Redecking of bridge No:12/1 on Alawwa Dampalassa Road	23.99		√	√
11	RDA/MMC/BD/31	Reconstruction of bridge No:13/5 on Kiriella Nadurana Eheliyagoda Road	Mutual termination			
12	RDA/MMC/BD/33	Construction of bridge No:27/1 on Passara - Hingurukaduwa - Pelawatta Road	51.21	√		
13	RDA/MMC/BD/36	Reconstruction of bridge No:79/2 on Peliyagoda Puttalama Road	8.46		√	
14	RDA/MMC/BD/50	Reconstruction of bridge No:31/3 on Wattegama Kandenuwara Wariyapola Road	43.95	√		
15	RDA/MMC/BD/52	Construction of bridge No:11/1 on Passara - Hingurukaduwa - Pelawatta Road	48.55	√		
16	RDA/MMC/BD/55	Reconstruction of bridge No:6/1 on Kurunegala Narammala Madampe Road	36.11		√	
17	RDA/MMC/BD/63	Construction of bridge over Mahaweli ganga at Balantota on Balantota - Dekinda Road	18.6		√	√

Since there is a time value for the money, particular time period also selected for the research. The attempt was to utilize the most recently completed small bridge projects. As per the general practice, 2 years is more fairly enough to complete a bridge project. Therefore 2006-2008 period was selected as most recently completed bridge projects.

Among the listed bridge projects of Table 03, only 7 projects are coming under the specified cost range. From those, still one project is not completed. Hence only 6 projects have been considered for the research.

Among those selected bridge projects, 3 projects have accompanying cost overrun. This gives the understanding of prevalence of 50% cost overrun in small scale bridge projects. Those adverse bridge projects were analysed in depth to identify critical causes and then, those causes were evaluated.

CHAPTER 4: CASE STUDIES

The adverse three bridge contracts among the discussed cases were analysed in depth, to investigate whether the factors behind the cost overrun contribute to the contingency allocation. Background information, Bill of Quantities, Claims, Variation Orders and Extension of Times were mainly referred to identify the research objectives.

The selected critical bridge projects are listed in the following table.

Table 4 : Selected critical bridge projects

No:	Contract No	Project Name
1	RDA/MMC/BD/08	Reconstruction of bridge No:31/4 on Galle Deniyaya Madampe Road
2	RDA/MMC/BD/30	Widening and Redecking of bridge No:12/1 on Alawwa Dampalassa Road
3	RDA/MMC/BD/63	Construction of bridge over Mahaweli ganga at Balantota on Balantota - Dekinda Road

4.1 Case 1 : Bridge No 31/4 on Galle Deniyaya Madampe Road

Introduction

The Road Development Authority undertook the improvement and construction of roads and bridges, funded by GOSL. Construction of Bridge No 31/4 on the Galle Deniyaya Madampe Road is one of the projects carried under above.

The scope of the work is the construction of a 13.5m single span concrete bridge, providing clear carriageway of 7.4m with two 1.2m wide foot walks on either side. The Galle end abutment and wingwall are of reinforced concrete on pile foundations and Deniyaya end abutment and wingwall are of mass concrete on spread foundation. The deck is to be formed of 13.5m long PSC pretension beams placed side by side with in-situ in-filler concrete

This includes the construction of approaches of total length approximately 120m and the temporary bypass, in order to maintain a smooth traffic flow during the construction period.

Project Implementation

The Road Development Authority is the Executing Agency and General Manager, RDA is the Employer for the purpose of the contract. The Provincial Director of Southern Province, RDA is the Employer's Representative.

The Engineer is the Chief Engineer of Matara, Road Development Authority.

The Contractor is the M/S Jayawansa Constructions (Pvt) Ltd.

Other contractors are the public utility services comprising Ceylon Electricity Board, Sri Lanka Telecom, Water Board and the Divisional Secretary.

However at the implementation, it was not possible to construct the bypass due to the particular land not being acquired by the client. Hence the contractor had to change the method for stage construction (first do one half and allow traffic to move and then the other half) which resulted in an extension of the contract duration.

Project Details		
Engineering Estimate	:	Rs. 24.00 Mn
Contract Duration	:	545 Calendar days
Date of Commencement	:	21/07/2006
Original date of Completion	:	20/01/2008
Extension given (EOT 01)	:	244 days
Date of Completion	:	20/09/2008
Contract Sum	:	Rs. 20,631,996.00

Table 5 : Particulars of Bridge 31/4 on Galle Deniyaya Madampe Road

Construction of Bridge No 31/4 on Galle Deniyaya Madampe Road		
	Amount (Rs)	% from Initial Contract Amount
Initial Contract Amount Rs. (with Contingency)	20,631,996.00	
Contingency Amount Allocated	1,875,636.00	
Initial Contract Amount Rs. (without Contingency)	18,756,360.00	
Quantity Increase	1,628,370.17	8.68%
Price Escalation	153,214.08	0.82%
Total Increase	1,781,584.25	9.50%

At the completion of the contract, the total cost increased 9.50% from the initial contract amount whereas; the allocated contingency amount is 10% of the initial contract amount. The factors which contributed to these contingency expenses are listed in percentagewise (Table 5) and evaluated in depth to identify the main causes.

1. Quantity Increase

Quantity increases had been introduced through variation order no :01 to the contract. The items of quantity increased are listed in the Table b.1. As a result of approving the extention of time claim, preliminary items have been increased.

2. Price Escalation

Due to the price increase of major materials and the contract extension, price escalation variations were incurred. (Appendix B) The contractor requested for one extension of time. The days approved for the EOT were 244 days. The reasons considered for the extension are given in Table 06.

3. Extension of Time

One claim has been submitted by the contractor to extend the contract period. 244 days extension was granted. Reasons for extension are as follows.

Table 6: Particulars of Extension of Time for Galle Deniyaya Madampe Bridge

	Description	No: of Days
1	Change of construction sequence	173
2	Frequent flooding of the site	30
3	Adverse weather condition	18
4	Construction damage	23
	Total	**244**

4.2 Case 2 : Bridge No:12/1 on Alawwa Dampellassa Road

Introduction

The Road Development Authority had undertaken improvement and construction of roads and bridges, funded by GOSL. The Widening and Re-decking of Bridge No12/1 on Alawwa Dampellassa Road is one of the projects carried out under the above. The scope of work consists of construction of two spanning 9.5 m deck.

Project Implementation

The Road Development Authority is the executing agency and General Manager, RDA is the employer for the purpose of the contract. The Provincial Director of North Western Province, RDA is the employer's representative.

The Engineer is the Chief Engineer of Kurunegala, Road Development Authority.

The Contractor is the M/S K.D. Ebert and Sons Holding (Pvt) Ltd.

Other contractors are the public utility services comprising Ceylon Electricity Board, Sri Lanka Telecom, Water Board and the Divisional Secretary.

While the excavation work was progressing, weathered rock was encountered by the project team and this led to incurred extra work and extra time to the project budget and duration respectively.

Project Details

Engineering Estimate	:	Rs. 18.31 Mn	
Contract Duration	:	360 Calendar days	
Date of Commencement	:	03/04/2007	
Original date of Completion	:	27/03/2008	
Extension given (EOT 01)	:	165 days	302 days
Extension given (EOT 02)	:	137 days	
Date of Completion	:	31/12/2008	
Contract Sum	:	Rs. 23,992,168.00	

Table 7 : Particulars of Bridge 12/1on Allawwa Dampelessa Road

Construction of Bridge No12/1 on Alawwa Dampellassa Road		
	Amount (Rs)	% from Initial Contract Amount
Initial Contract Amount Rs. (with Contingency)	23,992,168.00	
Contingency Amount Allocated	2,399,216.80	
Initial Contract Amount Rs. (without Contingency)	21,592,951.20	
Extra Work	105,225.00	0.49%
Quantity Increase	3,850,868.00	17.83%
Price Escalation	4,410,029.01	20.42%
Total Increase	8,366,122.01	38.74%

At the completion of the contract, the total cost increased 38.74% from the initial contract amount, whereas the allocated contingency amount is 10% of the initial contract amount. Cost increases have been introduced to the project through five number of variation orders. The factors which contributed to this contingency exceedance are listed percentage-wise (Table 7) and evaluated in depth to identify the main causes.

i. Extra Work

Two extra works were introduced through variation order no:01, to accommodate rock excavation, which was not included in the original BOQ.

Table 8 : Extra work details of Allawwa Dampelessa Road

	Extra Work Items	Unit	Qty	Rate	Amount	Variation Order No:
E1	Excavation in weathered rock	m2	17.24	5,000	86,200	VO : 01
E3	Rough finish form work for pocket pilling of pier including dismantling	m2	19.025	1,000	19,025	VO : 01
	Total				**105,225**	**VO : 01**

The main cause for the extra work is excavation of rock for pier foundation to a depth of 3m in weathered rock to achieve good strata. Hence additional pocket filling and form work had been required.

ii. Quantity Increase

Quantity increases had been introduced through variation order no:02 , variation order no:03 and variation order no:04 to the contract. The items of quantity increased are listed in the Tables 9, 10 and 11.

As a result of approving the extension of time claim, preliminary items had been increased and quantities of concrete increased due to change of the grade of concrete for pocket filling.

Table 9 : Quantity Increase details of Allawwa Dampelessa Road

Item No.	Description (Variation Order 02)	Unit	Increased Quantity		
			Qty	Rate	Amount
1.1	Office for the Engineer	Mnth	5.5	20,000	110,000.00
1.4	Engineers' technical staff				
	1. Clerk	Mnth	5.5	16,000	88,000.00
	2. Office aid	Mnth	5.5	13,000	71,500.00
	3. Office watcher	Mnth	5.5	11,000	60,500.00
1.5	Provide vehicle for Engineer	Veh week	20	24,000	480,000.00
2.3	Excavation in unclassified soil and backfill for abutments, wingwalls and peirs.	Cu.m	50	1,000	50,000.00
2.25	Supply fabrication and lay hot rolled mild steel bars of Grade 250 in abutment capping beams, curtain walls, bearing pads and approach slab.	MT	1	135,000	135,000.00
	Required extra amount for mixing and laying using concrete mixture cement concrete 1:1/2:3(20) grade 25 for pocket filling of foundation slabs of abutment and wing wall and peir system.	Cu.m	68	14,500	986,000.00
Total					**1,981,000.00**

Table 10 : Quantity Increase details of Allawwa Dampelessa Road

Item No.	Description (Variation Order 03)	Unit	Increased Quantity		
			Qty	Rate	Amount
1.1	Office for the Engineer	Month	2	20,000	40,000.00
1.4	Engineers' technical staff				
	1. Clerk	Month	2	16,000	32,000.00
	2. Office aid	Month	2	13,000	26,000.00
	3. Office watcher	Month	1.25	11,000	13,750.00
1.5	Provide vehicle for Engineer	Veh.week	8	25,000	200,000.00
Total					**311,750.00**

Table 11 : Quantity Increase details of Allawwa Dampelessa Road

Item No.	Description (Variation Order 04)	Unit	Increased Quantity		
			Qty	Rate	Amount
1.1	Office for the Engineer	Mnth	4.5	20,000	90,000
	1. Clerk for Engineer's staff	Mnth	4.5	16,000	72,000
	2. Office aid	Mnth	4.5	13,000	58,500
	3. Office watcher	Mnth	5.25	11,000	57,750
2.3	Excavation on classified soil & back fill for abutment wing wall & peirs	Cu.m	10.2	1,000	10,200
2.11	Rough finish form work retaining wall and found of foot walk	Sq.m	10	600	6,000
2.12	Smooth finish formwork for abutments, wing walls & jacket walls bearing pads.	Sq.m	168.5	1,500	252,750
2.15	Forming weep holes in abutments and wing walls using 110mm dia P.V.C. pipes and finished smooth with dripledge and surround complete	LM	17.3	1,000	17,300
2.18	Clay puddle & laid behind abutments & wingwalls to form the impervious layer	Sq.m	1.12	2,000	2,240
2.28	Mixing and lay class A concrete of Grade 25(20) in foot walks & foot walk ramps.	Sq.m	13.22	14,500	191,690
2.29	Smooth finish formwork under side for deck & foot walk concrete.	Sq.m	17.7	1,800	31,860
2.34	Supplying and fixing of precast reinforced concrete railing & uprights in class A Grade25(20) concrete inclusive of light reinforcement & mould	Lm	3.6	6,000	21,600
2.39	Supplying and fixing of precast bridge kerbs in class B Grade25(20) concrete with light reinforcement & mould	Lm	7.6	750	5,700
2.42	150mm dia polithene displacers supplied filled with saw dust or similar light material in deck	Lm	8.6	600	5,160
2.43	Casting & placing of 500X500X50mm thick cover slabs for sevice ducts in Class B Grade25(20) concrete with light reinforcement & smooth shuttering	Sq.m	1.5	500	750
3.2	Embankment construction using borrow material type 1 compacted in position	Cu.m	698.04	850	593,334
3.4	Trim level & compaction of original ground	Sq.m	296.2	70	20,734
3.7	Solid sodding & watering for 03 months period	Sq.m	465	270	125,550
Total					1,563,118

iii. Extension of Time

Two claims have been submitted by the contractor to extend the contract period. The number of days extended through those claims are 165 days and 137 days respectively. Reasons for extension are as follows.

Table 12 : Extension of Time particulars of Allawwa Dampelessa Road

	Description	No: of Days
1	Non settlement of Mobilization Advance	249
2	Adverse weather condition	4
3	Floods	34
4	Rectification of damages	29
5	Variation (Extra Work)	15
	Total	302

iv. Price Escalation

Due to the price increase of major materials and the contract extention, price escalation variations occurred. (Appendices C)

4.3 Case 3 : Bridge over Mahaweli Ganga on Balantota - Dekinda Road

Introduction

The Road Development Authority had undertaken improvement and construction of roads and bridges, funded by GOSL. The Construction of bridge over Mahaweli Ganga at Balantota on Balantota - Dekinda Road is one of the projects carried under above.

Project Implementation

The Road Development Authority is the executing agency and General Manager, RDA is the employer for the purpose of the contract. The Provincial Director of Central Province, RDA is the Employer's Representative.

The Engineer is the Chief Engineer of Kandy, Road Development Authority, Asgiriya.

The Contractor is the M/S Valance Engineering Service (Pvt) Ltd.

Other contractors are the public utility services comprising Ceylon Electricity Board, Sri Lanka Telecom, Water Board and the Divisional Secretary.

The scope of the work was to construct the substructure portion initially. Accordingly initial design was to put up 26 steel piles up to 4m down and then on top of that capping and abutment at the Balantota end. At the Dekinda end only to construct the abutment.

However, while the excavation is progressing, it was found that bed rock is lower than the design level. Hence the initial design had to be changed.

According to the new design, for the Balantota end 18 piles were required up to 6m down and for the Dekinda end quantity of abutment increased. However after completion the initial scope, a steel superstructure also introduced to the contract as a variation order.

Project Details

Engineering Estimate	:	Rs. 19.54 Mn
Contract Duration	:	180 Calendar days
Date of Commencement	:	23/04/2009
Original date of Completion	:	15/10/2009
Extension given (EOT 01)	:	65 days
Date of Completion	:	19/12/2009
Defects liability period ends on	:	19/12/2010
Contract Sum	:	Rs. 18,600,383.69

Table 13 : Particulars of Balanthota Bridge

Construction of bridge over Mahaweli Ganga at Balantota on Balantota - Dekinda Road		
Description	Amount (Rs)	% from Initial Contract Amount
Initial Contract Amount Rs. (with Contingency)	18,600,383.69	
Contingency Amount Allocated	1,860,038.37	
Initial Contract Amount Rs. (without Contingency)	16,740,345.32	
Extra Work	1,427,252.50	8.53%
Quantity Increase	3,539,159.57	21.14%
Interest Claim	384,133.90	2.29%
Legal Claim	869,510.08	5.19%
Total Increase	6,220,056.05	37.16%

At the completion of the contract, the total cost increased 37.16% from the initial contract amount whereas, allocated contingency amount is 10% of the initial contract amount. The factors which contributed to this contingency exceedance are listed percentage-wise in Table 13 and evaluated in depth to identify the main causes.

1. Extra Work

Two extra works had been introduced through variation order no : 03, to accommodate the preparation of a launching platform and launching of the steel bridge between the abutments, which was not included in the original BOQ.

Table 14 : Extra Work Particulars of Balanthota Bridge

Extra Work Items	Unit	Qty	Rate	Amount	Remarks
Supplying and fixing MS dowels spliced and dove tailed at one end 1.2 m long	No.	60	1,561.75	93,705.00	VO : 01
Construction of Approaches	Item			247,545.90	VO : 03
Preparation of launching platform and launching Bridge in to position	Item			1,086,001.61	VO : 03
				1,427,252.51	

The main cause of these extra works item is the change in design. While excavating, bed rock found was lower than the design level at Balantota end and therefore dowels were introduced by the design engineer. This is a very common situation face by the design engineers due to the inadequacy of bore holes and site investigation records. Due to the uncertainty of the ground profile, the initial design became inappropriate for construction. That gave rise to the extra work of supplying and fixing mild steel dowels spliced and dove-tailed at one end 1.2 m long

2. Quantity Increase

Quantity increases had been introduced through variation order no:01, variation order no:02 and variation order no:04 to the contract. The items of quantity increased are listed in the Table 15.

Table 15 : Quantity Increase Particulars of Balanthota Bridge

Item No.	Description	Unit	Increased Quantity			VO
			Qty	Rate	Amount	
6	Clerical staff for the Engineer	Month	2.00	19,800.00	39,600.00	02
7	Provision and maintenance of Vehicle	Month	2.00	168,000.00	336,000.00	02
10	Insurance and securities	LS	Item	105,000.00	15,000.00	02
B.1.3	Excavation in unclassified soil and backfill of structures	Cum	311.0	522.00	162,342.00	01
B.1.6	Construction of cofferdams, cribs, sheeting, shoring and bracing and their subsequent removal.	LS	Item		292,342.92	01
B.1.7	Dewatering	LS	Item		422,389.54	01,02
B.1.10	Class B Concrete of grade 20(40) in abutments wing walls & retaining walls	Cum	82.00	14,456.40	1,185,424.80	01,02
B.1.13	Smooth finish formwork for abutments, wing walls & retaining walls	Sqm	40.00	1,625.00	65,000.00	02
B.1.14	Smooth finish formwork for capping beams, ballest walls, guard walls, curtain walls, bearing pads and approach slabs.	Sqm	20.00	1,820.00	36,400.00	04
B.1.22	Supplying and driving 305X305X94kg/m H Iron piles		PS		984,660.31	01
	Total Quantity Increase				**3,539,159.57**	

Reasons behind the quantity increase are as follows.

- Change of design
- Excavation depth increased due to change of design and hence depth of shoring increased

- Excavation depth increased due to change of design and hence the amount of dewatering increased
- Design level of the abutment of Balantota end is lowered due to the change of design and hence the height of abutment is increased
- Number of piles and length of piles increased due to the change of design
- Court case
- Excavation depth increased due to change in design and hence the amount and intensity of water flow increased due to heavy rain and floods. Therefore, amount of dewatering increased for the July 2009

3. Interest Claim

Due to the delay in payment of the mobilisation advance and bill no:01 to bill no:05, reference to Clause 43.1 of SBD1, the contractor was entitled to request interest claims.

4. Legal Claims

Site had closed from 19.08.2009 to 13.10.2009 due to an Injunction Order issued by the court in Nawalapitiya.

One of neighbours adjacent to the site had filed a case in the Nawalapitiya Court saying that the, contractor had illegally entered to her premises and damaged the ground by digging holes. Therefore an Injunction Order had been issued from 19.08.2009 to suspend the site work.

However the RDA management advised the contractor to provide necessary security arrangements for the superstructure items belongings to the RDA. Accordingly, the contractor employed a watcher to look after the above. As a result, additional overhead was incurred by the contractor for the reasons listed below.

- Daily attendance of Watcher and the staff
- Document preparation
- Telephone and Electricity bills for the relevant period

In addition to the above, for appearance in the Court for Case No. L198/09 and travelling expenses had been claimed by the contractor after producing the

- Originals of lawyer's charges for appearance in Court
- Originals of lawyer's charges for preparing documents
- Evidence of travelling expenses of officers for legal proceedings
- Evidence of labour idling, with attendance

The site was closed from 13.11.2009 to 04.12.2009 due to the order issued by the Police of Nawalapitiya.

A fatal accident took place at the site premises on 13.11.2009, and due to that the site had been closed for 21 days, due to an order issued by the Nawalapitiya police. Therefore this was cause to incur extra overhead cost for daily attendance of a watcher.

5. Extension of Time

One claim was submitted by the contractor to extend the contract period. The details of extension are as follows.

Table 16 : Extension of Time particulars of Balanthota Bridge

	Description	No: of Days
1	Site shut down due to Injunction order issued by the Court	55
2	Site shut down due to order by the Police	10
	Total	65

6. Delay of Drawings

As a result of change in the design, drawings had to be re-prepared by the design office at Kandy. This cause a few weeks delay.

CHAPTER 5: ANALYSIS AND DISCUSSION OF RESULTS

5.1 Analysis

For the selected three cases the contingency budget has been spent to the cost factors of extra work, quantity increase, price escalation, interest claims and legal claims. The percentage-wise increase for the each factor was analysed separately and study the causes for those.

For the evaluation purpose each and every cost figure was compared with the justified more reasonable figure, which was developed by considering the Engineer's estimate and average bid amounts of the other parallel bids for the corresponding contract.

5.1.1 Case 1 : Bridge no : 31/4 on Galle Deniyaya Madampe Road

There is a 9.5 % total cost overrun for this project from the initial construction amount (Table 17), 8.87% total cost overrun compared to the Engineer's Estimate (Table 18) and 7.09% cost overrun compared to the average bid amounts (Table 19).

Table 17: Bridge No 31/4 on Galle Deniyaya Madampe Road

Bridge No 31/4 on Galle Deniyaya Madampe Road		
	Amount (Rs)	% from Initial Contract Amount
Initial Contract Amount Rs. (without Contingency)	18,756,360.00	
Contingency Amount Allocated	1,875,636.00	
Quantity Increase	1,628,370.17	8.68%
Price Escalation	153,214.08	0.82%
Total Increase	1,781,584.25	9.50%

Table 18 : Bridge No 31/4 on Galle Deniyaya Madampe Road

Bridge No 31/4 on Galle Deniyaya Madampe Road		
	Amount (Rs)	**% from Engineer's Estimate**
Engineer's Estimate Rs. (without Contingency)	20,076,573.96	
Contingency Amount Allocated	2,007,657.40	
Quantity Increase	1,628,370.17	8.11%
Price Escalation	153,214.08	0.76%
Total Increase	1,781,584.25	8.87%

Table 19 : Bridge No 31/4 on Galle Deniyaya Madampe Road

Construction of Bridge No 31/4 on Galle Deniyaya Madampe Road		
	Amount (Rs)	**% from Average Bid Amount**
Kumothi Engineering Services (Pvt) Ltd	28,702,775.98	
Jayawansa Construction	18,756,360.00	
Valance Engineering	27,905,342.51	
Average Bid Amount Rs. (without Contingency)	25,121,492.83	
Contingency Amount Allocated	2,512,149.28	
Quantity Increase	1,628,370.17	6.48%
Price Escalation	153,214.08	0.61%
Total Increase	1,781,584.25	7.09%

Table 20 : Bridge No 31/4 on Galle Deniyaya Madampe Road

Construction of Bridge No 31/4 on Galle Deniyaya Madampe Road		
	Amount (Rs)	% from C
Average Bid Amount Rs. (A)	25,121,492.83	
Engineer's Estimate Rs. (B)	20,076,573.96	
(A +B) / 2 = C	22,599,033.40	
Contingency Amount 10% of C	2,259,903.34	
Quantity Increase	1,628,370.17	7.21%
Price Escalation	153,214.08	0.68%
Total Increase	1,781,584.25	7.88%

For the evaluation purpose average of Engineer's Estimate and average bid amounts were considered.

The analyzed results are as shown by Table 20.

Total cost overrun is 7.88%. Out of that 7.21% is increased as BOQ quantity increase. The increased BOQ quantity consists of 2.84% for superstructure items, 3.16% for substructure items , 0.27% for pavement items and 0.93% of preliminary items.

Main causes behind the above 2 factors are (Fig 02) BOQ quantity increase, Land acquisition problems, floods and adverse weather condition and price escalation.

In this Contract contractor was entitled to claim a price escalation for the months of August 2006 and April 2007. Hence that amount contributed a 0.68% to the total cost overrun.

The contractor had to change the construction sequence due to the land acquisition problem raised. This led to 173 days of time extension and therefore preliminary overhead incurred for additional 6 months, which is 0.66% contributed to the total cost overrun.

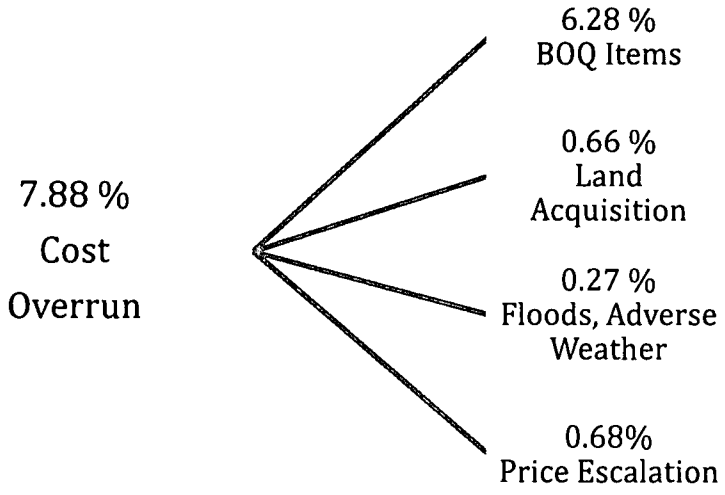

Figure 2 : Bridge No 31/4 on Galle Deniyaya Madampe Road

Further, due to the adverse weather and floods, site work was interrupted. Therefore, 41 days extension of time had been given to recover the works. Therefore the preliminary overhead incurred for an additional 1.5 months, which is 0.27% contributed to the total cost overrun.

Among the above four causes, the BOQ quantity increase cannot be considered as a risk, since there is no specific reason behind it. However the latter three reasons of construction sequence change, floods, adverse weather and price escalation can be considered as risks, since those arose unexpectedly while construction was in progress.

Hence for this case out of 7.88% of total cost overrun, there exists only 1.61% for risk cost overrun and other 6.28% non-risk cost overrun. Therefore, this case actually consumed only 1.61% of contingency amount, and this can be cover through the contingency budget.

5.1.2 Case 2 : Bridge no : 12/1 on Alawwa Dampellassa Road

There is a 38.74 % total cost overrun for this project from the initial construction amount (Table 21), 50.27% total cost overrun compared to the Engineer's Estimate (Table 22) and 30.28% cost overrun compared to the average bid amounts (Table 23). However, for the evaluation purpose average of Engineer's Estimate and average bid amounts were considered.

The analyzed results are as shown by Table 24.

Total cost overrun is 37.79%. Out of that, 11.07% is the BOQ quantity increase and 5.53% is the preliminary overhead increase. The preliminary overhead has been incurred as a time extension given for the increased BOQ quantities and delayed mobilization advance.

Table 21 : Bridge No12/1 on Alawwa Dampellassa Road

Widening and Redecking of Bridge No12/1 on Alawwa Dampellassa Road		
	Amount (Rs)	% from Initial Contract Amount
Initial Contract Amount Rs. (without Contingency)	21,592,951.20	
Contingency Amount Allocated	2,159,295.12	
Extra Work	105,225.00	0.49%
Quantity Increase	3,850,868.00	17.83%
Price Escalation	4,410,029.01	20.42%
Total Increase	8,366,122.01	38.74%

Table 22 : Bridge No12/1 on Alawwa Dampellassa Road

Widening and Redecking of Bridge No12/1 on Alawwa Dampellassa Road		
	Amount (Rs)	% from Engineer's Estimate
Engineer's Estimate Rs. (without Contingency)	16,642,521.90	
Contingency Amount Allocated	1,664,252.19	
Extra Work	105,225.00	0.63%
Quantity Increase	3,850,868.00	23.14%
Price Escalation	4,410,029.01	26.50%
Total Increase	8,366,122.01	50.27%

Table 23 : Bridge No12/1 on Alawwa Dampellassa Road

Widening and Redecking of Bridge No12/1 on Alawwa Dampellassa Road		
	Amount (Rs)	% from Average Bid Amount
Lanka Trading Construction Pvt Ltd	35,639,120.00	
K.D. Ebert & Sons (Pvt) Ltd	21,811,061.82	
Jayawansa Construction	25,381,650.00	
Sathuta Builders	27,684,050.00	
Average Bid Amount Rs.	27,628,970.45	
Contingency Amount Allocated	2,762,897.05	
Extra Work	105,225.00	0.38%
Quantity Increase	3,850,868.00	13.94%
Price Escalation	4,410,029.01	15.96%
Total Increase	8,366,122.01	30.28%

Table 24 : Bridge No12/1 on Alawwa Dampellassa Road

Widening and Redecking of Bridge No12/1 on Alawwa Dampellassa Road		
	Amount (Rs)	% from C
Average Bid Amount Rs. (A)	27,628,970.45	
Engineer's Estimate Rs. (B)	16,642,521.90	
(A +B) / 2 = C	22,135,746.18	
Contingency Amount 10% of C	2,213,574.62	
Extra Work	105,225.00	0.48%
Quantity Increase	3,850,868.00	17.40%
Price Escalation	4,410,029.01	19.92%
Total Increase	8,366,122.01	37.79%

Main causes behind the above 3 cost factors are (Fig 03) BOQ quantity increase, preliminary quantity increase, floods and adverse weather condition, uncertain ground condition and price escalation.

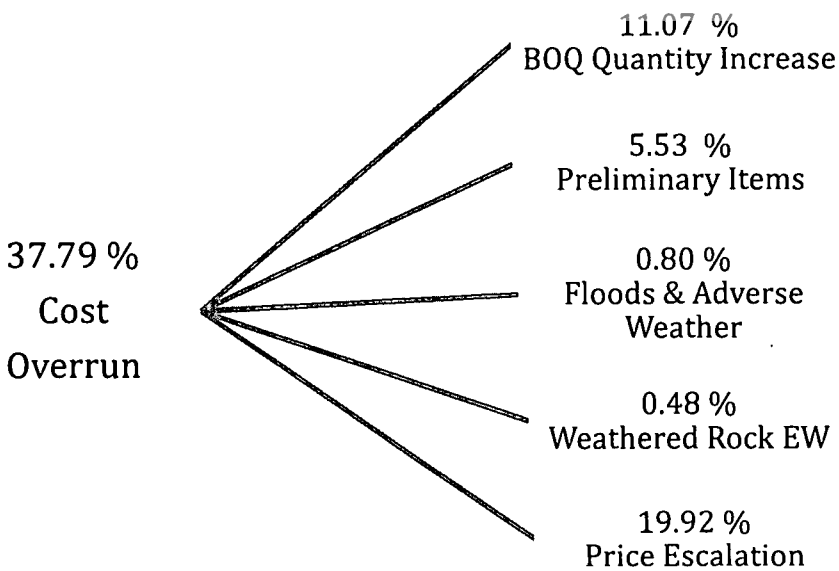

Figure 3 : Bridge No12/1 on Alawwa Dampellassa Road

The contractor was entitled to claim the price escalation for 15 months from April 2007 to January 2009 (not continuous). Hence that amount contributed 19.92% to the total cost overrun. The reason for build-up of this much of price escalation, is the 10 months extension of time given to the contractor and at the commencement stage due to the delay in payment of mobilization advance, the contractor had abandon the work for 08 month and resume.

In addition to that while excavation was in progress, weathered rock was found in the design level thus a further 3m had to be excavated until good strata was found. Hence extra work had been incurred for weathered rock excavation and pocket filling which contributed 0.48% for the cost overrun.

Further, due to the adverse weather and floods, site work was interrupted. Therefore 38 days extension of time was given to recover the works. Therefore, a preliminary overhead was incurred for an additional one month, which is 0.80% of the initial contract amount.

Among above five causes, BOQ quantity increase and preliminary overhead increase cannot be considered as risks, since there is no specific uncertainty behind it. However the latter three reasons of excavating weathered rock, floods, adverse weather and price escalation can be considered as risks, since they occurred unexpectedly while construction was in progress.

Hence, for this case out of 37.79% of total cost overrun, there exists only 21.19% of risk cost overrun and the other 16.60% is non-risk cost overrun. Therefore, this case actually consumed only 21.19% of initial contract cost, whereas 10% had been allocated as contingency budget. Out of that 21.19% of cost 19.92% is price escalation. If the project is completed on time, the price escalation amount would be reduced by half, since the project duration has doubled due to the EOT. If so, project risks could be managed through the allocated contingency amount of 10%.

5.1.3 Case 3 : Bridge over Mahaweli ganga on Balantota - Dekinda Road

There is a 37.16 % of total cost overrun for this project from the initial construction amount (Table 25), 35.01% total cost overrun compared to the Engineer's Estimate (Table 26) and 34.45% cost overrun compared to the average bid amounts (Table 27). However, for the evaluation purpose average of Engineer's Estimate and average bid amounts were considered.

Then the analyzed results are as shown by Table 28.

Total cost overrun is 34.73%. Out of that, total cost overrun, 7.97% is scope change, 17.58% is BOQ quantity increase and 2.18% is the preliminary overhead increase. The preliminary overhead has been incurred due to the scope change and the BOQ quantity increase. The BOQ quantity increase has resulted due to the change of the initial design.

Table 25 : Bridge over Mahaweli ganga on Balantota - Dekinda Road

Construction of bridge over Mahaweli ganga at Balantota on Balantota - Dekinda Road		
	Amount (Rs)	% from Initial Contract Amount
Initial Contract Amount Rs. (without Contingency)	16,740,345.32	
Contingency Amount Allocated	1,674,034.53	
Extra Work	1,427,252.51	8.53%
Quantity Increase	3,539,159.57	21.14%
Interest Claim	384,133.90	2.29%
Legal Claim	869,510.08	5.19%
Total Increase	6,220,056.06	37.16%

Table 26 : Bridge over Mahaweli ganga on Balantota - Dekinda Road

Construction of bridge over Mahaweli ganga at Balantota on Balantota - Dekinda Road		
	Amount (Rs)	% from Engineer's Estimate
Engineer's Estimate Rs.	17,764,419.94	
Contingency Amount Allocated	1,776,441.99	
Extra Work	1,427,252.51	8.03%
Quantity Increase	3,539,159.57	19.92%
Interest Claim	384,133.90	2.16%
Legal Claim	869,510.08	4.89%
Total Increase	6,220,056.06	35.01%

Table 27 : Bridge over Mahaweli ganga on Balantota - Dekinda Road

Construction of bridge over Mahaweli ganga at Balantota on Balantota - Dekinda Road		
	Amount (Rs)	% from Average Bid Amount
Central Engineering Construction Bureau	19,953,325.91	
Neat Soulution (Pvt) Ltd	17,299,553.15	
Valance Engineering	16,909,479.31	
Average Bid Amount Rs.	18,054,119.46	
Contingency Amount Allocated	1,805,411.95	
Extra Work	1,427,252.51	7.91%
Quantity Increase	3,539,159.57	19.60%
Interest Claim	384,133.90	2.13%
Legal Claim	869,510.08	4.82%
Total Increase	6,220,056.06	34.45%

Table 28 : Bridge over Mahaweli ganga on Balantota - Dekinda Road

Construction of bridge over Mahaweli ganga at Balantota on Balantota - Dekinda Road		
	Amount (Rs)	% from C
Average Bid Amount Rs. (A)	18,054,119.46	
Engineer's Estimate Rs. (B)	17,764,419.94	
(A +B) / 2 = C	17,909,269.70	
Contingency Amount 10% of C	1,790,926.97	
Extra Work	1,427,252.51	7.97%
Quantity Increase	3,539,159.57	19.76%
Interest Claim	384,133.90	2.14%
Legal Claim	869,510.08	4.86%
Total Increase	6,220,056.06	34.73%

The main causes for the above cost factors are given in figure 04

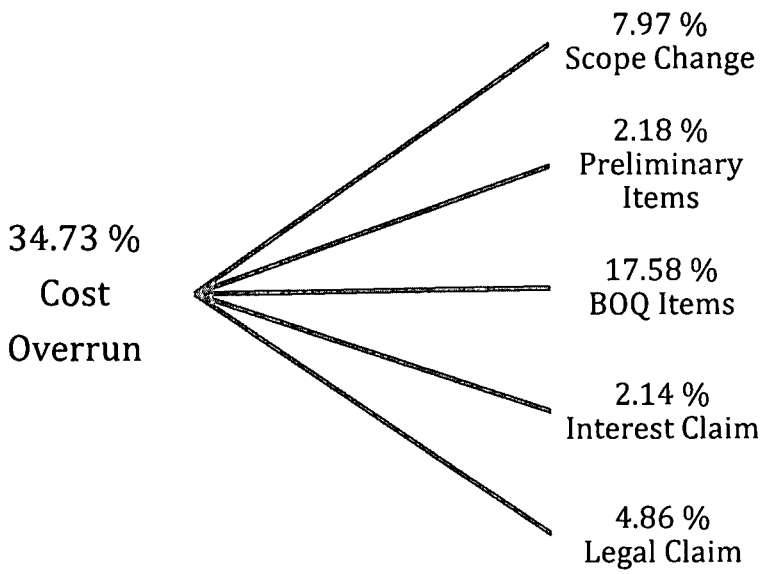

Figure 4 : Bridge over Mahaweli ganga on Balantota - Dekinda Road

The initial scope was to construct the substructure only. However after completing the substructure, a steel superstructure was introduced to the contract as a variation. Hence 7.97% cost increase was incurred for the scope change and 2.18% of cost increase for the preliminary overhead.

Further, while the excavation was going on was found that bed rock was lower than the design level. Hence the initial design had to be changed and introduced a new design. As a result, BOQ quantity increased by 17.58% of initial contract amount.

While commencing the construction work, a fatal accident took place at the site premises and therefore site was closed due to Police Order issued by the Nawalapitiya Police. Also injunction orders issued for suspend the site work by Nawalapitiya High Court. The reason was, neighbour adjacent to the site went before the court saying that, contractor illegally enters to her premise and done damages to the ground by digging holes. Due to these site closers, two months extension was given to the project and contractor had to keep a watcher for that period. Hence this resulted a claim of 4.86% of the initial contract amount.

Due to the delay payments of the certified bill no 1 -7 client had to pay the interest charges to the contractor according to the Clause 43.1 of SBD 1. The reason was the prevalence of financial constraints to the client during that period.

Among above five causes, scope change, BOQ quantity increase due to design change and preliminary overhead increase cannot be considered as risks, since there is no specific uncertainty behind it.

However the latter two reasons of interest claim and legal claim can be considered as risks, since those have risen unexpectedly while processing the construction due to site accidents and client's financial constraints.

Hence for this case out of 34.73% of total cost overrun, there exists only 7.00% of risk cost overrun and other 27.73% is non-risk cost overrun. Therefore for this case risk cost can be covered through the contingency budget.

5.1.4 Risk percentages

The summary of the evaluated three critical case studies were given in the Table 29, and it has shown percentage figures of cost overrun, risk cost and non-risk cost.

Table 29 : Summary of Non Risk Cost and Risk Cost

Case Study	Project Name	% of **Cost** Overrun	% of **Non Risk** Cost Overrun	% of **Risk** Cost Overrun
A	Construction of Bridge No:31/4 on Galle Deniyaya Madampe Road	7.88%	6.28%	1.61%
B	Construction of Bridge No:12/1 on Alawwa Dampalassa Road	37.79%	16.60%	21.19%
C	Construction of bridge over Mahaweli Ganga at Balantota on Balantota - Dekinda Road	34.73%	27.73%	7.00%

The result shows that, Non –risk cost portion governs the cost overrun except for the case B. For the case B governing risk factor is the price escalation and otherwise there would be only 2% of risk cost.

The risk factors identified through the case studies are given in Table 30.

Table 30 : Summary of Risk Percentages

Case No:	Risk Cost	Price Contingency	Physical Contingency				
		Price Escalation	Legal Claim	Interest Claim	Floods & Adverse Weather	Land Acquisition Problems	Unexpected Ground Condition
A	**1.61%**	0.68%			0.27%	0.66%	
B	**21.19%**	19.92%			0.80%		0.48%
C	**7.00%**		4.86%	2.14%			

The percentage of risk cost has further divided as price escalation and the other. This is because presently RDA is practicing to allocating 5% of allocation as Price Contingency Budget to cover up the price escalation amount. RDA has came to this decision due to the experience of past projects and this allocation is not providing for each and every projects, but for the projects, which TEC has given the consent for the same.

When consider the physical risk factors for the three cases, the total is below the 10% and therefore can cover through the physical contingency budget.

However price escalation amounts varies drastically from project to project and it needs more studies on this.

The price escalation amount formed in project A is 0.68% and this can be covered through the price contingency budget. The price escalation amount formed in project B is 16.6% and there are several reasons for this much higher value.

First reason is the contractor had abandoned the site initially for 08 months. Second reason is there was 10 months extension for this project and this has doubled the contract duration. Third reason is contractor has attended for the work at latter stage of the contract duration. All these reasons have coursed to increase the gap between the current indices and base indices of the price escalation calculations.

5.2 Discussion

The research reveals that the cost overrun consists of three components. That is non-risk cost, risk cost and price escalation cost. Since non risk costs adding values to the projects, separate estimates should introduce to manage those costs. To manage the non risk cost and risk costs there is physical contingency budget and the price contingency budget.

Therefore factors affecting the cost overrun of small bride projects can be separated to three as follows

1. Factors affecting the non contingency cost
2. Factors affecting the price contingency cost
3. Factors affecting the physical contingency cost

5.2.1 Factors affecting the non contingency cost

Due to the extension of time, contract duration becoming elastic and leads to increase the overhead costs like rent of engineer's office, utility bills of offices, watcher charges, office aids salaries, vehicle monthly rents etc. If a simple EOT is given under Cl. 44.1, for special circumstances, this amounts to an admission that delays was not the fault of the contractor and in turn it will an additional cost to the client

Scope changes and design changes also affect for the cost increases. Since time, scope and cost are known as the iron triangle in construction project management and hence if one changes it will affect to the others too. All of these cost factors have bound with the time extension ended up with cost increases. Therefore it is necessary to introduce new estimates on this.

Inaccurate Estimation also leads to increase the cost of projects and, there should be an adequate site investigation, design and adequate time provision for prepare estimates and tender documents. Otherwise there is a possibility of occurring design changes or improvements to standard drawings during construction stage. Further

there can be taken place errors while taking off quantities when bustling through the works. Therefore it is very necessary to provide an adequate time for proper planning.

Other than that adequate time will omit incomplete work descriptions in tender documents.

5.2.2 Factors affecting the price contingency cost

Resource cost escalation directly causing the price escalation of the project costs since material, plant and people are considered as the backbone of the construction projects. In case of unavailability of these resources or increase of prices compared to the bidding stage, projects are exposed to cost increases. However the effect of this issue becomes more adverse due to some tendering manures by the contractor. Loading the rates of higher input % materials incorporated items of contract is a common strategy use by the contractors.

Due to this when calculating the price escalation amount according to the ICTAD formula, if the monthly bill value is higher, it results a higher amount of escalation amount. Hence the TFC's and PC's should pay much attention on this at the bid document preparation stage as well as the bid evaluation stages.

Extension of time mainly affecting on this price escalation, because when increasing the time gap between current indices and the base indices, it increase the price escalation cost in the calculation.

When sites abandoned by contractors, this leads to later attendance of works or time extent ions and causing the same phenomena in price indices and increase the price escalation cost. Most of situations, contractors abandon the sites due to payment delays and later on once they resume the work price escalation had been paid, in addition to the interest payments and the time extensions. Then the price escalation gets doubled due to the extended period. This should be avoided and professionals

must pay due care to sign memorandum of understandings' with contractor's to not to pay price escalation for the abandoned periods.

Post tender correspondents and negotiations on major items also affecting on price escalation. Earlier the material index considered for the ABC aggregate and Bitumen 60/70 were M7 and M30 respectively. But subsequently this changed to M48 and M30C respectively and the projects executing at year 2008 were affected from that, due to the negotiations as per the ICTAD statistics. This led to the massive increase of price escalation amounts of the road and bridge construction projects.

Poor Contract Management Practices causes many constraints at the projects, such as poor follow up of progress, incorrect distribution of works, poor monitoring of progress, non-commitment of site employees, material wastage, delay of material ordering to the suppliers etc, which in turn contribute to the delay and cost increases through the price escalation.

5.2.3 Factors affecting the physical contingency cost

It is obvious there is a considerable uncertainty prevails in the weather conditions and causes unexpected damages and time extensions for the contract. However with a thorough awareness of the previous experiences of the area more uncertainty will be possible to manage. At the planning stage also this has to be considered and should incorporate to the contract data and the schedule.

Land acquisition issues come up due to intervention of out side parties and protests by neighbours. Most frequently a positive response cannot experience from the stakeholders when acquiring the lands as well as executing the works. There are evidences that, some stakeholders are behaving very offensive way, consulting the court cases, while the execution stage. Once court cases are initiated, it leads to site closure and compensation events like extension of times and legal charges.

When there are elections and other political backgrounds, politicians influence to expedite the works before their due sits in the parliament. Hence contractors are being pressurising to change the method of construction and all initial work plans. Once the construction schedule gets changed, it affects to the scope and cost as well, since, these are in the iron triangle. Hence ultimately cost increases taking place

Interest Payment is resulting mainly due to client's financial constraints, lack of commitment by the officials and inflation.

Road Development authority relies on the treasury transactions to accomplish day today each and every transactions. Hence if the funding gets delays from the treasury, then RDA has to hold the bills of contractors, without paying, until funds receiving. Due to this sometimes contractors' bills get late around 2-10 months and ultimately, RDA has to pay the interest for the delay payments of the interim bills and mobilization advances. This was very high during the 2008 period due to the financial crisis at that period.

Official's commitment also very much important in avoiding this interest claims. The Chief Engineer should check the contractor' monthly bill statements and certify the amount to be paid to the contractor within 21 days of the receipt of the contractor's statement. Then the Provincial Director should pay the contractor the amounts certified by the Chief Engineer within 14 days of the date of each certificate. If the RDA unable to the pay the monthly bills on time, contractor should be paid interest payment on the late payment.

Here the interest should be calculated from the date by which the payment should have been made up to the date when the late payment is made at the rate of interest of 1% over the prevailing lending rate of the Central bank to commercial bank. Therefore when inflation is high, it results high interest payments on bills.

Unexpected Ground Conditions adding a considerable risk for the bridge projects and main reasons are the compromise between number of boreholes and cost incurred,

time gap between ground investigation & construction, improper selection of bore hole locations and lack of communication between site investigation ,bridge designs and construction teams.

Since it requires considerable cost for borehole digging, always site investigation team likes to go for minimum number of boreholes. However this increase the uncertainty of ground and end up with design changes, weathered rock excavation and quantity increases.

Further when time gap is higher between the site investigation and construction, this also caused to change the site condition and increase the uncertainty.

Also when there is no proper coordination between the site investigation, bridge designs and construction teams it causes to select improper borehole locations and in quality constructions.

Legal Issues take place mainly due to intervention of out side parties and protests, road accidents at the site premise, incapability of construction teams to adapt with site context.

To commence the work successively and uninterruptedly, contractor must develop a good rapport with the site environment and neighbours. The construction team should aware about the possible natural events, cultural events and other social issues inhabitant to the area and develop strategies to manage them positively. In addition to that it is very vital to operate the site without obstructing the traffic movement and road accidents.

However small contractors get fails to achieve above, due to the lack of skill full professionals for the site works as well as the technical incompetence and the poor organizational structures.

Poor site management practices leads to lot of conflicts on bridge projects. Therefore it is very necessary to provide the indication signboards and proper barricading

And allow the traffic movement without obstructions and avoid the material stacking at site premise during construction

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The content of this research is intended to identify the general view of the cost overrun due to risk factors which contribute to the contingency allocation consumption, exist in small bridge contracts of Road Development Authority.

Contingency allocation is introduced as an active acceptance strategy, under the risk responding planning to absorb the risk cost without making a burden to the project. However, it is only to spend when taking place the unexpected events inside the project and not for the non risk events like scope and design changes.

The key risk factors which contribute to the contingency budget expenses are price escalation, legal issues, interest claims, unexpected weather, change of construction sequence and unexpected ground conditions.

Road Development Authority practising to allocate two contingency budgets as physical contingency budget and price contingency budget. Price contingency budget is to absorb the price escalation cost and physical contingency budget is to absorb risk costs other than the price escalation.

This research reveals that there is no physical contingency overrun in small-scale bridge projects of Sri Lanka and allocated contingency percentage, which is 10% from initial contract amount, is well adequate to manage the physical risk costs.

However it exhibits a huge variation in price escalation cost and it needs further research studies to conclude on this price contingency budget.

Adopting more attentive contract management procedures, enhancing continuous coordination and direct communication among the investigation, design and construction teams and following strict rules in granting extension to schedules, the Road Development Authority will be able to arrive at saving the contingency amounts allocated.

In addition, this research will provide an opportunity to the RDA to forecast possible scenarios of claims and thereby avoid common pitfalls so as to eliminate the avoidable claims and highlight them to enable the management to avoid a recurrent of

such phenomena. Further, the management and staff allocated to settling and dealing with such situations will be reduced.

The production of this research will be taken in to account when preparing contract documents as well as during the administration of contracts.

6.2 Recommendations

According to the result of the research study recommendations for the contingency cost management are as listed follows.

6.2.1 Recommendations for the non contingency cost

Even though it is not emphasized directly, it is fairly noticeable that most variation orders and extra works have been covered through the contingency allocation available for the corresponding projects. Instead of that practice it is recommended to introduce separate estimates to scope and design changes, in order to minimize the conflicts on project cost overrun.

Also attention should be paid to allocating adequate time period for site investigations and estimate preparation. This will not only enhance estimation accuracy, but also reduce the errors of taking off and work descriptions in the bidding documents and drawings.

Further it should be emphasized the importance of production of monthly cost reports and progress reports to indicate the cost performance indices and schedule performance indices using contract management packages of MS Project / Premavera packages and this will motivate the managers to come back to the track when project is out.

6.2.2 Recommendations for the price contingency cost

Adequate time period should allocate for correct analysis of input percentages and emphasize should be given on the accuracy.

Even though it is difficult to predict exact price escalation amounts, considering the main input percentage and the time duration allocated, the RDA will able to predict a fairly reasonable figure for price escalation in order to minimize the contract price overrun. Therefore rather than putting a percentage figure, it is recommended to predict price escalation amount considering the allocated contract duration and keep an allowance on that.

It is necessary to control the time extensions, since it builds up more and more escalation amounts.

Further If site abandoned by the contractor due to payment delays only interest payment should done on it and, memorandum of understanding's should produce to omit price escalation claims.

6.2.3 Recommendations for the physical contingency cost

Realistic time frames should allocate for contracts basis on nature of work involved, weather patterns, terrain and traffic intensity. This will eliminate the unnecessary extension of times and resource idling of the projects. Also strategies should be established to complete the project within the initial contract schedule.

Adequate time period should provide for site investigation and this will avoid uncertain ground conditions.

More specific conditions should be included in the qualification criteria in bidding documents, to select the most appropriate contractor for the work, since the risk handling strategies and capabilities get differs from contractor to contractor.

Land acquisition should be completed before the commencement of work. This will avoid resource idling and price escalation risk cost for the projects

Interest payments should be granted only on payment delays and extension of time should be strictly avoided. This will reduce the financial pressure on the client through the minimization of price escalation and preliminary overheads.

Works should not commence until land acquisition is completed, since this leads to extension of time and price escalations.

If a contractor abandons a site, a memorandum of understanding should be signed to avoid EOT and compensate only for the relevant issue.

6.3 Recommendations for Future Research

The writer recommends carrying out further researches on the following subjects in order to improve the contract management practices of road and bridge contracts in Sri Lanka.

- The effective number of bore holes for the bridge projects, which maintains the balance between costs incurred for site investigation and estimation accuracy.
- An appropriate price escalation forecasting model for bridge contracts in Sri Lanka.
- Factors to be considered in improving the estimation accuracy.
- Estimation accuracy improving system for bridge projects.
- Strategies to timely complete bridge and highway projects.
- Develop a model for an optimum time frame for bridge contracts in Sri Lanka.

REFERENCES

Alavi, M, and P Carlson. "A review of MIS research and disciplinary development." *Journal of Management Information Systems, Vol 8*, 1992: 45-62.

Ashworth, A. and Hogg, K. *Willis's procedure for the Quantity surveyors.* Oxford: Blackwell Science Ltd, 2002.

Bhandari, P, M Nunes, and F Annansingh. "Analysing the penetration of knowledge management practices in organisations through a survey of case studies." *4th European Conference on Research Methodology for Business and Management Studies.* Paris: University of Dauphine, 2005. 21-22.

Dada, Joshua O., and G O Jagboro. "An evaluation of the impact of risk on project cost overrun in the Nigerian Construction Industry." *Financial Management of Property and Construction, Volume 12, No:01*, 2007: 37-44.

Easterby-Smith, M. *Management Research: An Introduction.* London: Sage, 2002.

Enshassi, Adnan, Jomah Al-Najjar, and Mohan Kumaraswamy. "Delays and cost overruns in the construction projects in the Gaza Strip." *Financial Management of Property and Construction Volume 14 (No02)*, 2009: 126-151.

Frimpongs, Y., Oluwoye, J. and Crawford, L. "Causes of delays and cost overruns in construction of ground water projects in a developing countries; Ghana as a case study." *International Journal of Project Management, Volume 21 No.5*, 2003: 321-326.

Glesne, C, and A Peshkin. *Becoming Qualitative Researchers.* New York: Longman, 1992.

Hester, W, J A Kuruprenas, and T C Chang. *Construction Changes and Change Orders: Their Magnitude and Impact.* University of California, Berkely, 1991.

Institution for Construction Training andDevelopment. *Standard Bidding Document : Procurement of Works* . ICTAD, 2007.

Kaming, P., Olomolaiye, P., Holt, G. and Harris, F.C. "Factors influencing construction time and cost overruns on high rise projects in Indonesia." *Journal of Construction Management and Economics, Volme 15 No. 1*, 1997: 83-94.

Koushki, P.A., Al-Rashid, K. and Kartam, N. "Delays and cost increases in the construction of private residential projects in Kuwait." *Journal of Construction Management and Economics, Volume 23 No.03*, 2005: 285-294.

Kumaraswamy, M M, R A Millar D, and K Yogeswaran. "Claims for Extension of Time in Civil Engineering Projects." *Construction Managment Economics*, 1998.

National Procurement Agency. *Procurement Guide Lines.* National Procurement Agency, 2006.

—. *Procurement Manual , Goods and Works.* National Procurement Agency, 2006.

Nawfal, M A.M. *Study of contract price overrun with particular emphasis on claim situations in road and bridge contracts, in the road development authority.* MEng Thesis, University of Moratuwa, 1997.

Odeyinka, H.A. "An evaluation of the use of insurance in managing construction risk." *Construction Management and Economics, Volume 18*, 2000: 519-524.

Orlikowski, W, and J Baroudi. "Studying information technology in organizations: research approaches and assumptions." *Information System Research, Vol. 2*, 1991: 1-28.

Perry, J.G. and Hayes, R.W. "Risk and its management in construction projects." *The Institution of Civil Engineers Proceedings. Part 1, Vol. 78.* London, 1985. 499-521.

Project Management Institute. *A Guide to the Project Management Body of Knowledge.* Pennsylvania: Project Management Institute, 2004.

Saunders, M, P Lewis, and A Thornhill. *Research Methods for Business Students.* Harlow: Pearson Education Limited, 2000.

Tah, J.H.M. and Carr, V. "A proposal for construction project risk assessment using fuzzy logic." *Construction Management and Economics , Volume 18*, 2000: 491-500.

Thompson, A, and J G Perry. *Engineering Construction Risks : A Guide to Project Management.* London: Thomas Telferd, 1992.

Yin, R. *Case Study Research: Design and Methods.* Sage: Beverly Hills, 1984.

Zeitoun, A, and G Oberlender. *Early Warning Signs of Project Changes.* Stillwater: Oklahoma State University, 1993.

BIBLIOGRAPHY

Sooriyaarachch,i S.N.A.W. (2007). A study of factors affecting cost variation in building construction projects. MEng diss.,University of Moratuwa

Daluwatta, V.R. (1993). Life cycle cost analysis for road pavements. MEng diss.,University of Moratuwa

Wijegunawardana, K.M. (2007). Methodology for distribution of yearly road maintenance allocation for a given region at provincial level. MEng diss.,University of Moratuwa

Wanniarachchi, T.A. (2009). Risk management process for power generation projects in Srilanka. MEng diss.,University of Moratuwa

Talagala, S.J. (1997). Evaluation of advance payment systems. MEng diss.,University of Moratuwa

Tennakoon, S.D. (1990). Role of project management in road and bridge construction claims: :MEng diss.,University of Moratuwa

Appendices A: Data Gathered on Bridge Contracts

Project No	RDA/MMC/BD/02	Case Study No	1
Project Name	Widening of bridge no: 2/2 on Hendala Hunupitiya Road		
Employer Representative	Provincial Director of Western Province		
Engineer	Chief Engineer of Gampaha		
Contractor	Valance Engineering Services (Pvt) Ltd		
Date of Commencement	9/25/2006	Contract Period	549 days
Time Extention		Date of Completion	12/23/2008
EOT 01	271 days		
Initial Contract Price (Rs.)	91,487,529.46		
Claim	Amount (Rs.)	Reasons	
Claim 01	69,555.20		
Claim 02	243,200.00		
Claim 03	7,851,498.52		
Claim 04	1,455,307.74		
Claim 05	3,646,602.97		

Project No	RDA/MMC/BD/05	Case Study No	2
Project Name	Reconstruction of bridge no: 5/1 on Hendala Uswetakeiyawa Road		
Employer Representative	Provincial Director of Western Province		
Engineer	Chief Engineer of Gampaha		
Contractor	State Development & Construction Corporation		
Date of Commencement	5/8/2009	Contract Period	305
Time Extention		Date of Completion	3/9/2010
-	-		
Initial Contract Price (Rs.)	42,089,894.56		
Claim	Amount (Rs.)	Reasons	
Claim 01	-		

Project No	RDA/MMC/BD/06	Case Study No	3
Project Name	Reconstruction of bridge no: 25/6 on Wanduramba Ethumale Yakkatuwa Road		
Employer Representative	Provincial Director of Southern Province		
Engineer	Chief Engineer of Galle		
Contractor	Valance Engineering Services (Pvt) Ltd		
Date of Commencement	5/8/2006	Contract Period	549 days
Time Extention		Date of Completion	1/21/2011
EOT 01	74 days		
Initial Contract Price (Rs.)	18,082,958.00		
Claim	Amount (Rs.)	Reasons	
Claim 01	-		

Project No	RDA/MMC/BD/07	Case Study No	4
Project Name	Construction of bridge no: 25/3 on Galle Udugama Road		
Employer Representative	Provincial Director of Southern Province		
Engineer	Chief Engineer of Galle		
Contractor	Jayawansa Constructions (Pvt) Ltd		
Date of Commencement	26/07/2006	Contract Period	365 days
Time Extention		Date of Completion	3/22/2008
EOT 01	240 days		
Initial Contract Price (Rs.)	15,844,715.70		
Claim	Amount (Rs.)	Reasons	
Claim 01	-		

Project No	RDA/MMC/BD/08	Case Study No	5
Project Name	Reconstruction of bridge no: 31/4 on Galle Deniyaya Madampe Road		
Employer Representative	Provincial Director of Southern Province		
Engineer	Chief Engineer of Matara		
Contractor	V.V. Karunarathne & Company		
Date of Commencement	7/21/2006	Contract Period	545 days
Time Extention		Date of Completion	9/17/2008
EOT 01	244 days		
Initial Contract Price (Rs.)	20,631,996.00		
Claim	Amount (Rs.)	Reasons	
Claim 01	1,628,370.17		
Claim 02	153,214.08	Price Escalation	

Project No	RDA/MMC/BD/10	Case Study No	6
Project Name	Construction of suspension bridge across Ma-oya at Waddeniya		
Employer Representative	Provincial Director of Sabaragamuwa Province		
Engineer	Chief Engineer Projects		
Contractor	Sathuta Builders(Pvt) Ltd		
Date of Commencement	11/6/2006	Contract Period	365 days
Time Extention		Date of Completion	11/6/2007
Initial Contract Price (Rs.)	22,612,810.00		
Claim	Amount (Rs.)	Reasons	

Project No	RDA/MMC/BD/17	**Case Study No**	7
Project Name	Re-construction of bridge no: 2/1 on narahenpita Nawala Nugegoda Road		
Employer Representative	Provincial Director of Western Province		
Engineer	Chief Engineer of Colombo		
Contractor	Jayawansa Constructions (Pvt) Ltd		
Date of Commencement	5/18/2007	**Contract Period**	540 days
Time Extention		**Date of Completion**	11/8/2008
Initial Contract Price (Rs.)	66,746,344.50		
Claim	**Amount (Rs.)**	**Reasons**	

Project No	RDA/MMC/BD/21	**Case Study No**	8
Project Name	Widening and Re-decking of bridge no: 5/3 on Ja-Ela Ekala Gampaha Road		
Employer Representative	Provincial Director of Western Province		
Engineer	Chief Engineer of Gampaha		
Contractor	Jayawansa Constructions (Pvt) Ltd		
Date of Commencement	3/14/2007	**Contract Period**	273 days
Time Extention		**Date of Completion**	1/9/2009
EOT 01	394 days		
Initial Contract Price (Rs.)	21,342,002.00		
Claim	**Amount (Rs.)**	**Reasons**	

Project No	RDA/MMC/BD/22	Case Study No	9
Project Name	Widening of bridge no: 7/1 on Hendala Uswetakeiyawa Road		
Employer Representative	Provincial Director of Western Province		
Engineer	Chief Engineer of Gampaha		
Contractor	Lanka Trading and Construction (Pvt) Ltd		
Date of Commencement		Contract Period	
Time Extention		Date of Completion	
Initial Contract Price (Rs.)			
Claim	Amount (Rs.)	Reasons	

Project No	RDA/MMC/BD/30	Case Study No	10
Project Name	Widening of bridge no: 12/1 on Alawwa Dampelessa Road		
Employer Representative	Provincial Director of North Western Province		
Engineer	Chief Engineer of Kurunegala		
Contractor	R.D. Ebert & Sons Holding (Pvt) Ltd		
Date of Commencement	4/3/2007	Contract Period	360 days
Time Extention		Date of Completion	1/24/2009
EOT 01	137 days		
EOT 02	165 days		
Initial Contract Price (Rs.)	23,992,168.00		
Claim	Amount (Rs.)	Reasons	
Claim 01	105,225.00	Weathered Rock found	
Claim 02	1,981,000.00	Qty increase / EOT	
Claim 03	311,750.00	Qty increase / EOT	
Claim 04	1,558,118.00	Qty increase	
Claim 05	4,410,029.01	Price Escalation	

Project No	RDA/MMC/BD/33	Case Study No	11
Project Name	Construction of bridge no:27/1 on Passara Hingurukaduwa Pelawatta Road		
Employer Representative	Provincial Director of Uva Province		
Engineer	Chief Engineer of Monaragala		
Contractor	Jayawansa Constructions (Pvt) Ltd		
Date of Commencement	10/5/2007	Contract Period	365 days
Time Extention		Date of Completion	3/28/2009
EOT 01	175 days		
Initial Contract Price (Rs.)	51,210,549.50		
Claim	Amount (Rs.)	Reasons	
Claim 01	-	-	

Project No	RDA/MMC/BD/36	Case Study No	12
Project Name	Re-construction of bridge no:79/2 on Piliyandala Puttalama Road		
Employer Representative	Provincial Director of North Western Province		
Engineer	Chief Engineer of Chilaw		
Contractor	M.R. Henry & Company		
Date of Commencement	8/28/2007	Contract Period	273 days
Time Extention		Date of Completion	12/3/2008
EOT 01	190 days		
Initial Contract Price (Rs.)	8,461,124.72		
Claim	Amount (Rs.)	Reasons	
Claim 01	-	-	

Project No	RDA/MMC/BD/50	Case Study No	13
Project Name	Re-construction of bridge no:31/3 on Wattegama Kandenuwara Wariyapola Road		
Employer Representative	Provincial Director of Central Province		
Engineer	Chief Engineer of Kandy		
Contractor			
Date of Commencement		Contract Period	
Time Extention		Date of Completion	
Initial Contract Price (Rs.)	43,949,935.00		
Claim	Amount (Rs.)	Reasons	
Claim 01	-	-	

* Not commenced

Project No	RDA/MMC/BD/52	Case Study No	14
Project Name	Construction of bridge no:11/1 on Passara Hingurukaduwa Pelawatta Road		
Employer Representative	Provincial Director of Uva Province		
Engineer	Chief Engineer of Monaragala		
Contractor	KES Engineering (Pvt) Ltd		
Date of Commencement	1/27/2009	Contract Period	364 days
Time Extention		Date of Completion	6/7/2010
EOT 01	132 days		
Initial Contract Price (Rs.)	48,546,312.33		
Claim	Amount (Rs.)	Reasons	
Claim 01	-	-	

Project No	RDA/MMC/BD/55	**Case Study No**	15
Project Name	Re-Construction of bridge no:6/1 on Kurunegal Narammala Madampe Road		
Employer Representative	Provincial Director of North Western Province		
Engineer	Chief Engineer of Kurunegala		
Contractor	Sthuta Builders (Pvt) Ltd		
Date of Commencement	6/16/2009	**Contract Period**	364 days
Time Extention		**Date of Completion**	10/24/2010
EOT 01	11 days		
EOT 02	120 days		
Initial Contract Price (Rs.)	36,111,403.20		
Claim	**Amount (Rs.)**	**Reasons**	
Claim 01	-	-	

Project No	RDA/MMC/BD/63	**Case Study No**	16
Project Name	Construction of bridge over Mahaweli ganga at Balantota on Balantota Dekinda Road		
Employer Representative	Provincial Director of Central Province		
Engineer	Chief Engineer of Kandy		
Contractor	Valance Engineering Services (Pvt) Ltd		
Date of Commencement	4/23/2009	**Contract Period**	180 days
Time Extention		**Date of Completion**	12/24/2009
EOT 01	65 days		
Initial Contract Price (Rs.)	18,600,383.24		
Claim	**Amount (Rs.)**	**Reasons**	
Claim 01	2,240,149.21	Extra work	
Claim 02	1,356,315.36	Quantity increase	
Claim 03	1,333,547.50	Extra work	
Claim 04	1,290,043.98	Legal claim & Interest claim	

Appendices B: Particulars of Galle-Deniyaya-Madampe Bridge

Table B.1 : Quantity Increase of Galle Deniyaya Madampe Bridge

Item No.	Description	Unit	Excessve Quantities		
			Excess Qty	Rate	Amount
4	Provide office for the Engineer	Month	7.00	12,000.00	84,000.00
8	Clerical staff for the Engineer	Month	7.00	10,000.00	70,000.00
8	Office aid for the Engineer	Month	7.00	8,000.00	56,000.00
B.6	Providing 355 X 355 mm reinforced concrete pilesin class A grade 40(20) con	LM	1.70	10,000.00	17,000.00
B.8	Class C concrete of nominal mix 1:3:6(40) as screed under foundation slabs of abutments & wing walls	Cum	0.21	12,000.00	2,532.00
B.10	Class A concrete of grade 25(20) in foundation slabs of abutments & wingwalls	Cum	0.65	12,500.00	8,100.00
B.11	Class A concrete of grade 25(20) in pile capping of abutments & wingwalls	Cum	0.02	12,500.00	250.00
B.12	Class B Concrete of nominal mix 1:3:6(40) in abutments & wing walls	Cum	49.82	11,000.00	548,020.00
B.13	Class A Concrete of grade 25(20) in abutments & wing walls	Cum	4.57	13,500.00	61,749.00
B.14	Class A Concrete of grade 25(20) in capping beams,ballest walls, guard walls, curtain walls, bearing pads, and approach s	Cum	0.09	13,500.00	1,269.00
B.15	Rough finish formwork for foundation slabs of abutments, wing & retaining walls	Sqm	8.08	750.00	6,060.00
B.16	Rough finish formwork for pile capping of abutments & wingwalls	Sqm	4.35	750.00	3,262.50
B.18	Smooth finish formwork for abutments, capping beams, ballest walls, curtain walls, bearing pads and approach slabs.	Sqm	2.97	825.00	2,447.78
B.19	Cold work deformed high yield steel bars of grade 460 in approach foundation slabs of abutments & wing walls	MT	0.34	130,000.00	43,680.00
B.21	Cold work deformed high yield steel bars of grade 460 in abutments & wing walls	MT	0.16	130,000.00	20,800.00
B.22	Hot rolled mild steel bars of grade 250 in abutment capping beams curtain walls ballest walls bearing pads approach slabs	MT	0.12	125,000.00	15,000.00
B.23	Cold work deformed high yield steel bars of grade 460 in approach slabs	MT	0.35	130,000.00	45,760.00
B.27	Clay puddled and laid behind abutments & wing walls to form the impervious layer as per drawing	Cum	2.40	700.00	1,678.60
C.1	Infiller concrete of class A grade 40(20) between beams in bridge deck inclusive of end makeup, screed and camber	Cum	16.39	14,000.00	229,446.00

Item No.	Description	Unit	Excess Qty	Rate	Amount
C.3	Smooth finish formwork under side for deck concreting	sqm	3.25	800.00	2,596.00
C.4	Smooth finish formwork on sides for deck and foot walk concreting	sqm	23.00	800.00	18,396.00
C.5	Smooth finish formwork at ends for deck tie beam and foot walk	sqm	4.95	800.00	3,960.80
C.7	Hot rolled mild steel bars of grade 250 in in deck, tie rods of deck and foot walk	MT	0.02	130,000.00	2,340.00
C.11	Precast reinforced concrete railling and uprights in class A grade 25(20?) concrete inclusive of light reinforcement and mould as per drawing	Lm	8.00	12,000.00	96,000.00
C.13	Precast kerb in class B grade 25(20) concrete inclusive of light reinforcement and mould as per drawing	Lm	10.10	3,000.00	30,300.00
C.14	Lower kerbs in class B grade 20(14) concrete cast insitu as per drawing	Lm	10.10	2,900.00	29,290.00
C.22	Service duct of size 450X350 mm formed in deck as per drawing	Lm	6.10	700.00	4,270.00
C.23	500X450X100 mm thick cover slabs for service ducts in class B grade 25(20) concrete inclusive of light reinforcement and smooth shuttering as per drawing	Nos	43.00	3,000.00	129,000.00
B.9	Grouted rip rap filled with 1:3 cement motar as per drawing	cum	5.76	6,000.00	34,560.00
C.1	Soil sub base Type 1 material compaction in position	cum	4.19	1,000.00	4,190.00
C.3	Dense graded aggregate base of nominal maximum size of 50 mm for existing carriageway and widening section to a maximum thickness of 225mm	cum	12.10	3,500.00	42,332.50
C.4	MC30 or Bituminous emulsion of grade CSS-I or CSS-2 applied at the rate of 0.9-1.5 l/m2 over the finished dense graded agg.base.	sqm	128.00	110.00	14,080.00
	Total				**1,628,370.18**