DISPUTES ARISING FROM VARIATIONS IN ROAD CONSTRUCTION PROJECTS IN SRI LANKA

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Dissertation submitted in partial fulfillment of the requirement for the Master of Science in Construction Law and Dispute Resolution

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DECLARATION

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

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Jayathilaka G.R.H. Date

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

……....…….. 07.06.2018

Ch. QS. Prof. (Mrs.) B.A.K.S. Perera Date

Dissertation Supervisor

ABSTRACT

Disputes arising from variations in Road construction projects in Sri Lanka

Sri Lanka is rapidly developing from the infrastructure sector with the emergence of huge and highly costly road networks and highway projects. This complexity gives rise mostly to unwanted situation as variations together with their attached effects, and greater likelihood that they become time consuming and costly than as-planned projects. Therefore, dispute arises naturally from the construction process largely where players involved must coordinate their work in all stages.

On the other hand, though much literature had developed on the broad view on variations and disputes, there is no literature which deeply addresses disputes arising from the variations within the Sri Lankan road projects by analyzing the cases.

Therefore, this research aims to fill the gap of disputes arising from variations in road projects in Sri Lanka and to propose probable attributes towards managing of such disputes.

The research aim was approached through case studies based on three road projects. During the data collection, semi-structured interviews were conducted with top level professionals of all three projects who had participated in the dispute procedures adopted in the Contract. Thereafter, the gathered data was analyzed using content analysis and mapping techniques (with NVivo 2011).

Findings deeply revealed that the existing disputes arise from the variations in Sri Lankan road projects. Causes of variations, contractual provisions for the variations and effects and the disputes arising from such variations in existing practice are discussed. Finally suggest probable measures to manage such disputes by developing a frame work.

Keywords: Variations, Disputes, Roads projects Sri Lanka

DEDICATION

May this work be

A dedication to

My beloved parents

&

all who wish for my success …

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Jayathilaka G.R.H.
07 th June 2018

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LIST OF ABBREVIATIONS

Abbreviation	Description
ABC	Aggregate Base Course
BOQ	Bill of Quantities
CIDA	Construction Industry Development Authority
ICTAD	Institute of Construction Training and Development
FIDIC	Federation International De Ingenieros Consoltores
MH	Manhole
No. /Nr	Number
NWS&DB	National Water Supply & Drainage Board
RDA	Road Development Authority
RP	Road Projects
SBD	Standard Bidding Document
SL	Sri Lanka
Sqm/m^2	Square meter
VO	Variation Order

1. INTRODUCTION

1.1 Background

Construction industry has become more complex and difficult to manage than any other industries as it needs special skills, techniques and a huge capital. According to Egbu (2010), the complexity of the construction industry due to different stakeholders' involvement makes it differ from other industries. Therefore, disputes arise- naturally from the construction process largely where players involved must coordinate their work in all stages of design and development (Raji, Mohamed & Oseni, 2015). This complexity gives rise mostly to unwanted situations as variations together with their attached effects, and the more variation orders in projects, greater the likelihood that they become time consuming and costly in construction projects (Mohamed, 2001). According to Ramachandra, Rotimi and Gunarathna (2014), claims are one of the significant concerns in the construction industry especially with increasing magnitude of complexity of modern day projects. In modern complex construction contracts claims have become inevitable when things go wrong (Ramachandra et al., 2014). Therefore, it is almost becoming a rarity for a project not to have variations, thus becoming a normal occurrence in all construction projects (Finsen, 1999; Wainwright & Wood, 1983).

Hence, Finsen (1999); Wainwright and Wood (1983) stated that most contracts these days must make provisions for possible variations given the nature of construction. However, an unfortunate aspect of the variation clause is that it tends to encourage clients to change their minds and embark on construction projects without having properly thought their project requirements (Finsen, 1999). Moreover, Egbu (2010) pointed out that a clause permitting variation of works is an essential feature of any construction contract because, without it the contractor is not bound to execute additional work or to make omissions or changes. It is the same for the architects; they tend not to crystallize their intentions on paper before the contract is signed because they know the variation clause will permit them to finalize their intentions during the term of the contract (Wainwright & Wood, 1983). On the other hand, Ashworth (2001)

added that the advantage of the variation clause is that it allows the architect or other designers to delay making some decisions almost until the last possible moment.

However, Eden, Williams, Ackermann, and Howick (2000) and Ciccarelli (2004) mentioned that a major factor during the execution phase is the intervention of the client to change the scope, thereby altering the project's time schedule and cost. Hatush et al. (2005) stated that clients change the scope and requirements quite frequently without a proper recognition of the consequences thus resulting in project overrun.

Subsequently, there are more misunderstandings and disputes about variations than any others aspect of construction contracts. Changes to the work on construction projects are a common cause of dispute (Sergeant & Wieliczko, 2014). Such variations lead to thousands of claims in Sri Lanka every year and many more internationally. Sergeant, and Wieliczko (2014) further emphasize that the liability for variations is not only relevant to claims for sums due for extra work but this is also an important underlying factor in many other construction disputes, such as delay, disruption, defects and project termination.

Moreover, Akinsola and Potts (1998) highlighted those variations as a critical issue with reference to claims and disputes caused by variations. Also, Nishanth (2005) indicates that this results in cost and time overruns in road projects. Thus, Bogamuwa (2006), emphasized that the variations cause about 13% increase over the initial contract sum in road projects in Sri Lanka.

The contracting parties of the construction industry does not often seek legal remedies (Abrahaso, 2005). He further mentioned that, some of them incur the loss of their interest to contract. Therefore, the contractual provisions for varied works and conditions to contract of constructions industry than any others aspect need to be identified.

According to the analysis done by Priyantha, Karunasena and Rodrigo (2011), it is identified that variations cause at least a 9.9% mean change of initial contract sum in Sri Lankan road Construction. Thus, it can be argued that the effect of variations is visible in the form of cost overruns in roads construction.

The Road Development Authority (RDA) of Sri Lanka, due to the ever-increasing traffic volume, is planning for the future development of a national highway network (RDA, 2017). Accordingly, researchers address the variations and disputes in Road Construction as a need of the current situation in Sri Lanka. More over, since the variation dispute is a burning issue, the study contains the currently prevailing consequences due to variation disputes and possible settlements of such disputes which are applicable to Sri Lankan Roads Construction Industry.

1.2 Problem Statement

In most of the cases many well planned variations later raised claims and disputes. Somehow, claims made by the Contractor on just legitimate issues should be honored by the Engineer and Employer. However, in some instances it is not so and therefore needs to be identified and make the necessary steps to overcome such disputes and other causes which give rise to legitimate claims and disputes. It is also of paramount importance to know the conceivable outcomes due to problems arise on variations to the parties of the construction industry. Instead of that when considering the current situation of construction sector in Sri Lanka, there is a huge trend to develop a highway network-all over the country as rehabilitations, improvements, widening to of existing roads as well as new express ways and roads connectivity projects which have a high financial involvement than the building projects. When developing those projects there is no doubt ~~to~~ have variations and claims which may cause disputes. More over there is no literature that deeply addresses this scenario within the Sri Lankan context regarding road construction projects, while more literature had developed on a broad view on variation disputes; namely construction claims; delay analysis; disputes and Alternative Dispute Resolution methods. Similarly, though the researchers have done the researches on variations, effects, causes in Sri Lankan context on a broader view with statistical quantitative analysis, that do not directly address the disputes arising from variations in road projects of Sri Lanka through deep analysis of the cases.

Therefore, this research aims to fill the gap of dispute arising from variations in road projects in Sri Lanka and to address the problem of “How to manage the disputes arising from variations in road construction projects in Sri Lanka through identifying

the situations, reasons and effects of the variation disputes in road projects in Sri Lanka" and to propose probable attributes towards managing such disputes.

1.3 Aim and Objectives

The aim of this research is to develop a frame work to manage disputes due to variations in road construction projects in Sri Lanka. To achieve the aim, it is found necessary to set the following objectives.

- Identify the types of variations and contractual provisions related to the variation claims.
- Identify the reasons for disputes due to the variations.
- Identify the practical situations and causes which create disputes arising from variation in the road construction projects in Sri Lanka.
- Identify the solutions to minimize the disputes due to variations

1.4 Research methodology

Literature survey and Desk Study

A comprehensive literature survey was carried out regarding contractual provisions, situations, reasons and solutions in existing disputes due to variations in construction projects through Journal articles, books, e- journals and research papers. Findings from the literature had strong reviews through a desk study. Those findings by desk study were analyzed in order to achieve the first two objectives.

Semi- Structured interviews & Case studies

Semi-structured interviews were conducted among the industry professionals who are currently experiencing the situation of variation disputes in road construction projects in Sri Lanka and three cases were analysed. From that literature findings were validated and last the two objectives were achieved by investigating actual reasons and solutions to minimize the disputes due to the variations.

Data Analysis

The collected data was analyzed using content analysis with NVivo 2011 (copyright @ 2011 qualitative solutions and research private limited) software and the framework were developed to manage disputes due to variations in road construction projects in Sri Lanka.

1.5 Scope and limitation

This study considered disputes arising only from variations in road construction projects in Sri Lankan construction industry. Nine experts were selected for the semi-structured interviews and three cases were studied.

1.6 Chapter Breakdown

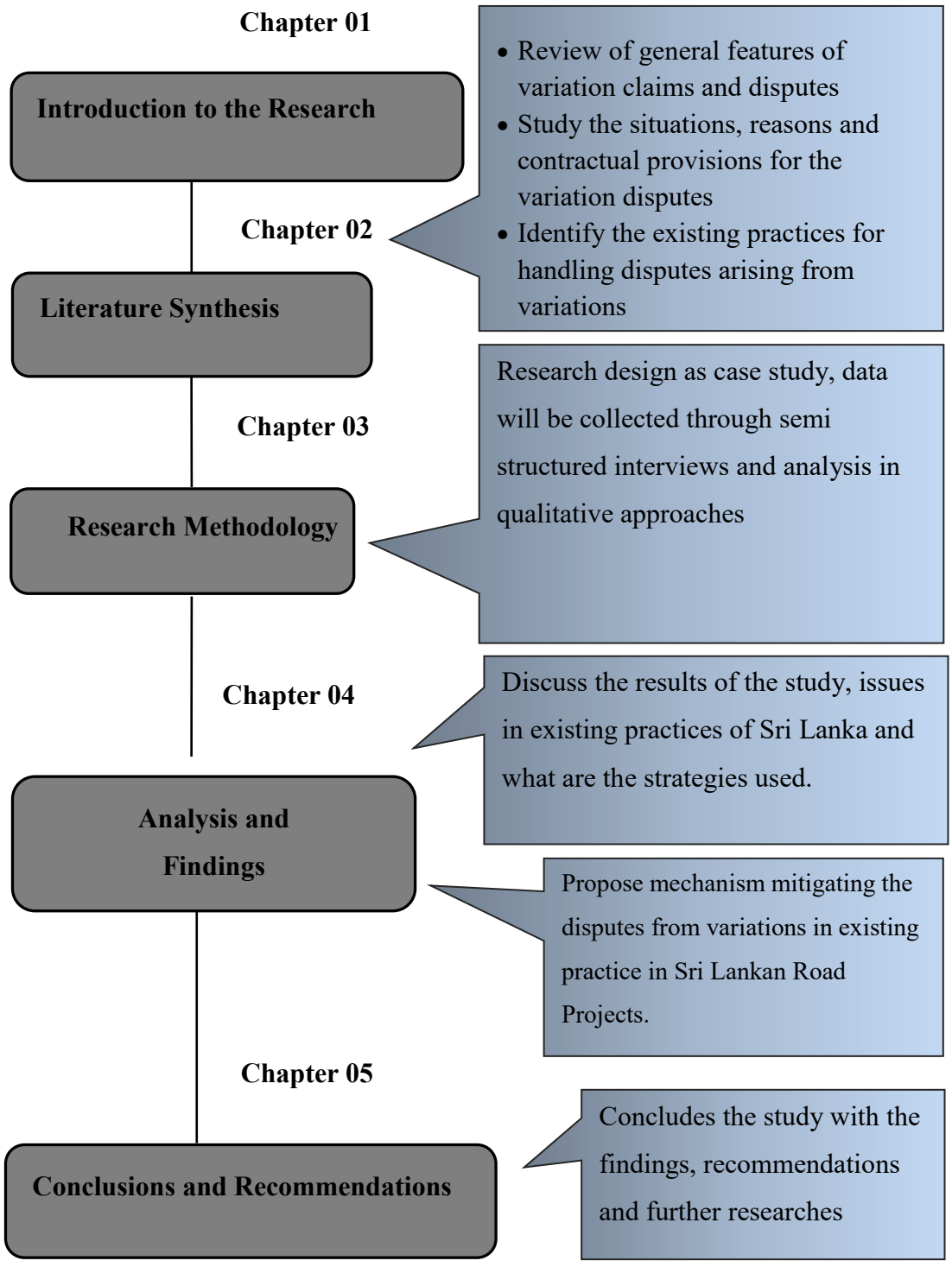

Figure 1-1: **Chapter Breakdown**

1.7 Summary of the Chapter

This Chapter precise identifying the research problem and background to the research, strengthened by the literature review. Moreover, the aim and objectives of the research have been highlighted with a research methodology in a brief manner as well as describing the scope and limitations to the research. Then, the research is further strengthened through the literature in the next Chapter.

2. LITERATURE REVIEW

2.1 Introduction

A brief introduction to the research was given in Chapter one. This chapter is aimed to synthesize the current knowledge level regarding the research area and to establish the research problem. Firstly, the Construction Variations are identified through definition, then gradually the contractual conditions and disputes arising from variations are identified. Their contents are analyzed to identify whether those are interrelated or not. Then key factors of the research namely; concept of variation, contractual provisions, reasons, effects and handling variation disputes are analyzed through this chapter.

2.2 Concept of Construction Variations

According to most of the researchers like Jamil, Mufti, and Khan(2008) and Allen (2010) the construction industry unlike in other industries is more complex and difficult to manage because it needs special skills and techniques. That is why construction project subjected to more risks as compared to other business activities (Ozorhon, Arditi, Dikmen,& Birgonul, 2007a). Moreover, Construction projects are complex endeavors majorly because they involve many human and non-human factors and variables (Arain & Pheng, 2007). And also, Construction projects are unique, one off task that last for a defined period. Another important fact about the project is that no two projects are entirely the same (Babalola & Idehen, 2011). Furthermore, they mentioned that a project involves different stages ranging from initial stage, feasibility analysis, design stage, procurement, construction, turnover to the disposal of the facility. Thus, the need to make variations in a construction project is a matter of practical reality. Even the most thoughtfully well-planned project may necessitate variations due to the above factors (O'Brien, 1998 cited from Babalola, & Idehen, 2011). Hence, variations orders often occur in construction projects, whether they do so during the early, middle, or late stage of the project (Mega & Waty, 2008). That's why Kwakye(1997) and Ssegawa, Mfolwe, Makuke and Kutua, (2002) explained that

the construction industry due to its compartmentalization has made variation almost an inevitable element and has become so prevalent that it is hardly possible to complete a project without changes to the plans or the construction process itself. There for it is important to identify what variation is or the definition of variation.

2.3 Definition of a Variation

Various researchers have described variations in different ways but generally, variations refer to a change in the requirement of the original contract signed by the parties, or a variance from what was originally stated in the contract documents (Kassim & Boong, 2002; Ssegawa et al, 2002; Ibrahim, 2006).

Whether such a variation is in law strictly a variation with its attendant legal consequences has to be established in relation to the particular contract involved (Nachatar, Hussein & Omaran, 2010). Usually, each standard forms of contract will contain a definition of a variation in terms of specific actions and activities. According to the Sub Clause 13.1 of FIDIC (1999) (call as New red Book) and ICTAD (2007), the Standard Bidding Document (call as SBD 02) which are mostly used in Road construction Projects Sri Lanka defined variation as follows,

a. *changes to the quantities of any item of work included the Contract. (However, such changes do not necessarily constitute a variation)*
b. *changes to the quality and other characteristics of any item of work*
c. *changes to the levels, positions and/or dimensions of any part of the works*
d. *omission of any work unless it is to carry out by others*
e. *any additional work, Plant, Materials or services necessary for the permanent works including any associated Tests on Completion, boreholes and other testing and exploratory work; or*
f. *changes to the sequence or timing of the execution of the works.* (pp. 36 - 37).

As per Fisk (1997); Nachatar et al. (as cited in O'Brien, 1998), "*a variation order is the formal document that is used to modify the original contractual agreement and becomes part of project's documents*". Furthermore, a variation order is a written order issued to the contractor after execution of the contract by the owner, which authorizes

a change in the work or an adjustment in the contract sum or even the contract time (Nachatar et al. cited in Clough & Sears, 1994).

Accordingly, researcher identified that there is no single definition of what constitutes a variation. In general, researcher simply define a variation as *"any change to the works as described in the Contract document."*

After defined defining the variation, the significant point is the root cause for the variations may occur in a construction project.

2.4 Causes for Variations

Arain (2005) quoting various sources states that "*variations are common in all construction projects*." Thus, variations have a definite impact on the success and failure of a project and hence a significant amount of work has been done by researchers to identify the various types of variations and their causes.

Koushki and Kartan (2004) quoting Hafez (2001) assert that the implementation of construction projects is usually accompanied with time delays and cost increases. Their assertion is supported by Morris and Hough (1998) whose extensive examination of more than four thousand construction projects revealed that such projects were rarely finished on time or within the cost. A similar outcome has been observed by various other researchers worldwide (Koushki & Kartan cited in Hammad, 1993; Rad, 1979; Taha et al., 1993).

The subject of the causes of variations had also been explored by a large number of researchers who have adopted different methodologies for classifying such causes. Hensey (1993) has proposed a classification system which 'included materials, labor, equipment and financial constraints as the main contributory variable to causes of construction delays' (Koushki & Kartan, 2004).

Moreover, many researchers discuss various causes for variations in roads construction, mainly categorized in to three sources of origin as by Client, by Consultant and by unforeseeable events (Priyantha et al., 2011) which illustrated in ŧTable 2.1.

Table 2-1: Sources of Variations in Road Construction

Sources of Variation	Cause of Variation
Originated by Client (Huiwu et al, 2003; Nishanth, 2005; Halwathura et al, 2013; Sunday, 2010)	Increasing the Requirement Inadequate time for preparation of Tender Documents Change in mind-choice Change in mind-forced Poor/unclear briefing by Client Financial problems
Originated by Consultant/Engineer (Huiwu et al,2003; Nishanth, 2005; Wickramasinghe, 2006; Halwathura et al, 2013; Sunday, 2010)	Design Changes/ Errors & Omissions of Design Poor Design with inadequate consideration of design Incorrect assessment of briefing Defects in BOQ and specifications Inadequate site investigation Shortcomings in Contractual Pricing documents
Originated by Unforeseeable Events (Nishanth, 2005; Halwathura et al, 2013; Sunday, 2010)	Restrictions due to existing utility lines Floods and landslides Shortage of Materials

Similar output discussed by Sunday (2010) in his study on Impact of variation orders on public construction projects. According to his review causes of variations had been categorized into consultant related, owner related, contractor related variation orders and the other changes that can be referred to as force majeure which is similar to findings of Priyantha et al. (2011).

The categorization by Sunday (2010) has been further emphasized by various authors by identifying different causes of variation orders in construction projects both on the private and public projects. The enormity of the various causes of variations identified over the years by various author shows that variation has come to stay as part of the construction projects and it has cut across various stakeholders as shown in Table 2.2.

Table 2-2: Various causes of variation order and their categorization

Category of Variation	**Causes of Variation**	**Identified Author(s)**
Consultant /Engineer related changes	Design change by consultant; Errors and omissions in design; Conflicts between contract documents; inadequate scope of work for contractor; Technology change; Lack of coordination; Design complexity; Inadequate working drawing details; Inadequate shop drawing details; Consultant's lack of judgment and experience; Lack of consultant's knowledge of available materials and equipment; Consultant's lack of required data; Obstinate nature of consultant; Ambiguous design details;	Assaf, et al. (1995); Fisk (1997); O'Brien (1998); Mokhtar et al. (2000); Wang (2000).Enshassi et al (2010)
Client/Owner related changes	Change of plans or scope by owner; Change of schedule by owner; Owner's financial problems; Inadequate project objectives; Replacement of materials or procedures; Impediment in prompt decision making process; Obstinate nature of owner; Change in specifications by owner.	Fisk (1997); O'Brien (1998); Wang (2000); Gray and Hughes (2001); Arain and Pheng (2005); Mokhtar, et al. (2000); Gray and Hughes (2001).

Contractor related changes	Complex design and technology; Lack of strategic planning; Contractor's lack of required data; Lack of contractor's involvement in design; Lack of modern equipment; Unfamiliarity with local conditions; Lack of a specialized construction manager; Fast track construction; Poor procurement process; Lack of communication; Contractor's lack of judgment and experience; Shortage of skilled manpower; Contractor's financial difficulties; Contractor's desired profitability; Differing site conditions; Defective workmanship; Long lead procurement	Thomas and Napolitan (1994); Clough and Sears, (1994); Assaf, et al. (1995); Fisk (1997); O'Brien (1998); Wang (2000); Arain and Pheng (2005); Enshassi et al (2010)
Other changes	Weather conditions; Safety considerations; Change in government regulations; Change in economic conditions; Socio-cultural factors; Unforeseen problems.	Fisk (1997); Kumaraswamy et al. (1998); O'Brien, (1998); Wang, (2000); Arain and Pheng (2005)

Apart from that, considering the Sri Lankan Context, Halwatura and Ranasinghe (2013) had ranked the causes of variations as follows in their study through the analyzing of cases in road projects in Sri Lanka.

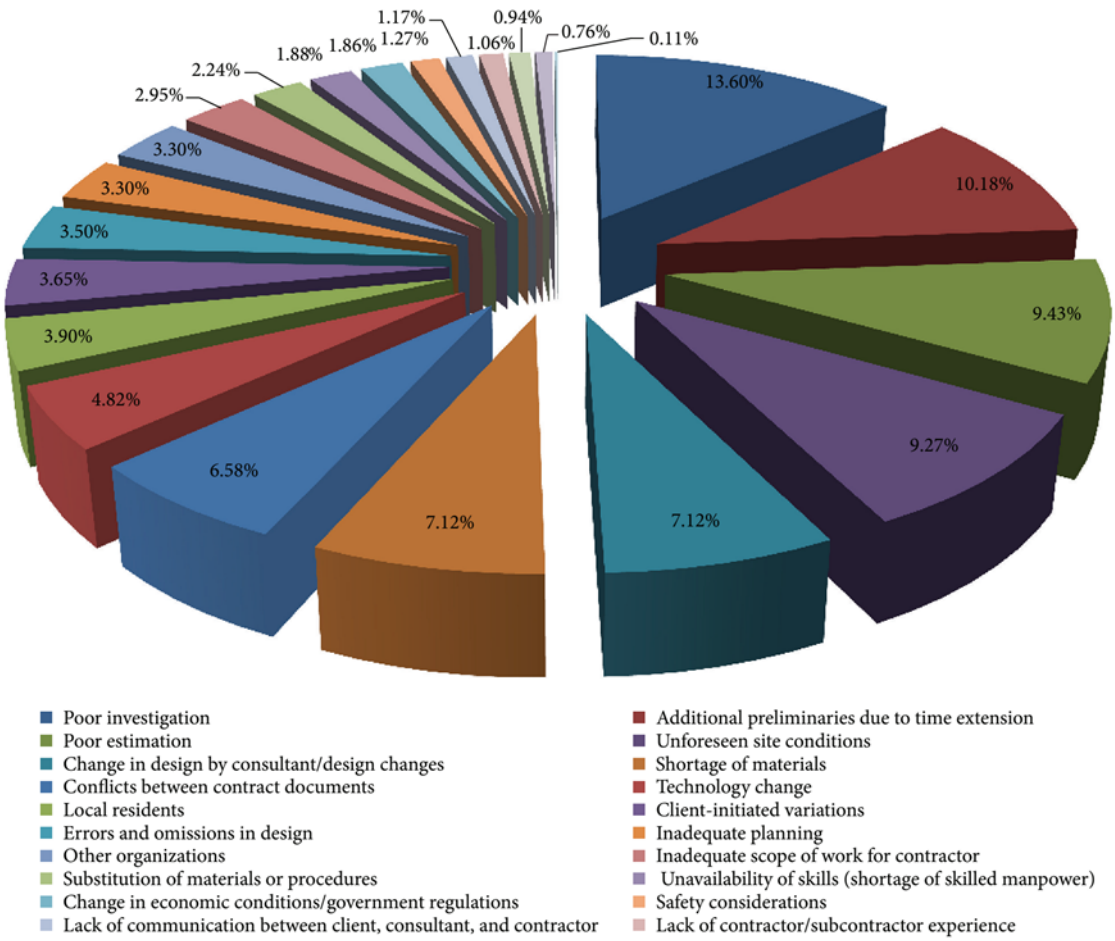

***Figure 2-1*: Contribution of each factor to variation**

Source: Halwatura and Ranasinghe (2013), p.4

According to their survey, poor estimation is the most significant cause of variation orders. Unforeseen site condition is the second cause. Further, political pressure during construction stage, poor investigation, and client-initiated variations are at the 3rd, 4th, and 5th places in the ranking, respectively.

However, the researcher identified that based on the monitory value of the claims, poor investigation, and additional preliminaries due to extension of time, poor estimation, unforeseen site conditions, and change in design by consultant/design changes are the first 5 causes, respectively in variations of Sri Lankan road construction projects.

2.4.1 Nature of variations in Roads Projects

Six factors which account for the nature of issuing variations identified through ICTAD (now call as CIDA) SBD 02 (2007) and FIDIC (1999) were taken into consideration to find out the nature of variations in road projects by Priyantha et al. (2011). Their study on Causes, Nature and Effects of Variations in Highways in Sri Lanka can be illustrated in figure 2.2.

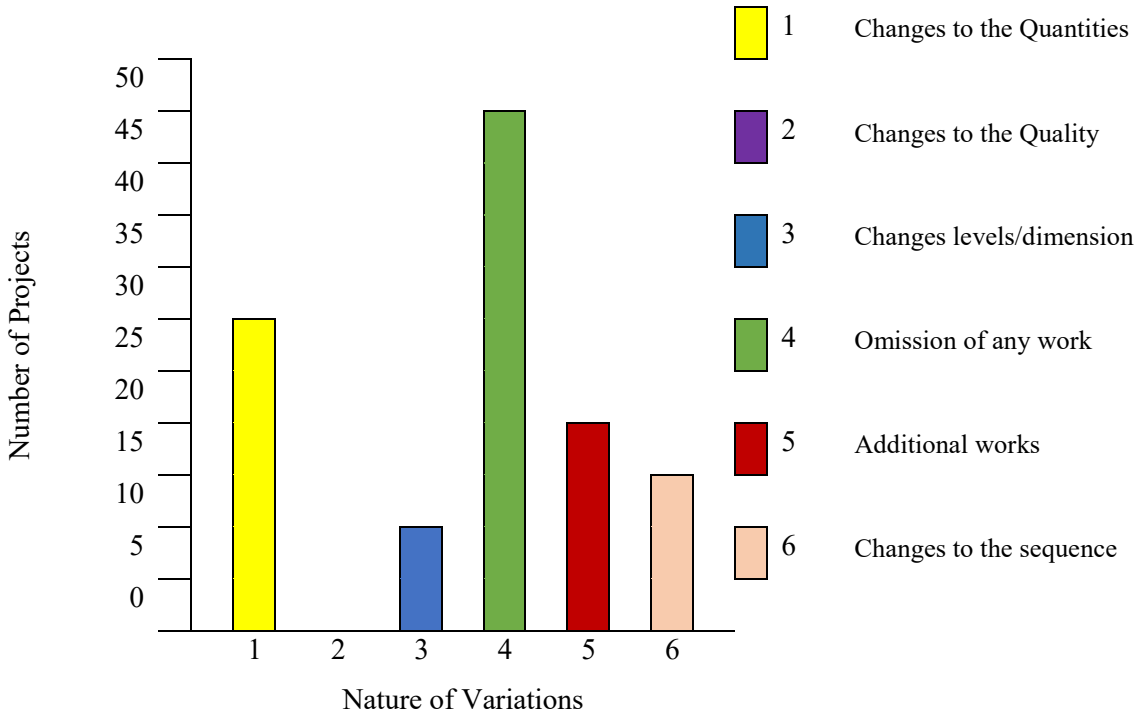

***Figure 2-2*: Nature of variations in road projects, Sri Lanka**

Source: Priyantha et al (2011), p.17

Accordingly, the nature of the variations is significant as an omission of any work. This is reasoned due to problems of land acquisition and arranging funds. Land acquisition in the past has caused significant delays to project implementation. This applies to both, the actual acquisition and the subsequent resettlement of the affected people. While the process of land acquisition has often taken an inordinately long time, the ambiguous guidelines on resettlement have led to disputes over a fair compensation causing additional delays (RDA, 2017).

According to Priyantha et al. (2011), when variations often come into account, it may increase the final contract sum. In this instance, some items in original scope of work have to be deleted to manage variations within budget. During the construction stage, some materials will be required in quantities more than estimated in the BOQ. This condition is an inevitable aspect in highways construction. This is mainly due to defects in BOQ. Apart from the above, changes to sequence and levels/dimensions also occasionally occurred. However, changes to quality have not been observed in any highway project due to the defined quality aspects of highway projects. All works of highways construction are carried out to some defined standards and specifications of the RDA.

2.5 Contractual provisions for variations

The usage of a variation order is to effect a change in the contract (Nachatar et al., 2010). According to Fisk (1997), the following are some of the purpose served by variation orders,

1. To change contract plans or to specify the method and amount of payment and changes in contract time.
2. To change contract specifications, including changes in payment and contract time that may result from such changes.
3. To effect agreements concerning the order of the work, including any payment or changes in contract that may result.
4. For administrative purposes, to establish the method of extra work payment and funds for work already stipulated in the contract.
5. For administrative purposes, to authorize an increase in extra work funds necessary to complete previously authorized change.
6. To cover adjustments to contract unit prices for overruns and under runs, when required by the specifications.
7. To effect cost reduction incentive proposals (value engineering proposals).
8. To effect payment after settlement of claims.

The same researcher further e emphasizes that, a variation order is used in most instances when a written agreement by both parties to the contract is either necessary

or desirable. Such use further serves the purpose of notifying a contractor of its right to file a protest if it fails to execute a variation order (Fisk, 1997). The absence of a variations clause undoubtedly makes it difficult to vary the terms of the contract but it is at least possible that the courts would imply a term allowing minor variations to be made (Nachatar et al., 2010).

In any event, it would of course be most unusual for a contractor to attempt to refuse to carry out small changes and even less likely that the contractor would go to court over an attempt to impose them (Nachatar et al., 2010). Accordingly, he further explained that, by inserting a clause which allows for changes to be made to the works as it is being constructed, the employer, through the contract administrator, can alter the works as and when necessary. The purpose of the variation clauses is to allow such changes to be made, and also to permit any consequential changes to be made to the contract sum.

On the other hand, it is always possible for a contract to include a clause that fixes express limits on the amount of variations. In any event, it must be borne in mind that the existence of a variation clause does not entitle the employer to make large scale and significant changes to the nature of the works, as these are defined in the recitals to the contract (Murdoch & Hughes, 1996).

Finsen (1999); Wainwright and Wood (1983) also stated that most contracts these days must make provisions for possible variations given the nature of the construction project. An unfortunate aspect of the variation clause is that it tends to encourage clients to change their minds and embark on projects without having properly thought their project requirements (Finsen, 1999). Uff (2005) further pointed out that a clause permitting variation of works is an essential feature of any construction contract because without it the contractor is not bound to execute additional work or to make omissions or changes. It is the same for the architects, they tend not to crystallize their intentions on paper before the contract is signed because they know the variation clause will permit them to finalize their intentions during the term of the contract (Wainwright & Wood, 1983). Ashworth (2001) added that the advantage of the

variation clause is that it allows the architect or other designers to delay making some decisions almost until the last possible moment.

In Sri Lanka, parties involved in highways construction generally adopt two types of standard forms of conditions of contract. Most government funded projects use ICTAD (2007), 02nd edition standard bidding document for major contracts, commonly referred to as SBD 2, and foreign funded projects use FIDIC (1999) conditions of contracts, called the New Red Book (Priyantha et al., 2011).

According to the Sub Clause 13.1 of FIDIC (1999) New red Book and SBD 02, the Standard Contracts which are mostly used in Road construction Projects allows for the variations as follows.

Sub Clause 13.1 – Right to Vary

> *Variations may be initiated by the Engineer at any time prior to the issuing Taking Over Certificates for the works, either by an instruction or by the request for the Contractor to a submit a proposal.*
> *The Contractor shall execute and bound by each variation, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that the Contractor cannot readily to obtain the Goods for Variation. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction*

The clause simply describes that having received an instruction to execute a Variation, the Contractor must comply with it unless he promptly gives the notice described in the second paragraph of this Sub -Clause. He may be unable readily to obtain the Goods, which are the Contractor's Equipment, Materials, Plant and Temporary Works required for the Variation. If the Contractor gives notice under the second paragraph, the notice and supporting particulars should be studied carefully, by the Engineer, before the Variation is cancelled, confirmed or varied.

Accordingly,

- If the Variation is confirmed and not varied, the confirmation should be in writing and address the issues raised in the Contractor's notice.

- If the Variation is itself varied, it may be a new "Variation", to which the Contractor may respond by giving a new notice under the second paragraph.

2.6 Effects of Variations

Research on the effects of variation orders were done by many researchers (Clough and Sears, 1994; Thomas and Napolitan, 1995; Fisk, 1997; Ibbs, 1997; Veenendaal, 1998; Reichard and Norwood, 2001; Arain and Low, 2005; Moselhi et al., 2005; Zulkfili et al., 2009; Sunday, 2010). Changes that occur during construction will affect any project (Reichard and Norwood, 2001). Lewis (1991) indicated that change orders have its ripple effects as a contractor does not work in a vacuum; rather he must properly allocate his limited resources within the projects and between the actual and potential projects. Thus, whenever a change occurs, the contractor must make adjustments to work under the contract and reallocate time, material and labour resources (Zulkfili et al., 2009).

The researcher summarized identified potential effects of variation orders from the different authors in Table 2-3 below as many authors discuss in the same in different occasions.

Table 2-3: Effects of Variations

Effects from the Variations	**Researchers**
Progress is affected but without any delay	Arain and Low (2005); Assaf et al. (1995)
Increases in project cost	Clough and Sears (1994); Assaf et al. (1995); CII (1990)
Increases in overhead expense	O'Brien (1998); Arain and Low (2005)
Procurement delay	O'Brien (1998); Arain and Low (2005); Hester et al. (1991)
Logistics delays	Hester et al. (1991); Fisk (1997); Arain and Low (2005)
Delays in payment	CII (1990); CII (1995)
Additional payments for contractor	Arain and Low (2005); O'Brien (1998)

Completion schedule delay	Ibbs (1997b); Zeitoun and Oberlender (1993); Kumaraswamy et al. (1998); Reichard and Norwood (2001)
Quality degradation	Fisk (1997)
Rework and demolition	Arain and Low (2005); Clough and Sears (1994)
Productivity degradation	Hester et al. (1991); Thomas and Napolitan (1995); Reichard and Norwood (2001); Moselhi et al. (2005)
Damage to firm's reputation	Arain and Low (2005); Fisk (1997) and Kumaraswamy et al. (1998)
Hiring new professionals	CII (1995); Fisk (1997); Arain and Low (2005)
Poor professional relations	Fisk (1997)
Disputes among professionals	CII, 1986; Arain et al. (2004); Hanna (2007)
Poor safety conditions	O'Brien (1998); Arain et al. (2004); Arain and Low (2005)

According to the study of Zulkfili et al. (2009) it implies that top five most frequent effects of variations are increase in project cost, additional payment for the contractor, increase in overhead expenses, completion schedule delay and rework and demolition among other effects listed as above.

2.7 Disputes due to Variations

It is at the utmost importance to ensure the projects are being implemented successfully without any major problems while minimizing the delays and cost overruns that will badly affect the project outcome (Zulkfili et al., 2009). Zulkfili et al. (2009) further stated that the variations or change orders have been burden as a negative effect to construction projects. Furthermore, variations or change orders frequently pose serious problems to owners and contractors, leading to cost overruns and costly disputes (Moselhi et al., 2005). This could be attributed, at least in part, to inadequate understanding and lack of appreciation of the impact of these changes to project performance (Moselhi et al., 2005).

On the other hand, the contract price is also affected when there are variations in drawings and contract document (Zulkfili et al., 2009). The possibilities of contractual

disputes also increase due to variations (O'Brien, 1998). Basically, variations will cause problems for everyone that is involved in the project. Variations can be originated from numerous factors pertinent to the construction projects (Arain and Low, 2005). The construction of projects may face variations that could cause delay in the project completion time (Clough and Sears, 1994). Kumaraswamy et al., (1998) studied claims for extension of the due to excusable delays in Hong Kong's civil engineering projects. From their findings, inclement weather was mainly the cause for 15-20 percent in delays. While, a total of 50% of the projects surveyed were delayed because of variations. Construction projects in Sri Lanka would also experience similar delays. Kaming et al., (1997) in his study on factors influencing construction time and cost over runs, pointed out that the major factors influencing cost overrun were material cost increase due to inflation, inaccurate material estimating and the degree of project complexity. As for the time overrun, it was caused by a few important factors such as design changes, poor Labour productivity, inadequate planning, and resource shortages.

Although, the impact of variations varies from one project to another but it is generally accepted that variation can affect construction projects with unpalatable consequence in time and cost (Ibbs et al., 1998; Ibbs et al., 2001). Similarly, Mohomed (2001) pointed out that the more variation orders on a project, the greater the likelihood that they become time consuming and costly in construction projects. Further, Enshassi, Arain and Al-Raee (2010) mentioned that the variation orders result in time delay, cost overrun, quality defects, and other negative impacts.

As Potts (2003) discussed, variations are inevitable on building and civil engineering projects and may range from small changes having little consequential effects to major revisions, which result in considerable delay, and/or disruptions to a project. As claims and conflicts in construction have become endemic and those are especially caused by variations (Priyantha et al. cited in Akinsola & Potts, 1998) lack of effort in managing these conflicts can result in disputes (Finn & Games, 1997; Priyantha et al., 2011). Consequently, it is apparent that highways also face this problem as a civil engineering project (Priyantha et al., 2011).

Accordingly, the researcher identified basically the following two issues are arising with the variations which are the main reasons for claimable situations in a project.

1. Time overruns

   Time overrun means the actual delay of construction beyond the stipulated date of completion. The actual measure of time overrun means the difference between the actual construction completion period minus the planned construction completion period.

   Time Overrun = (Actual construction period – planned construction competition period.)

   It was realized that additional work, changes to sequence and levels/dimensions are aspects of variations that result in the requirement of additional time to complete the work.

2. Cost Overrun

   Cost overrun of a project means the actual cost increase to the client during the construction period of a project. It is merely the excess of value over the originally envisaged spending for the project (contract sum stated in the letter of acceptance).

   $$\text{Cost overrun} = \frac{(\text{Final account amount} - \text{Initial contract sum})}{\text{Initial contract sum}} \times 100$$

Priyantha et al. (2011) further stressed that time and the cost effect are the issues arising from variations in the road sector projects in Sri Lanka.

2.8 Reasons for Disputes

Dispute arises naturally from the construction process largely due to the complexity of the project where the players involved must coordinate their work in all stages of design and development (Raji & Mohamed, 2015). In construction disputes, usually complex issues of fact, and unanticipated events or conditions frequently occur (Leong, 2012). Parties to a construction dispute often have to deal with substantive changes in circumstances and how to address these changes have given rise to issues such as unexpected extension of time and failure to meet the standard, default payment and requirements of a particular project (Raji & Mohamed, 2015).

There are a number of factors that may arise for s may arise a dispute in any construction project and these are discussed by different authors. The causes of construction disputes identified by the researcher from the literature are summarized in below Table 2.4.

Table 2-4: Reasons for Disputes

Reasons for Disputes	**Identified Authors**
Design Errors	Herren and Cooper (2000); Cushman and Loulakis (2001); Bramble (1995)
Discrepancies or Mistakes in Contract Document	Chappell et al. (2001); Loots and Charrett (2009); Callahan (2005)
Incomplete Information	Emmitt (2002); Olawale and Sun (2010)
Delay in Issuing Information	Sommerville and Craig (2006); Dykstra (2011); Sido (2006)
Variation order	Barrie and Paulson (1992); Oladapo (2003); Arain and Low (2007); Wang, (2000); Gray and Hughes (2001); Arain and Pheng (2005)
Additional Works	Clough, Sears, G. A. and Sears, S. K. (2000); Murdoch and Hughes (2008); Snow (2002)
Disagreement on Claims	Raj (2009); Sears, Sears and Clough (2008); Fenn and Gameson (1992); O‟Brien (1998)
Finance and Payment Issues	Price (1995); Cushman and Myers (1999); Loosemore (2000)
Poor communication	Emmitt (2002); Richbell (2008); Sambasivan and Yau (2007); Sommerville and Craig (2006); Emmitt and Gorse, (2003)
Adversarial relationship	Bower (2003); Construction Industry research for the Century (1996); Pryke (2009); Cox and Thompson (1998); Chartered Institute of Building (2002)
Inclement Weather	Loots and Charrett (2009); Mincks and Johnston (2004)
Unforeseen Site Condition	Levin (1998); Cushman and Myers (1999); Edgerton (2008)
Poor Workmanship	Emmitt (2002); Sawczuk (1996); Griffin (2010)

Reasons for Disputes	**Identified Authors**
Unfair Risk Allocation	Smith (1995); Hibberd and Newman (1999); Cushman and Myers (1999)
Slow Client's Response	Boyd and Chinyio (2008); Jha (2011); Mosey (2009); Levy (2007)

According to the above Table 2.4 "Variation" is identified as a cause of construction disputes by different authors. Hence, Bassioni, El-Razekand and El-Salami (2012) from their survey on avoiding the construction claims they pointed out that, it can be seen from the figure that the major cause of claims is "variations initiated by the employer / engineer". Other important causes in their rank order are: "unexpected changes in materials prices"; "unexpected bidding, underestimation and incompetence of contractors"; "contract documents having errors, defects, omissions, and poor management"; and "delays in payments to contractors and resulting cash problems during construction".

According to their ranking the most important factor for disputes is "Variations" as illustrated in following figure 2.3.

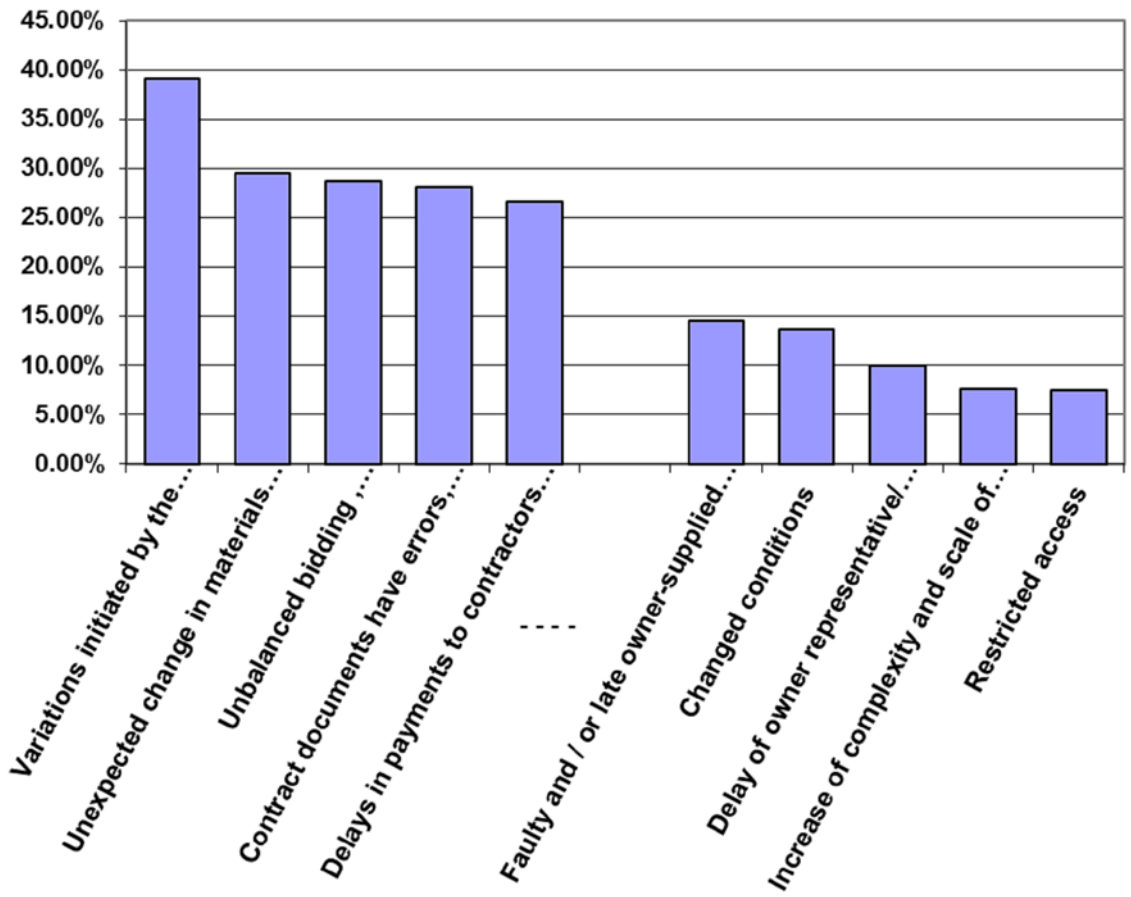

Figure 2-3: **Ranking of causes of Disputes/Claims**

Source: Bassioni, El-Razekand and El-Salam (2012), p.79

Accordingly, the researcher identified that variation is one of the major causes to arise claims which finally become disputes in construction projects unless otherwise resolved at the claim stage.

2.8.1 Disputes in Road Construction

According to Khekale and Futane (2015), during the execution of a project, several issues arise that cannot be resolved among project participants. Such issues typically involve the contractor requesting for either time extension or reimbursement of an additional cost, or sometimes both (Ekhator, 2016). He further explained that, if the owner accedes to the claim of the contractor and grants him extension of time or reimbursement of additional cost, or both, the issue is sorted out. However, if the

owner does not agree to the claim put out by contractor and there are differences in the interpretations, the issue takes the form of the dispute, as explained in fig. 2.4.

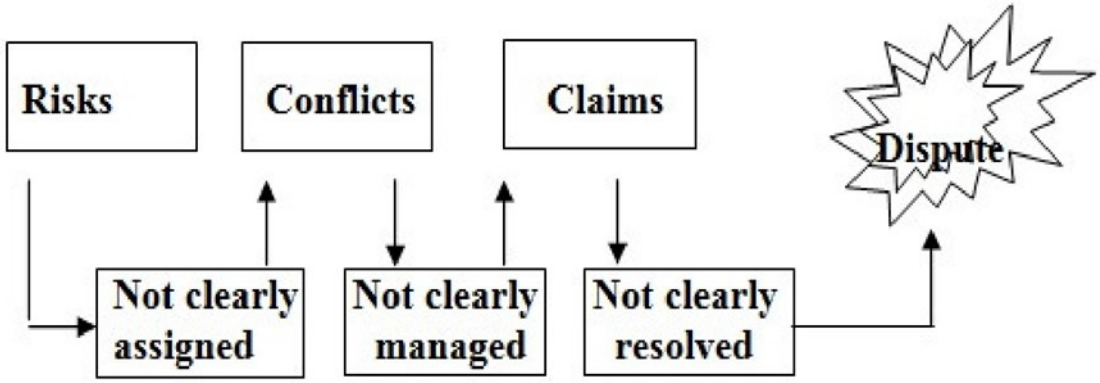

***Figure 2-4*: Risk, Conflict, Claim and Dispute continuum**

Source: Khekale and Futane (2015)

Further, Kumar et al. (2006) conducted a study to establish the causes of conflicts in the Korean construction industry based on a road construction cases. Out of many established dispute causes, the authors further categorized the causes into six root factors as illustrated in Figure 2.5 below.

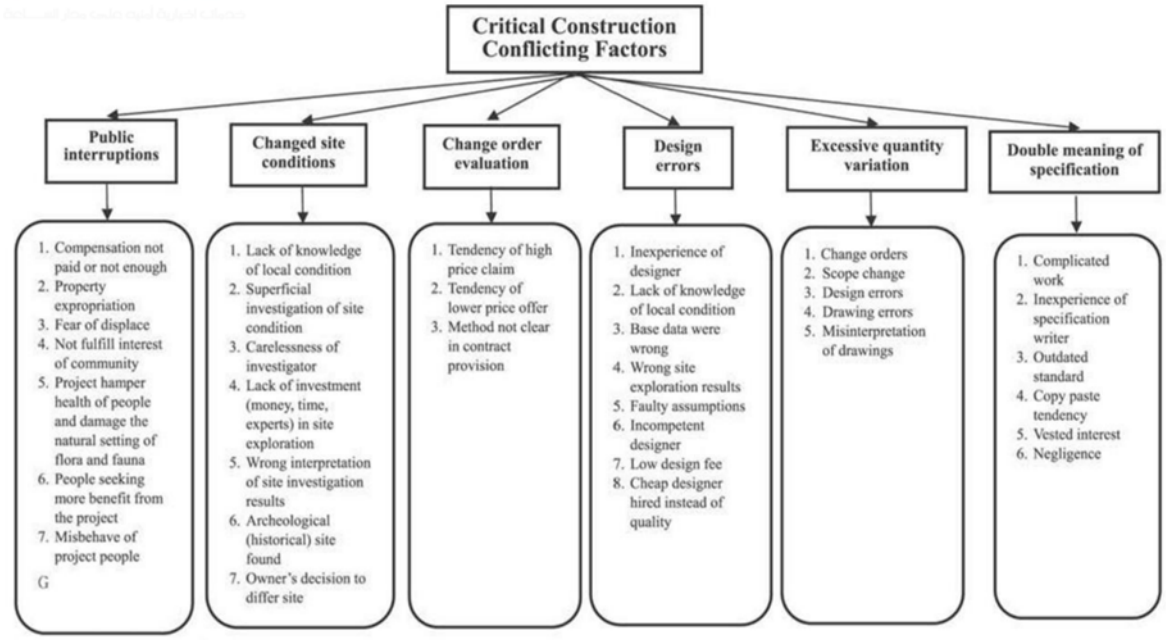

Figure 2-5: **Critical factors of construction disputes in road projects**

Source: Kumar et al. (2006)

Similar outcome is illustrated in different way by Perera, Dhanasinghe and Rameezdeen (2009) with the consent of Road Construction in Sri Lanka in their study of Risk management in road construction: The case of Sri Lanka as given below figure 2.6.

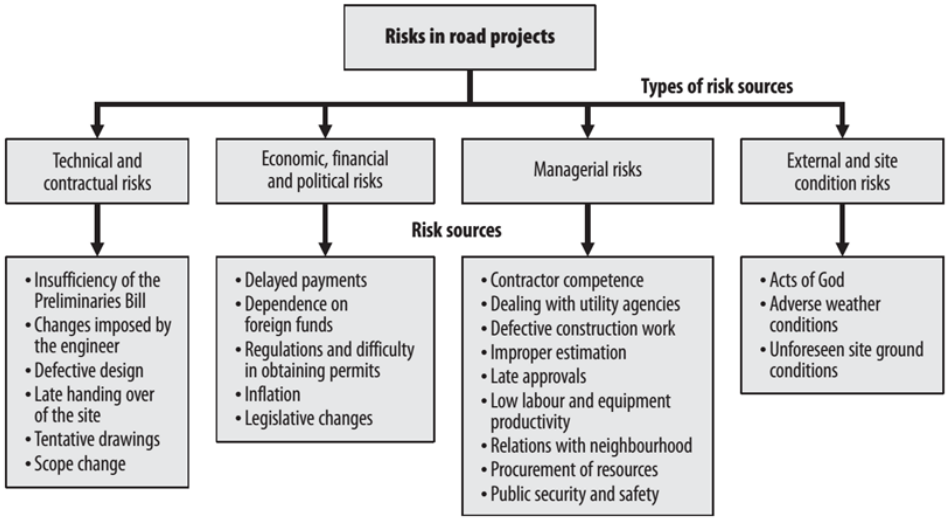

Figure 2-6**: Risk Clarification Framework**

Source: Perera (2009), p.91

Hence the figure 2.4 (Risk, Conflict, Claim and Dispute continuum) explains that the risk factors in a project may finally end up with the disputes. Therefore, risk, is also dispute related to road projects, as, illustrated above in figure 2.6.

However, considering Sri Lankan Road Construction Projects Priyantha et al. (2011) had pointed out major disputes with the effects of variations based on the Perceptions of Partners involved in Road Projects as illustrated in figure 2.7.

Perceptions of variations of Roads Projects in Sri Lanka

Contractor's perception	**Employer's perception**
"variation is an unfair situation and it will always issue bad results"	*"variation is not a big issue and it will always provide support to adjust the works*"

***Figure 2-7*: Perceptions of variations of Roads Projects in Sri Lanka**

According to their findings disputes in road projects can be summarized as follows,

- When variations are issued, although rate breakdown for a new rate is submitted, RDA may not approve a new rate. They usually give priority for prevailing quoted rates.
- When variations habitually emerge, it may affect the critical path of the master programme and thereby, future works and current works have to be changed and it may incur additional costs to the contractor.
- Contractor is that they may need various plants and equipment anticipated and some plants and equipment may have to be imported.
- Although time extensions are approved by RDA for delay due to variations, the corresponding claims may not be fully paid. Then contractors have to go into arbitration, adjudication etc. which is an additional cost as well.
- Even if RDA pays for a delay, it may not be adequate to cover loss of opportunity costs for delayed time.

- Omissions reduce scope of work. If there is an omission, the contractor suffers a loss, because RDA is very reluctant to pay a claim on loss of profit and overheads to a contractor

2.9 Need of Managing Disputes

Time and cost overruns in construction projects have become a ubiquitous feature of the industry (Love, Edwards & Smith, 2006). Significant factors that have been identified as contributing to time and cost overruns in construction projects are rework, variations, incorrect design and incomplete documentation, and late authority approvals as mentioned above. As a result of such issues arising in projects, conflict and disputes may occur, which can lead to the disruption of construction schedules, increased project costs, and even adversely influence relationships between project participants (Manvendra Sinha & Waya, 2009). If a dispute is not resolved promptly, then it may escalate, and ultimately require litigation proceedings, which can be extremely costly for the parties concerned (Cheung, Suen & Leung, 2004)

According to Ekhator (2016), conflict or disagreement is the character of construction development projects in either established construction market or energetic market. With impediment or hindrances of information and experiences, construction development parties, who are different in professional orientation, might feel aggravated when conflicts are inevitable in international construction administration. Thus, it is significant for construction development managers to prevent dysfunctional conflicts and encourage and support functional views (Ekhator, 2016).

Hence, Manvendra Sinha and Waya (2009) explained how the conflict, claims become disputes and the resolution method as in the following figure 2.8,

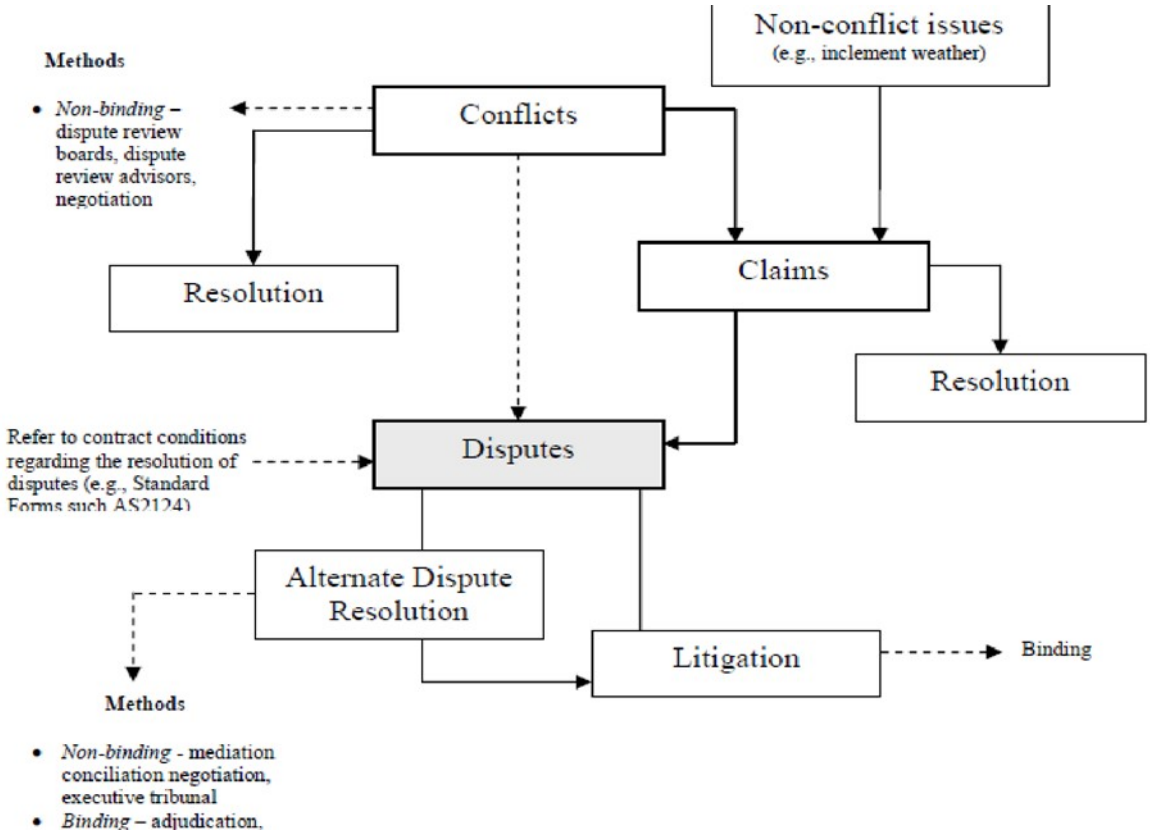

***Figure 2-8*: Conflict, claims and disputes**

Source: Manvendra Sinha & Waya, (cited in Kumaraswamy, 1997)

On the other hand, Bassioni et al. (2003) mentioned that, in general, avoidance of disputes needs real desire and complete coordination between parties. A policy of disputes avoidance should be adopted by all concerned with the project. This policy should apply like quality assurance from the day the owner takes the decision to build until the final account is agreed upon. The compiled suggestions of participants of their survey, to avoid causes of claims are as follows:

- Special consideration should be given to an appropriate contract type with a well-balanced contract.
- Special consideration for contract clauses dealing with variations / extras, disputes, inspections, approvals, payments, and delays.
- Owner must allow reasonable time for the design team to produce clear and complete drawings and specifications.

- Reasonable investigation is required from the owner in choosing consultants.
- Provision of a proper mechanism for processing and evaluating variations.
- Use of critical path scheduling, cost control, and productivity analysis to monitor progress and detect any changes in schedule, cost and productivity.
- Enforcing liquidated damage clauses and offering incentives for early completion.
- Developing human resources in the construction industry, through proper training. This calls for providing incentives such as offering a tax deduction on money spent on training. Also developing human resources applies to construction engineers who lack adequate managerial skills. There is an urgent need for offering training courses in scheduling, time and cost control, information systems, contracting, quantity survey and management of human resources.
- Contracts should mention the maximum or anticipated time for owner / consultant replies to contractor requests

Fundamentally, work processes, policies, and procedures as well behaviors need to change in concert if disputes are to be reduced in construction (Manvendra Sinha & Waya, 2009).

2.10 Conceptual model for Variations Disputes in Road Projects Sri Lanka

After comprehensive literature review about Variations Disputes related to the Road Projects in Sri Lanka a conceptual model can be developed as illustrated in Figure 2.9 and chapter four is based on this model.

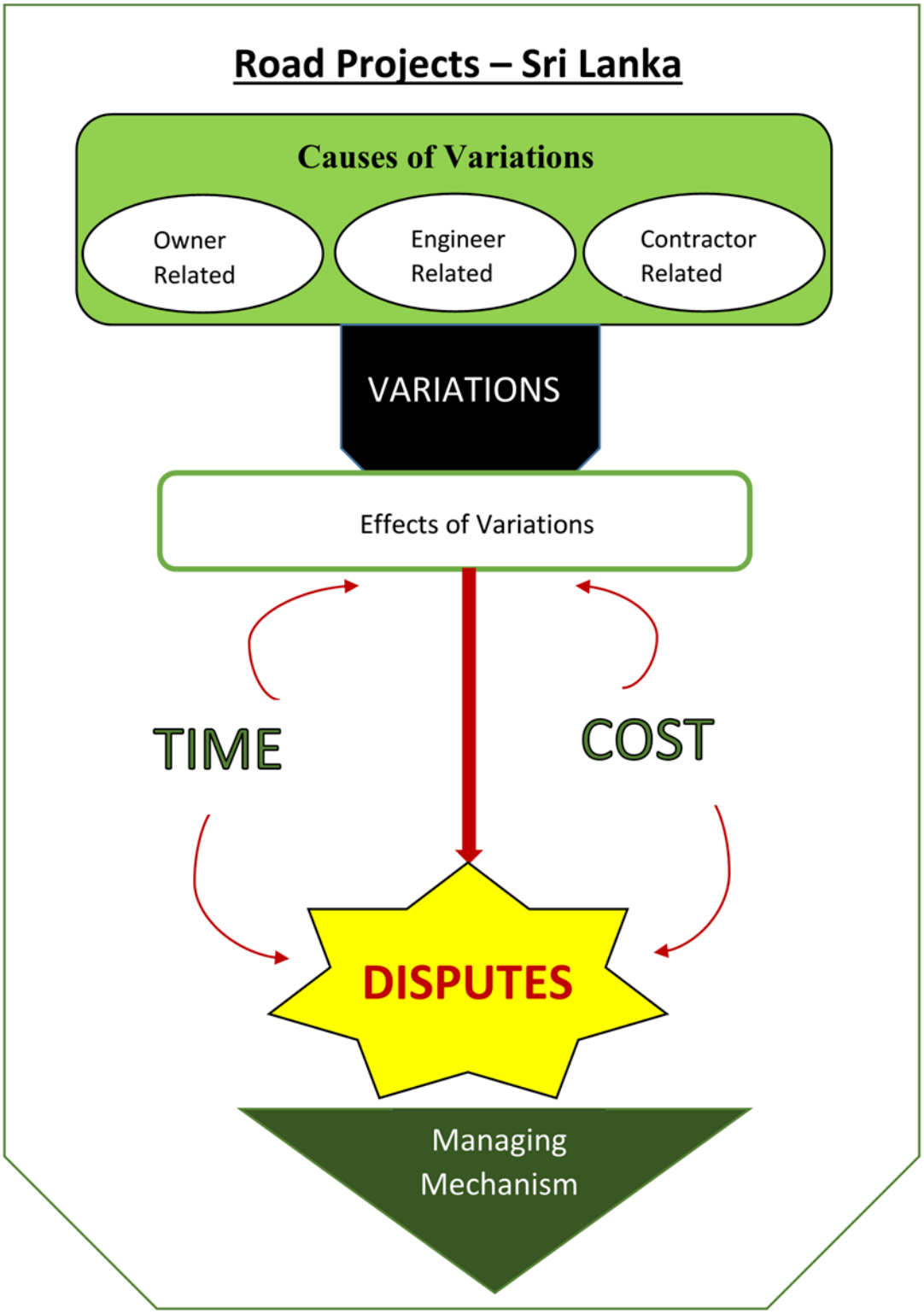

Figure 2-9: Conceptual model for Variations Disputes in Road Projects Sri Lanka

Figure 2.9 indicates that causes of variations are come up by main three categories to create variations. And also, effects of variations are basic conjunction to create crate the variation disputes which are mainly identified as time and cost overruns. Those are the basis for the chapter four of this research.

2.11 Summary of the Chapter

This chapter has demonstrated the concept of variations which was identified through the definitions, causes and effects of variations. Further, the researcher has identified the key factor as a variation to arising disputes in projects and address the disputes in road projects and how to manage them as the purpose of strengthening the research problem. The next chapter describes the research methodology of this study.

3. RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is the plan which shows how to reach a conclusion effectively when addressing a research problem. It deals with a logical, scientific inquiry .It is a strategy for testing a hypothesis and understanding the phenomenon in interpretive work. (Tan, 2002). Hence, this chapter illustrates the procedure adopted for the research, while establishing a theoretical background to the area of study in the previous chapter. Furthermore, this chapter presents research design, data collection method, and data analysis method.

3.2 Research process

The aim of this research is to develop a frame work to manage disputes arising from variations in road construction projects in Sri Lanka. Thus, the following process indicated in figure 3.1 will be adopted to achieve the research aim.

Figure 3.1, indicates the process of this research including the identification of problem, literature review, research design (case study), data collection methods, data analysis, conclusion and recommendation.

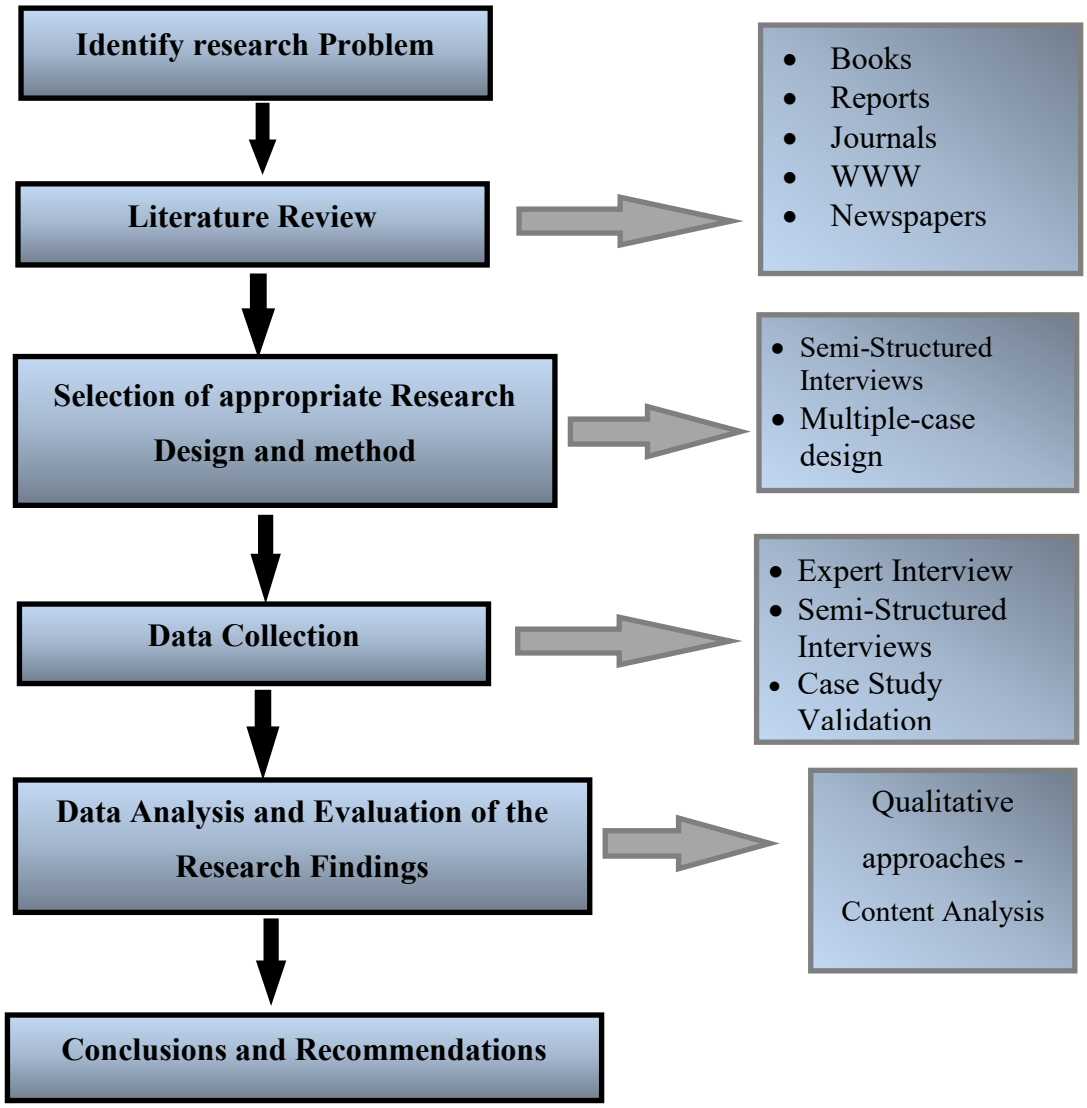

Figure 3-1 **: Methodological framework for research**

3.2.1 Identify Research Problem

The researcher carried out a background study on a broader perspective to familiarize with the subject area of Variations and Disputes referring books, journal articles reports and World Wide Web in order to address the research problem "How to manage the disputes arising from variations in road construction projects in Sri Lanka? Thus, a literature synthesis was undertaken to identify the Variation concept, causes and effects in depth with relevance to variations and disputes.

3.2.2 Literature Review

It is important to commence all research with a review of related literature or research, and to determine whether any data resource already exists that can be brought to bear on the problem at hand. Therefore, in this research, a comprehensive literature survey was carried out on Disputes arising from Variations in Road projects both in global and Sri Lankan context, through books, journals, reports and World Wide Web.

3.2.3 Research Approaches

A suitable research approach had to be selected to deal with the research problem. Easterby – Smith, Thorpe and Lowe, 2002 mentioned that the research approaches support to establish research activities, including the collection of data, in ways that are aimed to achieve research objectives.

According to most writers like Yin (2009), Rudestam and Newton (2007) and Flick (2006) research approaches can be mainly divided as qualitative and quantitative approaches. The same researchers further categorized different sub types of research approaches (refer Figure 3.2) under above main two approaches which can be adapted to undergo research aim.

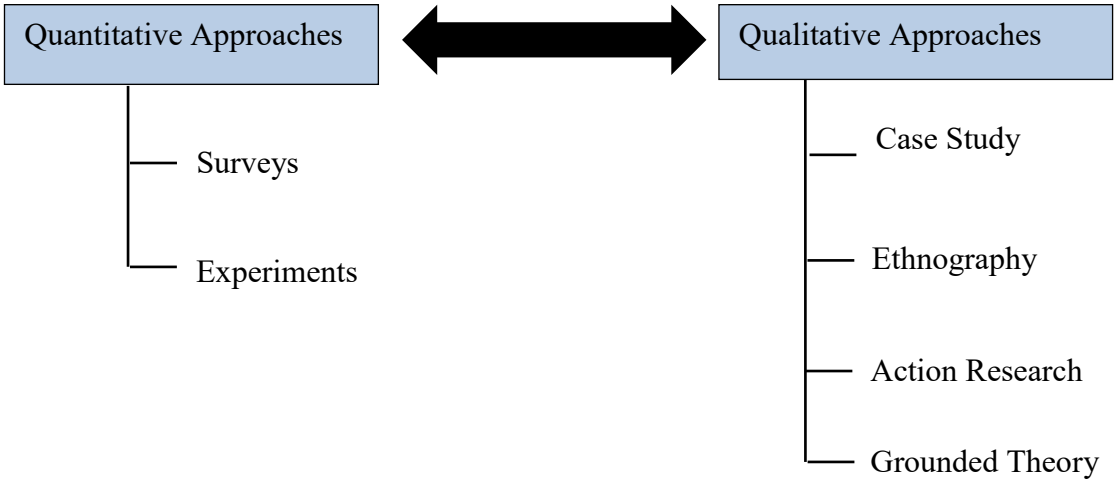

Figure 3-2 **: Types of Research Approaches**

After, identified the types of research approaches, the mutual differences in those two types are sorted out in below Table 3.1 according to Rudestam and Newton (2007) arguments.

Table 3-1 : Common Differences between Quantitative and Qualitative Research

Quantitative Approaches	Qualitative Approaches
Data expressed in numbers	Data expressed in words
Controlled research Situations	Naturally Occurring and contextual
Isolation of operationally defined variables	Holistic view of phenomena
Seeks objectively	Interested in subjectively
Statistical Analysis	Text Analysis

Source: Rudestam and Newton 2007

According to the above features of qualitative and quantitative approaches explained by Rudestam and Newton (2007) the research can be developed under qualitative approach as it is a textual analysis. In addition to that Patton and Appelbaum (2003) and Travers (2001) stated that case studies are more suited for the studies where qualitative data predominate.

Additionally, the aim of this research is to manage the disputes arising from variations in road construction projects in Sri Lanka. Therefore, the research problem could be developed as; "How to manage the disputes arising from variations in road construction projects in Sri Lanka?" Yin (2009) recommended that the case study research approach is suitable for the researches which have research problems based on "how" and "why" types. Although Yin (2009) explained that experimental and historical approaches also matching for 'how' and 'why' type questions the researcher focus this research through case studies. Hence, experiments are done when the researcher can manipulate behavior directly (Yin, 2009). According to Yin (2009),

case studies and histories do not require control over behavioral events. Thus, the behavior of construction projects is too complex and hard to control and experiments can also be rejected. Yin (2009) mentioned that, histories do not focus on contemporary events. The distinctive contribution of the historical method is in dealing with the dead past (Yin, 2009).

Moreover, Malewana (2009) specified that the case study research approach can be very useful when very little is known about a particular phenomenon. In this research, though the knowledge about the research area is wide due to the most of researches conducted with regard to Variations and Disputes in construction project, local consideration has not been spoken separately for road projects.

3.2.3.1 Case Study Design

The purpose of the case study is to gain an in depth understanding about the meaning of the subject being studied, focusing on the process rather than the outcome. Yin (2003) further stated that, generalize the stability of the study can be increased through the design of the case study and thus, special care should be taken in the case study design. According to Udawaththa (2010) in the case study design there are two main aspects to be considered: identification of the unit of analysis and the criteria for selection of cases. The case study designing procedure which is emphasized next, includes the identification of the unit of analysis, defining the number of cases and criteria for selection of cases

Identification of unit of analysis

Identification of 'unit of analysis' or the 'case' is of primary standing to any research design which is connected with the mode of research problem created (Yin, 2009). The aim of this research is to manage the disputes arising from variations in road construction projects in Sri Lanka in order to suggest probable attributes towards improving such practice addressing on research problem as "how to manage the disputes arising from variations in road construction projects in Sri Lanka?" Thus, the unit of analysis or case in this research is the Disputes as illustrated in Figure 3.3 shown below.

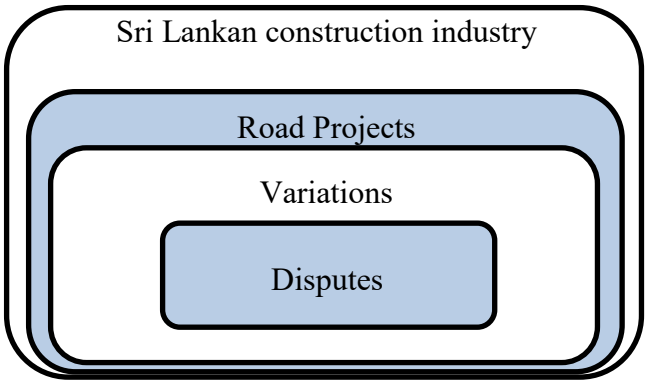

***Figure 3-3* : Unit of analysis**

After identifying the unit of analysis for this research as Disputes the next section discusses about the identification of the number of case studies.

Defining the number of cases

After identifying the unit of analysis of the case, it is important to define the number of cases. The number of cases in a case study could vary from one to eight according to the nature of the research (Yin, 2009). If there is one case it is a single case study and if there are more than one cases it is a multiple case study. According to Perry (1998), when the study area is too broad in a qualitative research, it is advisable to use only one or two or at the most four cases. Fong (2005) mentioned that multiple case studies facilitate the researcher to explore the differences within and between cases. Accordingly, a multiple case study with three cases was selected for the research while also giving consideration to the time constraints prevailing on the study also. The criteria used for selecting the cases are discussed in the following section.

Criteria for selection of cases

Yin (2009) argued that the criteria for selecting cases is a matter of discretion and judgment, convenience, access and to be those which are subjective for the purpose of the research. Before moving into the empirical study, details of three construction projects were gathered through a pilot study. In addition to the that researcher selected the projects which have passed at least a period of six months from the date of

completion. Although, Hapuarachchi (2007) suggested that, around a six months period of construction period plus the design period is the sufficient time for a construction project teams to be developed as a matured team researcher identified that some of variations disputes shall not be finalized after the completion of project through the pilot study. Hence, this time period was considered by the researcher as sufficient enough to study the practice and internal issues.

After giving the explanation regarding the case study designing stage, the data collection stage is illustrated in the next section.

3.2.4 Data collection

Under case study design there are many sources of data collection identified by many authors as in Table 3.2 below,

Table 3-2: Methods of data collection under case study

Author	Data collection method
Yin (2009)	Documents, Archival records, Interviews, Direct observation, Participant observation and Physical artifacts.
Neergaard and Uihoi (2007)	Ethnographic field work, Interviews, Discourse analysis
Gillham (2005)	Observation, Interviews
Weinberg (2002)	Observational field work, Interviews, Discourse analysis, Artifacts.
Travers (2001)	Observation, Interviewing, Ethnographic field work, Discourse analysis and Textual Analysis

According to Table 3.2 most authors have explained about interviews and observation as data collection tools for case study researches. Among these, the interviews were used as the main data collection tool as, it is the most reachable and affordable method when considering the circumstances under which the research had to be carried out. The facts required to be collected from projects in this research are mostly qualitative

and lengthy; hence it would have been difficult to collect it using standard questionnaires. In addition to that the pilot study also verified that there might be some problems which occur when using other methods such as company documents and archival records in getting permission.

Yin (2003, p.92) stated that, interviews are an essential sources of case study evidence because most case studies are about human affairs and these human affairs should be reported and interpreted through the eyes of specific interviewees. According to Sekaran (2003) when interviews are conducted in a semi-structured manner, it supports to adopt the questions required, clarify doubts and ensure that the response is properly understood by repeating and rephrasing the questions. The author further stressed that, if the interviews are carried out in a face-to-face manner, the researcher can pick up the nonverbal indications from the respondent and it is advantageous to understand the response effectively and evaluate whether the respondent's mental condition is suitable to answer the question clearly.

Therefore, the interviews will be carried out face-to-face in semi structured manner. The structure of the interview and the interview process are explained in the next section.

3.2.4.1 Semi-structured Interviews

The interview structure was developed by using the interview guideline and this guideline will be formed to capture data around the research problem. Hence, these guidelines should be established with reference to the literature review and objectives of the study based on Concept of Construction Variations, Contractual Provisions, causes of variations, causes of disputes and industry views.

Interview Process

On behalf of this research semi-structured interviews have been conducted with industry experts who are involved in the selected cases. Interviewees will be selected from the top or middle management who are involved as a contractor partner of selected projects. And the interviews will be conducted with a Employer's/Engineer's

partner of each case as he is a key participant of the project. Altogether, 9 interviews were conducted (three from one case) according below Table 3.3 below and each usually took about for 30 to 45 minutes.

Table 3-3 : Interview description of the cases

Cases	Type of project	Interviewees
Project A	Rehabilitation/Improvement to Road	Contractor: Project Manager (PMA), Planning Manager (PEA) Consultant: Quantity Surveyor (QSA)
Project B	Rehabilitation/Improvement to Road	Contractor: Project Manager (PMB), Contract Manager (CMB) Consultant: Quantity Surveyor (QSB)
Project C	Rehabilitation/Improvement to Road	Contractor: General Manager (GMC), Quantity Surveyor (QSC) Consultant: Residential Engineer (REC)

The interviews will be tape-recorded (with permission of the interviewee) to avoid losing data since everything cannot be written down during the interview. Finally, interview transcripts were will be developed to adapt data of interviews. However, the actual names of the projects and the interviewees were not revealed in this report or any other document relating to this study to maintain confidentiality.

The next section describes the data analyzing process of collected data.

3.2.5 Data analysis

After developing interview transcripts, key themes (codes) emerging from the findings were identified within experts' interviews and in each case.

Although Yin (2009) has come up with several techniques to analyze qualitative data namely pattern matching, explanation building, time series analysis, logic models and cross case analysis the technique which was used to approach to this research was cross case analysis. Hence, Perry (1998) emphasized that these findings should be justified by using 'cross-case analysis' which is the process of identifying interrelationships and

the differences between each case and afterwards, the conclusions should be made. Then, to be adhered to a cross case analysis approach, content analysis technique were followed by the researcher and finally to illustrate the relationships between findings mapping technique will be used as Travers (2001) mentioned and those are discussed in the next sections.

3.2.5.1 Content Analysis

Code-based content analysis enables to find similar cognitions under a particular concept and considers its significance rather than the actual content of the segment (Senarathne, 2005). Therefore, code-based content analysis will be used in this study to capture important findings from the transcripts and for effective interpretation of that. The QSR NVivo 2011 (copyright @ 2011 qualitative solutions and research private limited); computer software was used in this study coding functions to simplify the works relating to content analysis

By using the findings from the literature review as the basis, major themes and sub themes will be formulated first and, the coding structure were developed accordingly. Then, all interview transcripts were will be coded based on the assistance of above mentioned software.

3.2.5.2 Cognitive Mapping

Data displaying capabilities of content analysis is always a problematic issue, even though it enables better interpretation of qualitative data (Malewana, 2009). Therefore, to overcome these failings, it is clear that a content analysis alone is not enough and effective. Hence, the need of proper data displaying techniques is highlighted. According to Miles and Huberman, (1994 as cited in Gunawardane 2011), formats for displaying qualitative data fall into two major families namely: matrices with defined rows and columns and networks with a series of ‘nodes’ with links between them. Cognitive mapping which is a network technique was selected for data displaying process within this study. Hence this method was used to display data due to its suitability in showing the relationships of views and concepts that identified from interview transcripts.

3.2.5.3 Conclusion Drawing

Conclusion drawing is the ultimate stage of data analysis. Patton and Appelbaum (2003) state that, "the ultimate goal of the case study is to uncover patterns, determine meanings, construct conclusions and build theory." Hence, constructing conclusions is one of the ultimate goals in the study the findings from the empirical study; their interrelationship with existing literature; and, the propositions from this study to both the theory and to the practice will be highlighted under conclusions. Further, limitations of the research and new research directions that were performed from this study will be illustrated in the conclusions.

The next section is dedicated for validity and reliability of qualitative research, which leads to enhance the quality of a research.

3.2.5.4 Validity and Reliability in Research Study

Any method of study is inadequate without considering the basic issues relating to review of the validity of any research outcomes (Malewana, 2009). Yin (2003) explained that, to confirm the validity of a research study and to pass certain design tests with regards to diverse levels of research validity, as explained below.

Construct Validity- Establishing correct operational measures for the concepts being studied.

Internal Validity- Establishing casual relationships, whereby certain conditions are shown to lead the other conditions, as distinguishes from spurious relationships

External Validity- Establishing a domain to which study's findings can be generalized.

Reliability- Demonstrating that the operations of a study such as data collection procedures can be repeated with the same results

The measures which were taken to ensure the validity and reliability of this research under each of above facts of validity are specified in the Table 3.4.

Table 3-4 : Measures taken to ensure validity and reliability

Test	Measures Taken in this Research
Construct Validity	• Semi-structured interviews with three industry experts on the unit of analysis • Conducting semi-structured face-to-face interviews while adapting the questions necessary, clarify doubts, picking up the nonverbal indications from the respondent for greater understanding.
Internal Validity	• Developing the research problem in a reasonable manner based on a comprehensive literature review • Pattern matching during cross case analysis
External Validity	• Selecting three cases to investigate the problem • Adapting reasonable criteria for selecting cases
Reliability	• Tape recording and note-taking during the interview and developing interview transcripts to avoid losing data. • From every case, all the partners of Contractor and employer's representative were interviewed.

3.3 Summary of the Chapter

Successfulness of a research study depends on the selection of proper methodology; hence this chapter has presented the research design and data analysis procedures. This research contains multiple case study research to study about practices and issues of variation disputes in road projects within Sri Lankan context and the unit of analysis of the study is 'Disputes'. Three number of variation disputes were selected for the study, based on access and time limitations. Semi-structured interviews were carried out with stake holders who involve in variation disputes as the primary data collection tool. Finally, the data was analyzed by appropriate methods (content analysis and mapping technique) regarding qualitative approaches. The next chapter describes research findings of this study.

4. ANALYSIS AND FINDINGS

4.1 Introduction

Research methodology used for this research study was discussed in chapter three. Then the aim of this chapter is to illuminate the research findings of the empirical investigation.

The data collection was carried out by expert interviews in selected cases and physical observations within them. The purpose of conducting expert interviews with in the cases was to assess the applicability of the literature review findings to Sri Lankan context while determining the best path to proceed to achieve the research aim. Then to validate the findings, in depth case studies were carried out selecting three cases with each having three disputes on variation. The expected final outcome of this chapter is to suggest recommendations to manage the disputes arising from variations in Sri Lankan road construction projects. Hence, the existing practice through interviews and similarities were identified and differences among three selected cases over cross-case analysis are presented in this chapter.

4.2 Analysis of Cases

While the above section gives an introduction to the research analysis and findings chapter, this section confers a brief introduction to selected cases and the procedures adopted in case analysis and cross-case analysis.

The case analysis is based on literature findings and developed conceptual model of identifying existing practice of variations in road projects Sri Lanka (RP SL) was developed and related disputes with managing mechanisms (refer Figure 2.9 in Chapter 2) and each case was analyzed under three broad headings as shown in Figure 4.1.

4.2.1 Cross case Analysis

Cross case analysis had been done through summarizing the case analysis and present the results under cross case findings in section 4.3 based on below coding structure in Figure 4.1.

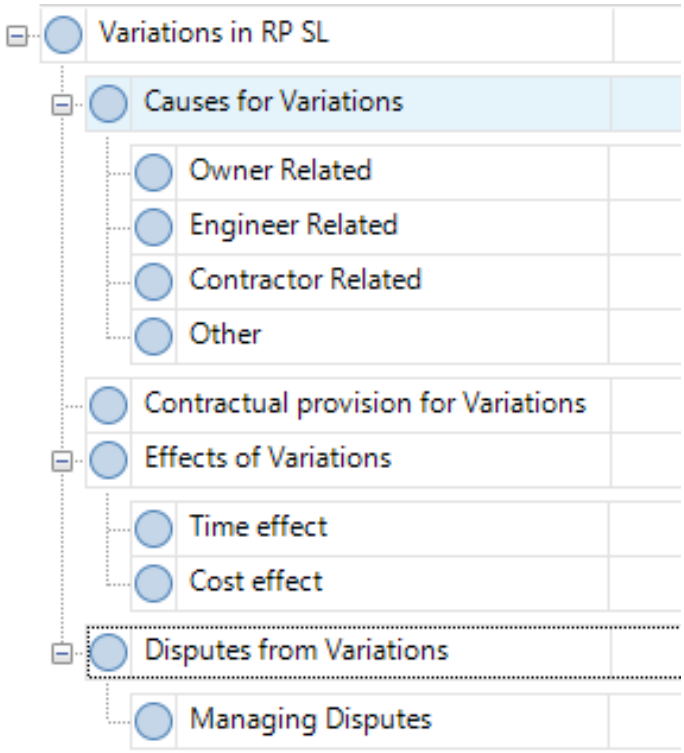

***Figure 4-1*: Coding structure used in analyzing empirical data**

4.2.2 Case Studies Description

The empirical study was focused on three road projects and each had three to four numbers of variation disputes.

The selected projects which were aimed to rehabilitated of a Road with town improvements under urban road improvement projects. Those were government Projects which were funded by a local authority. The contractor was a leading CIDA grade CSII Contractor and the Engineer was a pioneer consulting private entity in Sri Lanka.

A brief description about selected three projects are given in below Table 4.1.

Table 4-1 : Brief description about the selected projects

Project	Scope	Initial Contract sum (Rs/Mn.)	Final Contract sum (Rs/Mn.)	Original Contract period (days)	Project Duration (days)
A	Four lane asphalt road with median, foot path in urban area 2.7km length	813	912	300	431
B	Four lane asphalt road with median, foot path in urban area 3.8km length	1131	1301	365	456
C	Four lane asphalt road with median, foot path in urban area 3.8km length	1361	1560	365	497

Three interviews relevant to each case/project as described in Table 4-2 were conducted. Since, the consultancy for the all three projects are done by one entity with one professional team, it was difficult to find more than one expert for each case. However, as separate teams were occupied with each project by the Contractor two experts could be interviewed for the Contractor part.

Table 4-2: Brief description to the selected experts for the interviews

Cases	Interviewees	Discipline/ Contract Part	Designation	Profession	Experience in RP (years)
A	PMA	Contractor	Project Manager	Civil Engineering	21
	PEA	Contractor	Planning Engineer	Civil Engineering	15
	QSA	Engineer	Sr. Quantity Surveyor	Quantity Surveying	20
B	PMB	Contractor	Project Manager	Civil Engineering	18
	CMB	Contractor	Contract Manager	Civil Engineering	15
	QSB	Engineer	Quantity Surveyor	Quantity Surveying	6
C	GMC	Contractor	General Manager	Civil Engineering	25
	QSC	Contractor	Sr. Exe. Quantity Surveyor	Quantity Surveying	20
	REC	Engineer	Residential Engineer	Civil Engineering	17

4.3 Cross case Analysis

The cross-case findings are developed based on the above coding system (refer Figure 4-1) according to the gathered data from three projects.

4.3.1 Variations in road construction projects Sri Lanka

Variation orders often occur in construction project, whether during the early, middle or late stage of project. It is explained that the construction industry due to its compartmentalization has made variation almost an inevitable element and has become so prevalent that it is hardly possible to complete a project without changes to the plans or the construction process itself. It is proven by the number of variations occur in selected projects as Project A – 148 VO, Project B – 71 VO and Project C – 84 VO were implemented during the construction.

4.3.1.1 Causes of variations in road projects Sri Lanka

As found through the literature, causes of variations can be categorized in a regular uniform e manner in the practical scenario in Sri Lankan road projects. It can be emphasised by following Table 4-3 which summarizes the findings related to the cases.

Table 4-3: Types in Sources of variations in Road Projects SL

Types in Sources of variations	Number of Occurrence		
	Project A	Project B	Project C
Owner /Client related changes	37	14	22
Consultant /Engineer related changes	58	36	24
Contractor related changes	37	7	18
Unforeseeable Events/ Other changes	16	14	20
	148	71	84

Those findings can be graphically illustrated as follow Figure 4-2.

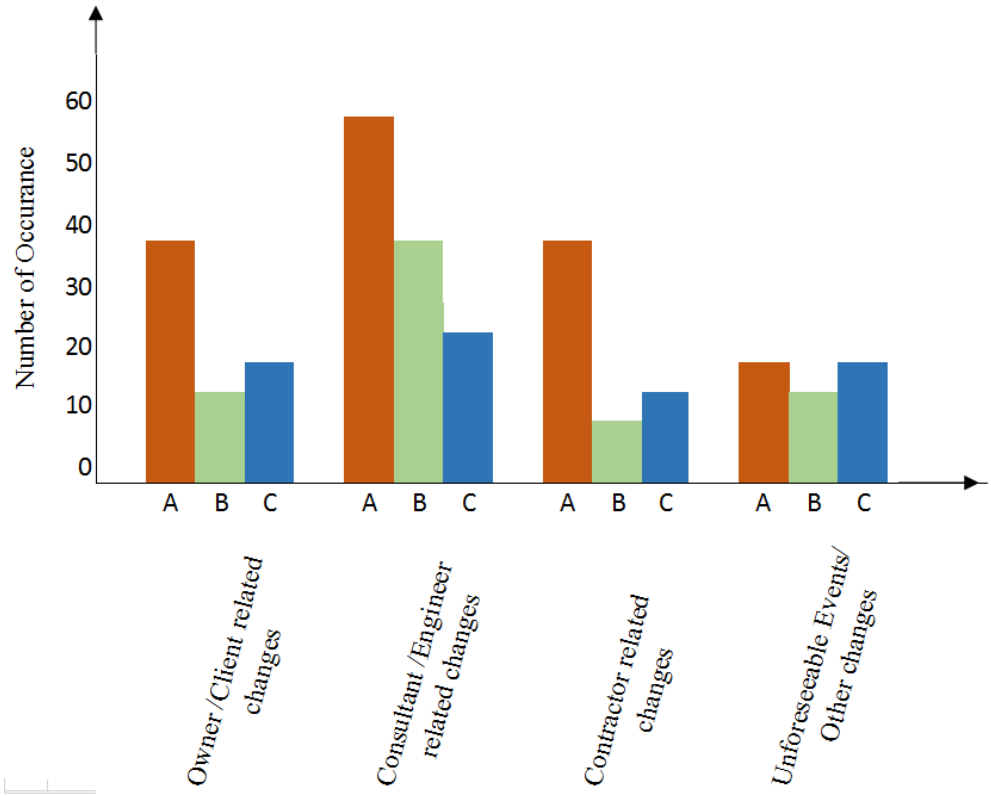

***Figure 4-2*: Graphical illustration of Types in Sources of variations in RP SL**

According to the above Table 4-3 above and the Figure 4-2 Engineer related changes are often occurring other than with the Client and the Contractor. Other changes due to the unforeseeable events also compatibly occur which are over control by the parties to the Contract.

Furthermore, those categorizations can be compared with the percentage value of the occurrence as shown in Figure 4-3. That shown the average percentage with the findings from three cases as described above Table 4-3 and the Figure 4-2 shown above.

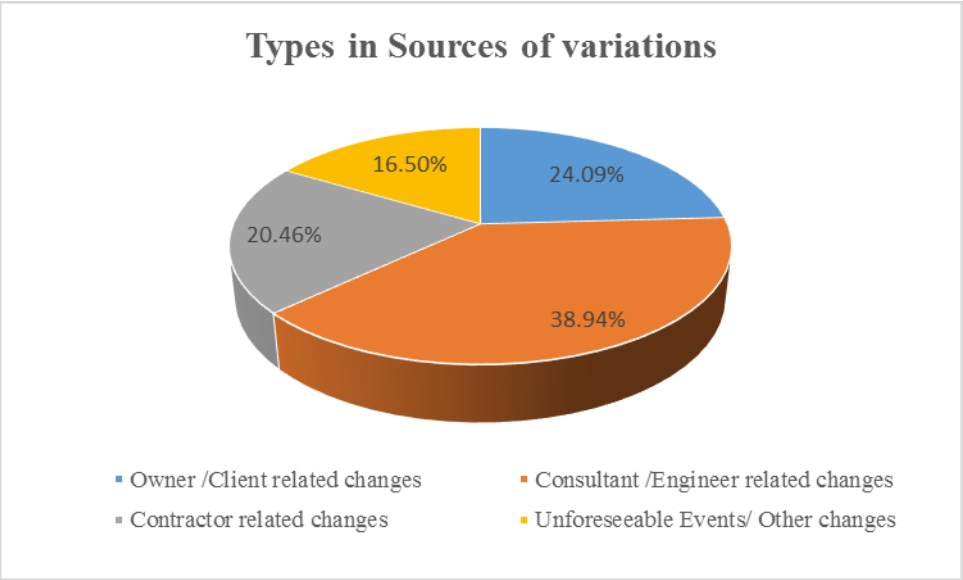

***Figure 4-3*: Comparison of the types in sources of variations in Road Projects Sri Lanka**

The illustration above shows that the most often occurrence for variations is Engineer related changes. Client related changes, Contractor related changes and other changes also occur in a similar measure of occurrence.

Furthermore, considering the causes of variations in relevant to the selected three projects can be identified as similar causes and project particular causes to the variations as summarized in following Table 4-4.

Table 4-4: Causes of variations in Road Projects Sri Lanka

Causes of variations	Case Reference		
	Project A	Project B	Project C
Owner /Client related changes			
Increasing the Requirement	√		
Poor/unclear brief by Client	√		√
Change in mind-forced	√		
Change in mind-choice	√	√	
Financial problems	√	√	√
Replacement of materials or procedures	√		√
Change of schedule by owner	√		√
Obstinate nature of owner			
Impediment in prompt decision making process	√		√

Consultant /Engineer related changes			
Design change by consultant	√	√	√
Errors and omissions in design			
Conflicts between contract documents	√	√	√
Design complexity			
Inadequate working drawing details	√	√	√
Consultant's lack of judgment and experience	√		√
Lack of consultant's knowledge of available materials and equipment	√		
Consultant's lack of required data	√		
Inadequate site investigation	√	√	√
Obstinate nature of consultant	√	√	√
Incorrect assessment of brief	√	√	√
Defects in BOQ and specifications	√	√	√
Contractor related changes			
Lack of strategic planning	√		√
Contractor's lack of required data	√		
Poor procurement process	√	√	
Shortage of skilled manpower	√		√
Contractor's desired profitability	√	√	√
Long lead procurement			
Lack of communication			√
Lack of a specialized construction manager	√		
Unforeseeable Events/ Other changes			
Weather conditions	√	√	√
Restrictions due to existing utility lines		√	√
Floods and landslides			
Shortage of Materials	√	√	√

In depth analyzing the cases, about the causes of variations as shown in above Table 4-4 above, some of the causes identified in literature are not seen in the selected cases namely, obstinate nature of the owner; lack of modern equipment; change in government regulations; change in economic conditions; socio-cultural factors; safety considerations and floods and landslides.

On the other hand, common identifications for the selected three cases are, Financial problems of the owner; Design change by consultant; Conflicts between contract documents; Inadequate working drawing details Inadequate site investigation;

Obstinate nature of consultant; Incorrect assessment of brief; Defects in BOQ and specifications; Contractor's desired profitability; Weather conditions and Shortage of Materials. It can be further proven by the following Table 4-5 which summarised the expert's opinions and who is practically participated in the selected projects.

Table 4-5: Sources of variations – Expert's view (case studies)

Sources of variations	Number of Experts out of three of each project					
	Project A		Project B		Project C	
	No	%	No	%	No	%
Owner /Client related changes						
Increasing the Requirement	3	100%				
Poor/unclear brief by Client	2	67%			2	67%
Change in mind-forced	2	67%				
Change in mind-choice	2	67%	3	100%		
Financial problems	3	100%	3	100%	3	100%
Replacement of materials or procedures	3	100%			3	100%
Change of schedule by owner	3	100%			3	100%
Obstinate nature of owner						
Impediment in prompt decision making process	2	67%			3	100%
Consultant /Engineer related changes						
Design change by consultant	3	100%	3	100%	3	100%
Errors and omissions in design						
Conflicts between contract documents	3	100%	3	100%	3	100%
Design complexity						
Inadequate working drawing details	2	67%	3	100%	2	67%
Consultant's lack of judgment and experience	2	67%			2	67%
Lack of consultant's knowledge of available materials and equipment	2	67%				
Consultant's lack of required data	2	67%				
Inadequate site investigation	2	67%	2	67%	1	33%
Obstinate nature of consultant	1	33%	2	67%		
Incorrect assessment of brief	3	100%	3	100%	3	100%
Defects in BOQ and specifications	3	100%	3	100%	3	100%

Sources of variations	Number of Experts out of three of each project					
	Project A		Project B		Project C	
	No	%	No	%	No	%
Contractor related changes						
Lack of strategic planning	3	100%			1	33%
Contractor's lack of required data	2	67%				
Lack of modern equipment						
Poor procurement process	2	67%	3	100%		
Shortage of skilled manpower	3	100%			3	100%
Contractor's desired profitability	3	100%	2	67%	3	100%
Long lead procurement						
Lack of communication					3	100%
Lack of a specialized construction manager	2	67%				
Unforeseeable Events/ Other changes						
Weather conditions	3	100%	3	100%	3	100%
Change in government regulations						
Change in economic conditions						
Socio-cultural factors						
Safety considerations						
Restrictions due to existing utility lines			3	100%	3	100%
Floods and landslides						
Shortage of Materials	3	100%	3	100%	3	100%

Accordingly, Engineer related variations are mostly seen in the RP SL among the others. Though the common idea is that the Contact Condition is to protect the Employer and the Representative in these three cases have not highlighted the Contractor related variations. Hence, the next section will analyse with the cross-case findings related to the Contractual provisions for variations in RP SL Sri Lanka.

4.3.1.2 Contractual Provision related to the Variations in Road Projects in Sri Lanka.

Any contracts current construction industry must make provisions for possible variations given the nature of construction project. Sometimes a negative aspect of the variation clause is that it tends to encourage clients to change their minds and embark on projects without having given properly thought to their project requirements

However, a clause permitting a variation of works is an essential feature of any construction contract because, without a variation clause in the contractor is not bound to execute additional work or to make omissions or changes. Hence, it is important to discuss the philosophies of industry experts about having such a valuable clause and its applicability to the Road Construction Contracts in Sri Lanka. Their opinions are discussed in the following coding structure in Figure 4-4.

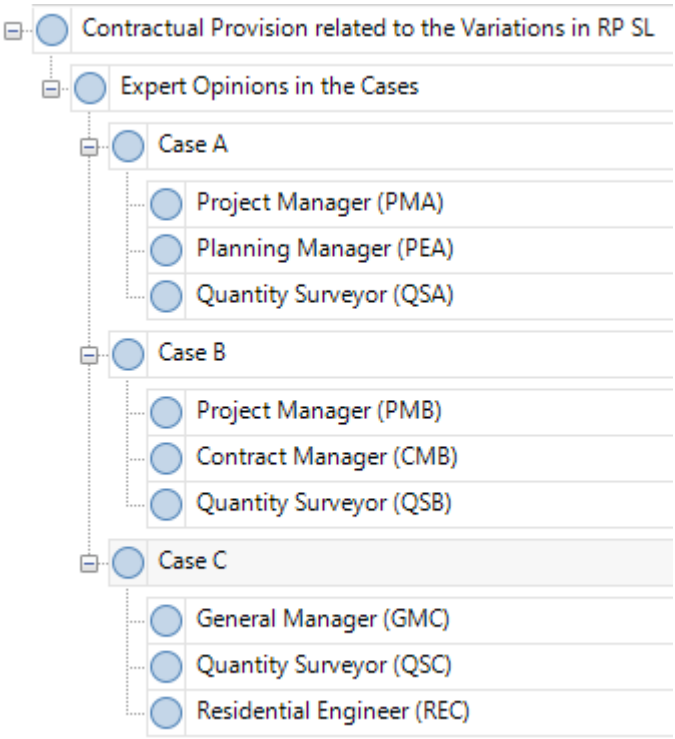

***Figure 4-4*: Expert Opinion on Contractual provision for Variations in Road Projects Sri Lanka**

According to the Expert ideas on the variation Clause most of them concluded that it's a very significant clause, since it allows to adopt the most suitable way to do the construction as well as to change the requirement according to the situations. Considering the existing practice in RP SL, QSC mentioned that the FIDIC conditions are used generally in most of the road projects and the provision is very clear and fair for both parties with his experience in the field. However, CMB emphasized that, there should be a clearly defined (but simple) variation provision in the contract method of evaluation of the variations. In addition to that the scope should be defined clearly in the drawings and specifications. Similarly, PEA stated that, variation clause is required

to work properly with variations, otherwise dispute arises. By adding furthermore PMA stressed that Contractual Provisions can be satisfied to mitigate the disputes.

As a summary of their concepts it is highly required to have variation clause which is very clear and simple with describing how to evaluate the variations in order to minimize disputes.

On the other hand, considering the Standard forms of contract such as FIDIC &SBD most of the interviewees are satisfied with existing standard forms of contract while others are stated it is required to be changed in order to minimize the variation disputes. Hence, PMB mentioned that the Contract can be used as the guidelines to administrate the projects. However, they must be adjusted or amended based on the nature of each project as required. Same impression is given by the REC as the provision should be change to suite the nature of the project and project requirements.

Accordingly, the selected projects are changed their Clause from the Particular Conditions of the Contract and sometimes those changes become finally reasons for the disputes.

After proving the necessity of the Contractual clause for the RP SL by the participants the next section deals with the effects from those variations related to the RP SL.

4.3.1.3 Effects of Variations

There are a number of effects of variations found from the literature. The applicability of them to RP SL can be analyzed through the findings of the cases.

Table 4-6: Effects of Variations Road Projects Sri Lanka.

Effects of Variations	Project A	Project B	Project C
Progress is affected but without any delay	√	√	√
Increases in project cost	√	√	√
Increases in overhead expense	√	√	√
Procurement delay	√		
Logistics delays	√		
Delays in payment	√		
Additional payments for contractor	√	√	√

Effects of Variations	Project A	Project B	Project C
Completion schedule delay	√	√	√
Quality degradation			
Rework and demolition		√	√
Productivity degradation			
Damage to firm's reputation			
Hiring new professionals	√		
Poor professional relations	√	√	
Disputes among professionals			
Poor safety conditions			

Considering all the variations that occurred in selected projects, the main effects can be identified namely, Progress is affected but without any delay; Increases in project cost; Increases in overhead expense; Additional payments for contractor and Completion schedule delay is summarised in the Table 4-6 shown above. Though the mentioned effects are common for all three projects some effects identified through the literature are practically not identified in RP SL (Quality degradation; Productivity degradation; Damage to firm's reputation; Poor safety conditions). It can be further clarified by the expert's view on time, cost and quality effect which are the key achievements in any construction project as shown in Table 4-7.

Table 4-7: Effects of Variations Road Projects Sri Lanka Expert's view

Effects of variations	Expert Reference								
	Project A			Project B			Project C		
	PMA	PEA	QSA	PMB	CMB	QSB	GMC	QSC	REC
Time Effect	√	√	√	√	√	√	√	√	√
Cost Effect	√	√	√	√	√	√	√	√	√
Quality Effect		√							

According to the above Table 4-7 shown above all nine interviewees are agreed about the time and cost effects from the variations while one person out of nine had experienced the quality effect due to the variations. That's why the interviewee GMC emphasized that, Quality and Productivity have not been experienced in his over 25 years RP SL, though Cost and Time effects were often experienced. Hence, it can be further understood by adding value for effects within the practical scenario (A number

of situations) of each project as illustrated in below Figure 4-5 to Figure 4-7 shown below.

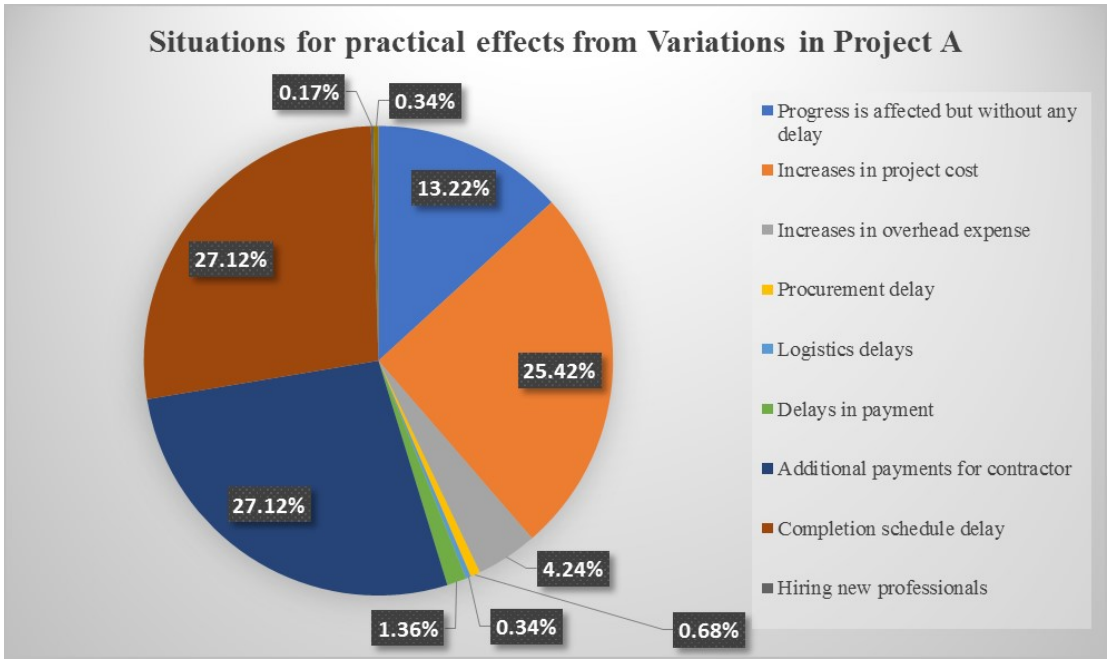

***Figure 4-5*: Situations for practical effects from Variations in Project A**

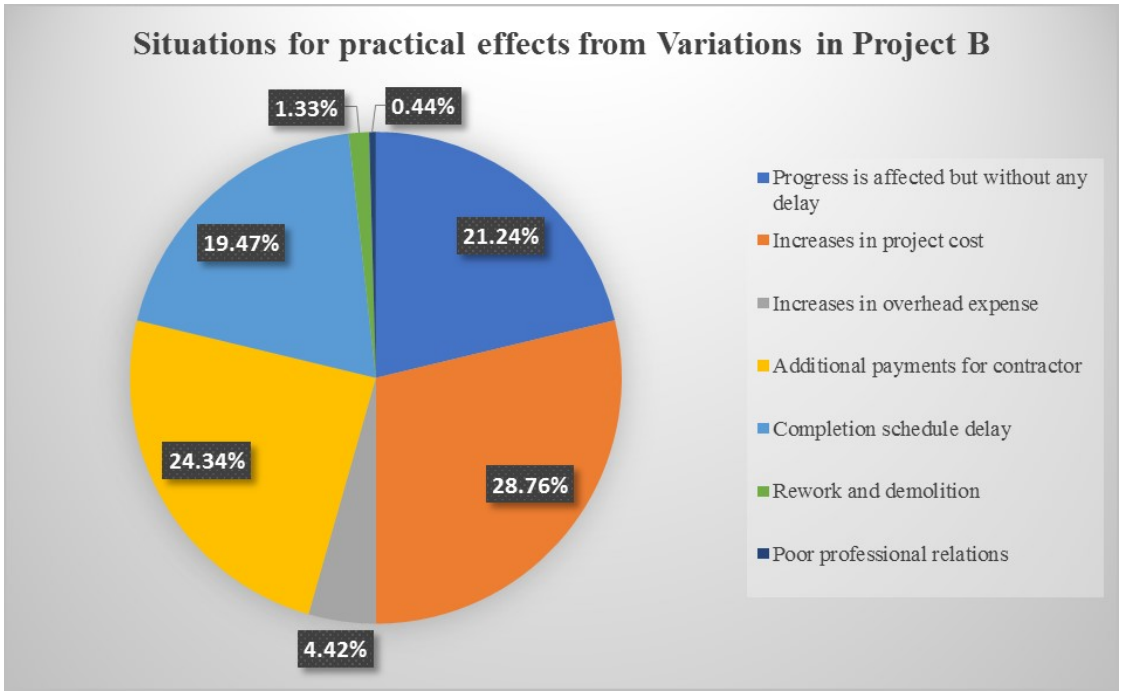

***Figure 4-5*: Situations for practical effects from Variations in Project B**

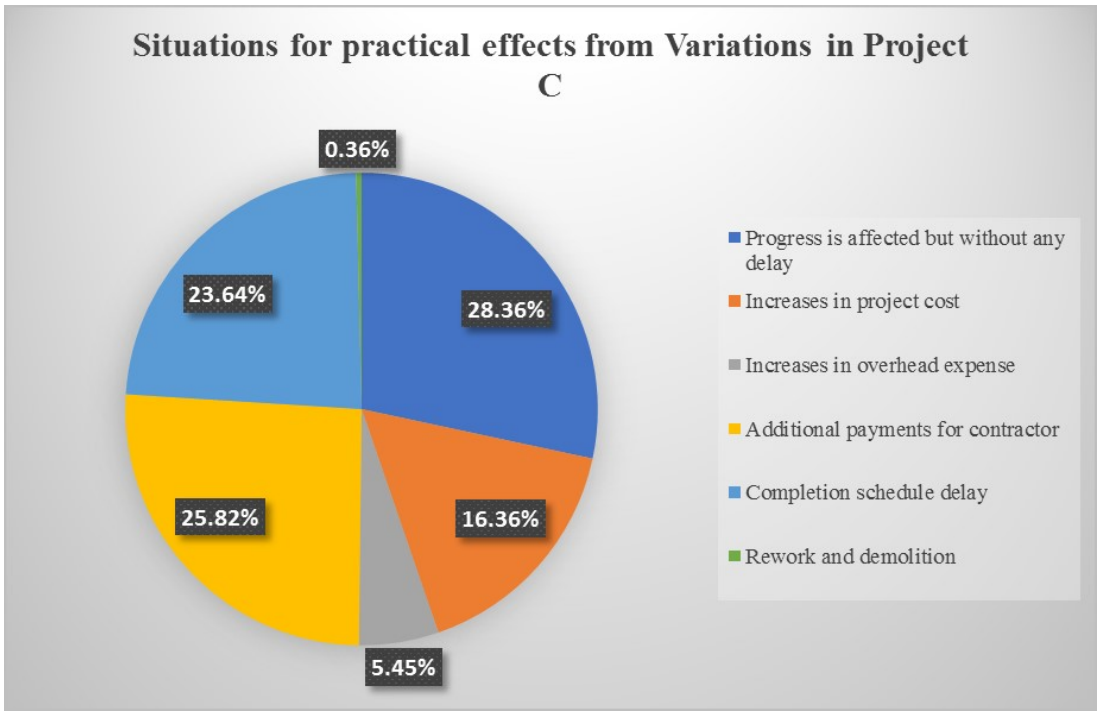

***Figure 4-6*: Situations for practical effects from Variations in Project C**

Considering the findings from all three projects as illustrated above the major effects from the variations in RP SL are identified as progress effect without delay; additional payment to the Contractor; increase of project cost and the completion schedule delay as summarized in Figure 4-7.

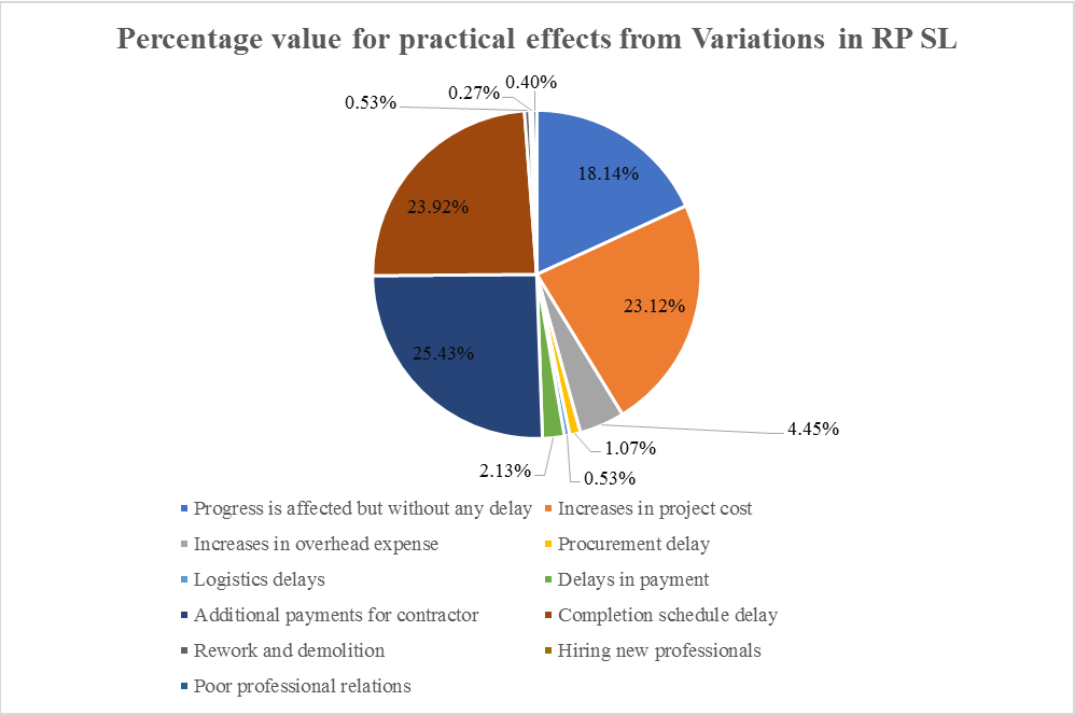

***Figure 4-7*: Percentage value for practical effects from Variations in Road Projects Sri Lanka**

Furthermore, Figure 4-7 proves the opinion of experts related to the selected projects. Since, the interviewee QSA mentioned that "*Contractor made an additional amount as a new project through those variations*" while CMB explained that the extra effort must provide to accelerate the work progress and minimize additional delays.

Accordingly the researcher identified the major effects as Cost and Time which is directly generate the disputes from the variations in RP SL.

4.3.2 Disputes arising from Variations in Road Projects Sri Lanka

The researcher identified that, it is almost becoming a rare situation for a project not to have variations, thus becoming a usual occurrence in RP SL with the response of interviewees and in depth analyzing the cases. Therefore, in some situations many well planned variations later raised to claims and disputes.

Accordingly, the selected projects also finally end up with the disputes due to some variations as summarized in the Table 4-8 given below.

Table 4-8: Brief introduction to cases

CASE NO	CASE DESCRIPTION	CONTRACTOR'S POSITION	EMPLOYER'S POSITION	AMOUNT (RS./mn)
A1	**Project A** Non-Payment for Connection of New Storm Water Line and existing MH	Engineer should issue a VO for Connection of New Storm Water Line and existing MH, which is no rate given in the BOQ	Connection of New Storm Water Line and existing MH is including at the pipe laying rate	3.00
A2	Withholding of Payment for Excavation and Backfilling of X duct line	Excavation and backfill should be certified by the Engineer for the re - excavation done for lay the X ducts where the other ducts already laid	Contractor entitle only for the excavation & backfill for laying one duct line	3.00
A3	Disagreement of rates for Traffic light signals at 'A' Junction	Engineer should certify the Variation which the rates based on contemporary junctions in similar contracts.	Rates of other contracts used for preparing Variation is inappropriate	5.00
B1	**Project B** Non-Payment for Connection of New Storm Water Line and existing MH	Engineer should issue a VO for Connection of New Storm Water Line and existing MH, which is no rate given in BOQ	Connection of New Storm Water Line and existing MH is including at the pipe laying rate	6.00
B2	Withholding of Payment for Excavation and Backfilling of X duct line	Excavation and backfill should be certified by the Engineer for the re - excavation done for lay the X ducts where the other ducts already laid	Contractor entitle only for the excavation & backfill for laying one duct line	20.00

CASE NO	CASE DESCRIPTION	CLAIMANT'S POSITION	RESPONDENT'S POSITION	AMOUNT (RS./mn)
B3	Under Payment for Bed Course material in foot path	The BOQ rate is remained unchanged for the increased quantity of (more than 125% of BOQ qty), since it is a mistake done at preparation of document by drafting party	Contractor not entitle to receive the payment at BOQ rate for the increased qty more than 125% of BOQ qty.	24.00
C1	**Project C** Non-Payment for Connection of New Storm Water Line and existing MH	Engineer should issue a VO for Connection of New Storm Water Line and existing MH, which is no rate given in BOQ	Connection of New Storm Water Line and existing MH is including at the pipe laying rate	3.00
C2	Withholding of Payment for Excavation and Backfilling of X duct line	Excavation and backfill should be certified by the Engineer for the re - excavation done for lay the X ducts where the other ducts already laid	Claimant entitle only for the excavation & backfill for laying one duct line	11.00
C3	Under Payment for Bed Course material in foot path	The BOQ rate is remained unchanged for the increased quantity of (more than 125% of BOQ qty), since it is a mistake done at preparation of document drafting party	Contractor not entitle to receive the payment at BOQ rate for the increased qty more than 125% of BOQ qty.	36.00
C4	Under Payment for Sub grade replacement	The BOQ rate is remained unchanged for the increased quantity of (more than 125% of BOQ qty), since it is a mistake done at preparation of document	Contractor not entitle to receive the payment at BOQ rate for the increased qty more than 125% of BOQ qty.	13.00

Since the selected projects are contemporary Contract packages under the same Employer and the Contract team is same organizations the occurred disputes are commonly for the selected three projects. Therefore, the disputes can be listed with their common nature as shown below.

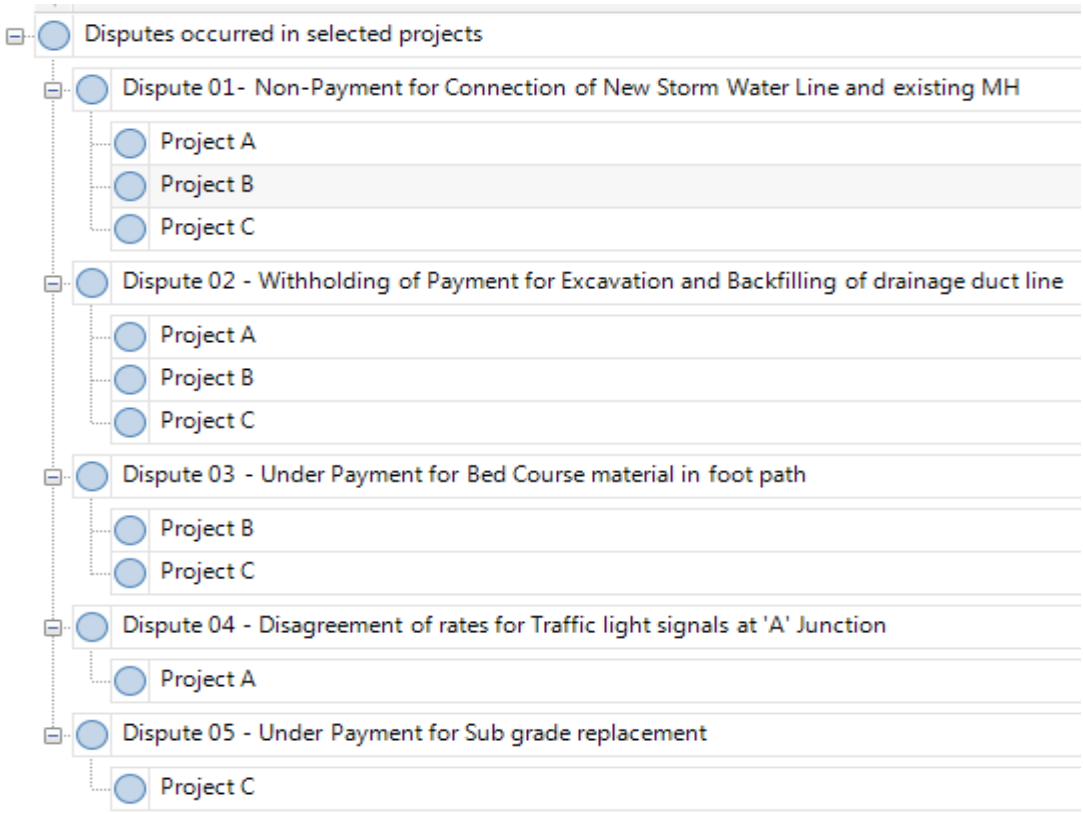

***Figure 4-8*: Disputes occurred in selected projects**

Above coding structure can be simply summarizes as Table 4-9 shown below.

Table 4-9: Common Disputes in the cases

Dispute no	Description	Project A	Project B	Project C
01	Non- Payment for Connection of New Storm Water Line and existing MH	√	√	√
02	Measurement of trench excavated for the CMC duct line	√	√	√
03	Under Payment for Bed Course material		√	√
04	Disagreement of rates for Traffic light signals at 'A' Junction	√		
05	Under Payment for Sub grade replacement			√

<u>Dispute 01</u>: Non-Payment for Connection of New Storm Water Line and existing MH

In the Tender Drawings, it shows that the road surface water flows to the Manholes via gullies and catch pits; Gullies and catch pits are connected with 160mm diameter PVC Pipe and catch pit to catch pit and catch pit to Manholes are connected with new Storm Water pipes of different diameters.

In the BOQ there are separate Pay Items for

a. Pipe lines of different diameters
b. Gullies
c. Catch pits having a depth less than 0.9m
d. Construction of new Man holes

But there are no Pay Items for

1. Catch pits having a depth more than 0.9m
2. Connection of Gulley to Manholes/ Storm Water main line where necessary
3. Connection of new Storm Water line to existing Man hole.

During construction, the Engineer (Employer's Representative) issued Variation Orders for the above 1 & 2 ie Construction of Catch Pits and Connection to Main Storm Line with gullies and no VO issued for the 3rd item. Hence, the Contractor (here in after called the Claimant) request for to issued a VO, as it is a new item and which is having constructive difficulties in practical scenario.

However, the Employer's (here in after called the Respondent) position is, it is not a variation and it is deemed to be included in the pipe length. Accordingly, the Claimant's argument is, though the Engineer had issued the Variation Orders for the catch pit and gully connection, he treats it in a completely a different manner for the connection of New Storm water line with existing manholes. Moreover, the Claimant also justified that the item is a variation to the scope by quoting the specifications and the constructive difficulty of the item.

<u>Dispute 02</u>: Withholding of Payment for Excavation and Backfilling of drainage duct line

According to the work scope of the Contract, various types of utility ducts were to be laid along the foot walk. Mainly Storm Water Lines, NWS&DB water line, X Duct line for future augmentation of services, underground cables for street lights, etc.

Further, due to the limited space available and with a view of minimizing the inconvenience to the public, in most of the locations separate trenches cannot be excavated for laying each type of utility ducts. Therefore, in some locations the X duct line had been laid in the same trench where other types of utility ducts are laid.

The issue arises only with reference to the X Duct laid in the same trench where NWS&DB line is laid at first in parallel to the road as this pipe had to be laid deeper than the X ducts. In parallel to the roads most of the stretches of the X duct is laid in the same trench of NWS&DB line.

In some locations, in parallel to the road, according to the drawing initially, a trench is excavated for the NWS&DB water line approximately in 0.9m to 1.2m in depth. Since the excavation is done in a highly congested area in terms of vehicular traffic and pedestrians and also the depth of excavation is 1m average, excavated open trenches cannot be kept longer in view of the safety of the people and to avoid the collapsing of very old boundary walls. Therefore, immediately after laying the NWS&DB water line, the open trenches had to be backfilled.

After laying the NWS&DB line to a reasonable length, it is mandatory to perform a pressure test to a pressure of 9 Bars maximum. Therefore prior to performing the pressure test, backfilling should be necessarily done except in joints immediately after laying in order to maintain the stability of the NWS&DB line by avoiding the displacing from its original position during the pressure test. Accordingly, the Claimant had to perform the backfilling immediately after laying of NWS&DB line.

For laying of X duct, there are separate BOQ items for Excavation, Backfilling with quarry dust, Backfilling with ABC and Laying. NWS&DB water lines are paid by separate BOQ item which includes the Excavations, Laying of pipe and Backfilling.

Since the X duct is laid in the same trench together with the NWS&DB line, the Respondent pays only for Laying of the X duct without Excavation and Backfilling emphasizing that Excavation and Backfilling is compensated under the NWS&DB line.

But the Claimant says that he had to re-excavate the backfilled trench for NWS&DB line to lay the X ducts by performing all associated activities; Excavation, Laying and Backfilling. Accordingly, it is irrational to withhold the due amount for Excavation and Backfilling as Claimant has done as these two activities are physically at two stages.

However, in the Statement of Response by the Respondent it is clearly explained step by step the method adopted in the site using combined trenches with the photo graphic evidence and the Respondent did not agree with the Claimant statement that re excavation and backfilling should be done separately for each pipe line.

Dispute 03: Under Payment for Bed Course material in foot path

The quantity allocated in the original BOQ for the particular item is 672.28 Sqm. But during the execution of the project, the quantity had been immensely increased and the final quantity achieved was 20.991.49sqm. Simply it is a 3022%, increment compared to the original BOQ quantity.

This increase was solely due to miscalculation of the quantity of Bed course area at the time of preparing the Tender Document. Although in the Tender BOQ, laying of Pre-cast Paving blocks quantity was given as 26,890.60Sqm, the area of Bed course was not given as the same quantity of paving blocks. According to the specification, and Tender Drawings, paving blocks should be laid over the bed course and hence both items should have the same quantities.

This huge mistake was done by the party who prepared the tender document. Hence the consequences and liabilities arising out of this mistake should be borne by the party who prepared the Tender Document. According to the natural law and as per the rule of contra preferentum (interpretation against the draftsman), the responsibility of ambiguities and mistakes of Contract Documents lies with the party who prepared the documents.

The Contract Variation Sub Clause of this projects, stipulates that,

> *if the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25percent, provided the change exceeds 1 percent of the Initial Contract Price, the Engineer shall adjust the rate to allow for the change*.

Accordingly, the Respondent derived a completely new rate (which is around 60% less than the original BOQ rate) for the item by taking cover under above phrase and applied for the exceeded quantity.

As stated in the Sub Clause which stipulates “only to adjust the rate to allow for the change”. This clearly says that the original rate “to be adjusted” and further it says, “to allow for the change”. In addition, there are no methodologies specified or illustrated in the relevant Sub-Clause with respect to “how the adjustment is to be done”. “The Engineer shall adjust the rate to allow for the change”.is the only statement there.

Therefore, the Claimant’s argument is, it is not fair and reasonable for the Respondent to determine a complete new rate (without adjusting the BOQ rate) where the meaning of the word “Adjustment” will not be achieved.

According to the next Sub-Clause of the Conditions of the Contract, which clearly states that due to a variation, a similar or an equivalent work item has to be executed above the limits of quantities (provided due to the large quantity or timing of execution, the unit cost is not changed). The same rate of BOQ has to be used to calculate the value of Variation.

Further, it is the International Standard Practice to adjust the rate due to change of BOQ quantity by a substantial percentage only if the change in quantity directly changes the cost per unit quantity of the BOQ item.

Dispute 04: Disagreement of rates for Traffic light signals at 'A' Junction

In the BOQ only 9 Nos. of Pelican control signal post Type - F had to be installed in the pelican crossings. During the execution of the Contract, the Employer decided to install Traffic Control system in the 'A' Junction.

In the absence of the relevant BOQ item, it should undoubtedly become a Variation and the Respondent requested to propose a rate breakdown for varied item.

As per the standard practice in derivation of new rates, available BOQ rates must be used as much as possible if relevant. In the absence of such similar BOQ item, market rates should be used to evaluate such Variation that are used for this item by the Claimant being an experience Contractor.

When the market rates are used to evaluate the Variation, it should not be selected in an arbitrary manner and those should be selected with due consideration of the applicability and appropriateness of the rates.

Accordingly, the Claimant uses the rates for this item using the rates of other two Contract packages which are having similar work scope, Projects executing in similar geographical conditions and Tendering process were at the same time or within a very short span interval of time. However, the Respondent stated that since there are no similar, appropriate and applicable rates in the BOQ, a new rate has to be derived based on the basic cost of materials, labour and plant.

The Respondent justifies his determination quoting the Sub-Clause in Conditions of Contract,

> *If the Contractor's quotation is unreasonable, the Engineer may order the Variation and make a change to the Contract Price, which will shall be*

> *based on the Engineer's own forecast of the effects of the Variation on the Contractor's cost*

This Sub-Clause authorizes the Engineer to derive a rate only if the Contractor's quotation; proposed rate, is unreasonable. However, the Claimant had used the similar rates of Contract Package B or C which are compatible and almost similar and also, have been accepted by the Respondent during the pre-contract stage.

Accordingly, the Claimant's argument is that the used rates are reasonable and which the Employer had determined and agreed as appropriate according to the market rates prevailing at the stage when tenders are called.

Dispute 05: Under Payment for Sub grade replacement

The Respondent unanimously determined a new rate quoting the Sub-Clause of Conditions of Contract as described in Dispute 03. With reference to the BOQ Item Sub grade replacement, the quantity allocated in the original BOQ is 3,821Sqm. But during the execution of the project, the quantity had been immensely increased and the final quantity achieved was 31,098.21sqm. Simply it is a 713.9%, increment compared to the original BOQ quantity.

This increase was solely due to miscalculation of the quantity of Preparation of Subgrade in Cut Areas at the time of preparing the Tender Document and the same arguments and procedures are followed as described in above Dispute 03.

After having several negotiations, without any agreement by both parties to the Contract, Claimant referred the disputes to the Dispute Adjudicators board as per the dispute procedure drafted in the Contract as follows.

> *If the Contractor believes that a decision taken by the Engineer either outside the authority given to the Engineer by the Contract or decision was wrongly taken, the decision shall be referred to the Adjudicator within 14 days of the notification of the Engineer's decision.*

> *Either party may refer a decision of the Adjudicator to an Arbitrator within 28 days of the Adjudicator's written decision. If neither party refers the dispute to arbitration within the above 28 days, the Adjudicator's decision shall be final and binding.*

Accordingly, the Claimant submitted his statement of Claim and the Respondent addressed their justifications by the Statement of Response. Then the Claimant counter arguments were presented in the Statement of Reply by the Claimant. Inquiry meetings were held by both parties with the Adjudicator and finally the Adjudicator's decision was made as stated in Table 4-9.

Table 4-10 : Award as per Adjudicator's Decision to the Dispute items

DIS NO	DESCRIPTION	CLAIMANT'S POSITION	RESPONDENT'S POSITION	ADJUDICATOR'S AWARD
01	Non-Payment for Connection of New Storm Water Line and existing MH	Engineer should issue a VO for Connection of New Storm Water Line and existing MH, which is no rate in the BOQ	Connection of New Storm Water Line and existing MH is including at the pipe laying rate	Claimant is entitled to separate payment for new item
02	Measurement of trench excavated for the X duct line	Excavation and backfill should be certified by the Engineer for the re - excavation done for lay the X ducts where the NWS&DB ducts already laid	Claimant entitle only for the excavation & backfill for laying NWS&DB ducts	Claimant is not entitled to receive payment for excavation & backfill for laying X ducts
03	Under Payment for Bed Course material	The BOQ rate is remained unchanged for the increased quantity of (more than 125% of BOQ qty), since it is a mistake done at preparation of document by drafting party	Claimant not entitle to receive the payment at BOQ rate for the increased qty more than 125% of BOQ qty.	Claimant is entitled to receive payment at BOQ rate for the full quantity

DIS NO	DESCRIPTION	CLAIMANT'S POSITION	RESPONDENT'S POSITION	ADJUDICATOR'S AWARD
04	Disagreement of rates for Traffic light signals at 'A' Junction	Engineer should certify the Variation which the rates based on Package B & C junctions for the Variation	Rates of other packages used for preparing Variation is inappropriate	Claimant proposal for the variation is reasonable and Engineer shall certify the VO on claimant's basis
05	Under Payment for Sub grade replacement	The BOQ rate is remained unchanged for the increased quantity of (more than 125% of BOQ qty), since it is a mistake done at preparation of document	Claimant not entitle to receive the payment at BOQ rate for the increased qty more than 125% of BOQ qty.	Claimant is entitled to receive payment at BOQ rate for the full quantity

After receiving the Adjudicator's decision, the Respondent not satisfied with that and as the next step he decided to refer the disputes to the Arbitration. However, the action by the Respondent was delayed by more the specified period (28 days) in the Contract to address the non-satisfaction to the Arbitration. Then only the Adjudicator's decision became final and binding as the solution for the referred disputes.

Accordingly, full filling the third objective of the research by the findings of the cross-case analysis the disputes aroused from the variations it can be basically identified as,

- Issue in identify the Variation
- Interpretation of Contract Close by the parties to the contract
- Disagreement for the Evaluation method of Variations
- Disagreement on the payment method of Variations
- Obstinate nature of the Parties to the Contract

After identifying the potential disputes the next section addresses the management of those disputes.

4.3.3 Managing Disputes arising from variations in Road Projects Sri Lanka

According to the opinions of Experts related to the selected projects avoidance of disputes needs real desire and complete coordination between the parties. A policy of disputes avoidance should be adopted by all concerned with the project. This policy should apply like quality assurance from the day the owner takes the decision to build until the final account is agreed upon. The compiled suggestions of Experts, to avoid disputes arising from variations RP SL are as follows:

- Special consideration for contract clauses dealing with variations / extras, disputes, inspections, approvals, payments, and delays. When preparing the Contract document, it is needed to join with the winning bidder also, without only give them to check immediately.
- Maximum usage of the standard document for the Contract documents.
- Contract clauses shall be adjusted or amended to match each project conditions rather than using them as it is.
- Owner must allow reasonable time for design team to produce clear and complete drawings and specifications to minimize the errors and ambiguities in the documents.
- There should be a clearly defined (but simple) variation provision, scope should be defined clearly in the drawings, specifications, etc.

- Reasonable investigation is required from the Employer in choosing consultants.
- Maintain records clearly/accurately and convey all the instructions from top to bottom of the organization
- Provision of a proper mechanism for processing and evaluating variations.
- Developing human resources in the construction industry, through proper training. This calls for developing human resources and it applies to construction engineers who lack adequate managerial skills. There is an urgent need for offering training courses in scheduling, time and cost control, information systems, contracting, quantity survey and management of human resources.
- The consultant and contractor act in a professional manner, leaving aside their vested interests to ascertain the true impact of variations adopting the standard methods.
- Having an Early warning system
- Pre-estimating and Value engineering

Validity and applicability of the listed suggestions can be visualized from the following Table 4-10.

Table 4-11: Expert's suggestions to manage Disputes arising from Variations

Suggesions to manage variation disputes	Expert Reference								
	Project A			Project B			Project C		
	PMA	PEA	QSA	PMB	CMB	QSB	GMC	QSC	REC
Special consideration for contract clauses dealing with variations / extras, disputes, inspections, approvals, payments, and delays in drafting of document	√	√	√	√	√	√	√	√	√
Maximum usage of standard document for the Contract documents and Contract clauses shall be adjusted or amended to match each project conditions	√	√	√	√	√	√	√	√	√
Owner must allow reasonable time for design team to produce clear and complete drawings and specifications		√	√	√	√	√	√		√
There should be a clearly defined (but simple) variation provision, scope should be defined clearly in the drawings, specifications	√	√	√	√	√	√	√	√	√
Reasonable investigation is required from the Employer in choosing consultants	√	√		√	√		√	√	√
Maintain records clearly/accurately			√			√			√
Provision of a proper mechanism for processing and evaluating variations			√			√			√
Developing human resources in the construction	√	√	√	√	√	√	√	√	
The consultant and contractor act in a professional	√	√	√	√	√	√	√	√	√
Having an Early warning system	√						√		
Pre-estimating and Value engineering				√	√		√		

From the above listed suggestions the following points can be mainly considered according to the expert opinions shown in Table 4-10.

- Proper documentation
- Adequate time allocation for each design & drafting document
- Select a professional construction team
- Record keeping
- Developing human resources in the construction industry

4.4 Developing a Frame work

After identifying the disputes, inter-relationship of those disputes with the causes and effect of variations, and mitigating measures the following framework can be developed to manage the variation disputes in Sri Lankan road construction industry as illustrated in Figure 4.9.

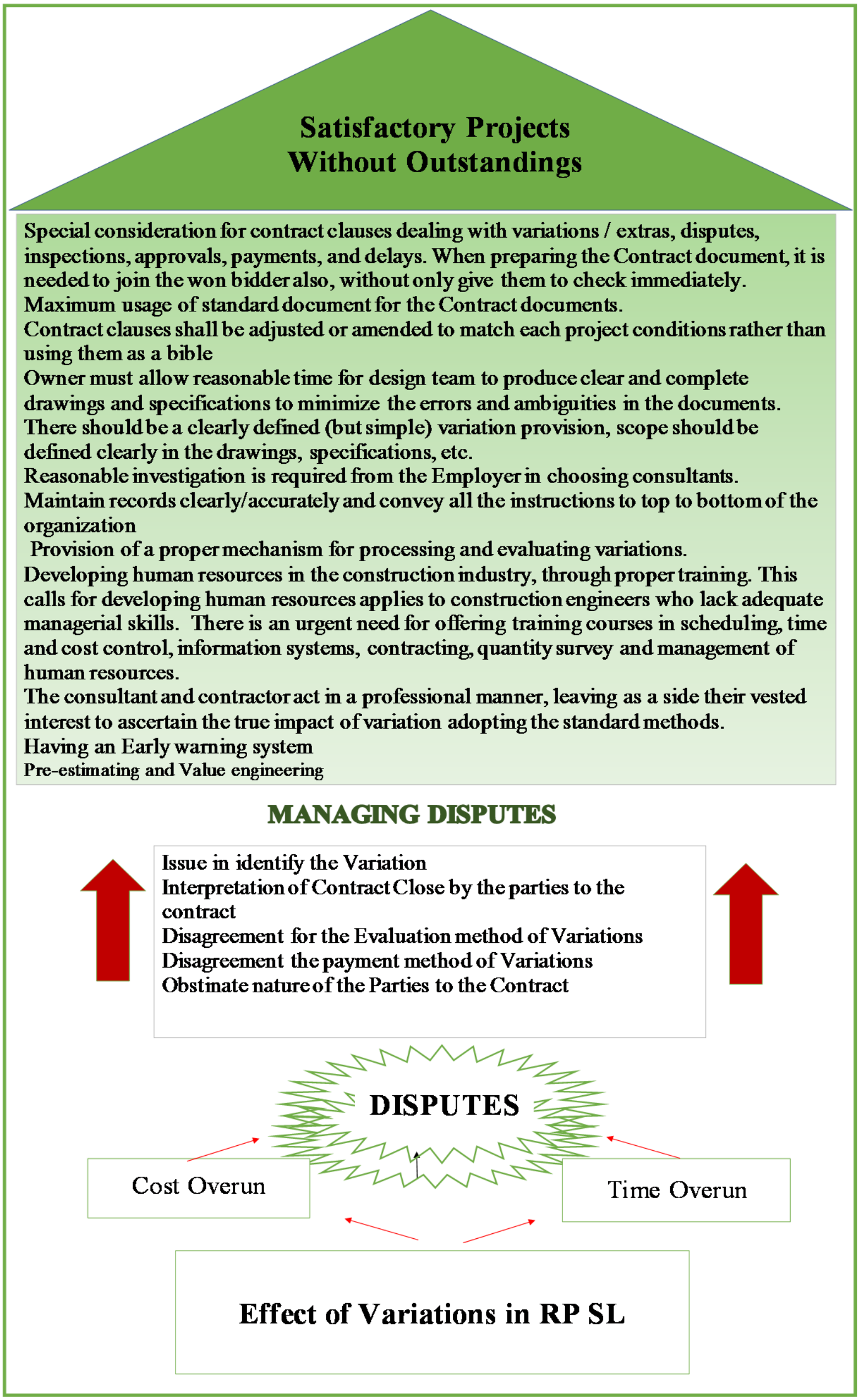

Figure 4-9: **Developed Frame work to Manage Variation Disputes in RP SL.**

When Figure 4-9 is read from the bottom to the top it shows that Cost and Time overrun as the effects of variations in RP SL which cause for the disputes. Those disputes are identified and listed in the middle rectangular and two arrows in right and left of the mentioned rectangular directed for the management of such disputes. Dispute managing measures are summarized the top rectangular in above Figure and by managing disputes finally achieved a successful project without any outstanding.

After developing the frame work to achieve the aim of the research the summary of this chapter is concluded in the next section before the closing this chapter.

4.5 Summary of the Chapter

This chapter presents the research findings including the process of variations, causes and effects of variations, disputes related variations and suggestions to manage the disputes in RP SL. After discussing about findings under those mentioned headings finally this chapter developed a frame work (refer Figure 4.9) to manage the variation disputes in Sri Lankan road construction industry. Moreover, the findings chapter revealed that many causes and effects are not seen in RP SL and all of them do not end up with the disputes which are discussed through the literature review. Then, the author focused on the practical causes, effects and practical situation on disputes in order to suggest measures to manage them and developed a framework targeting atisfactory project without outstanding.

Having analyzed and presented the findings related to the empirical study, the conclusions and recommendations will be drawn and discussed in the following Chapter five.

5. CONCLUSIONS & RECOMMENDATIONS

5.1 Introduction

Chapter four explicated and analyzed research findings of the empirical investigation tied with an elaborative pattern-match with the literature findings. The key findings are summarized under this chapter in order to establish conclusions and recommendations.

First, conclusions drawn on the overall research problem are presented. Next, it will attempt to prove research developed to answer research questions assistant with objectives. Thus, a summary on research aim and objectives is presented and every objective which was achieved through either literature or empirical findings, are summarized in this chapter. Subsequently, recommendations are provided based on the findings of this study. Suggestions are presented to manage the variation disputes under 'Recommendations'. Finally, limitations to this research and the new research directions emerging from this study are elaborated. The summery of findings is verified through achievement of objectives as exposed in the next section.

5.2 Conclusions under the research objectives

The aim of this study was "develop a frame work to manage disputes due to variations in road construction projects in Sri Lanka." Thus, four objectives were established to achieve the aim of the research and the concluded research findings together with followed methodology are illustrated under those research objectives mentioned in 1.3.

<u>Objective 01</u>: Identify the types of variations and contractual provisions related to the variation claims

The first objective was to emphasize, critically understand and identify the types of variations and Contractual provisions related to the variation claims. In terms of the first objective, to understand the concept of variations, analyzed the definition by different authors were analyzed and comparatively studied. It was finally defined as "any change to the works as described in the Contract document." Then as the type of

variations mainly identified were given a categorization namely, Owner related; Contractor related; Engineer related and other. In order to full filling the first objective contractual provision for variations are described with the much literature. As the contract clauses regarding variations in SBD 02 and FIDIC 1999 had explained, since both of those two documents are the standard use in RP SL.

Objective 02: Identify the reasons for disputes due to the variations

The second objective was established to investigate the reasons for disputes due to the variations. In terms of the second objective, Cost overrun and time overrun were mainly identified as the reasons for disputes due to the variations in Sri Lankan road Projects where, a number of reasons were identified as the sources of variations through the literature and the expert's interview related to the selected cases.

Objective 03: Identify the practical situations and causes which create disputes arising from variation in the road construction projects in Sri Lanka.

The Third objective was focused on practical situations and causes which create disputes arising from variations in the road projects in Sri Lanka. In terms of the third objective, practical situations and causes which create disputes arising from variation in the road construction projects in Sri Lanka were deeply analyzed through the selected projects. Finally summarized the main situation and causes for creating disputes in RP SL were summarized as follows,

- Interpretation of Contract Close by the parties to the contract
- Disagreement with the Evaluation method of Variations
- Disagreement with the payment method of Variations
- Obstinate nature of the Parties to the Contract

Objective 04: Identify the solutions to minimize the disputes due to variations

The final objective suggested suitable measures to manage those disputes in order to develop a framework to manage disputes due to variations in road construction projects

in Sri Lanka to achieve the aim of the research. In terms of the final objective, suggestions to manage those disputes can be concluded as,

- Proper documentation
- Adequate time allocation for each design & drafting document
- Select a professional construction team
- Record keeping
- Developing human resources in the construction industry

Then, the development of a framework for the management process of disputes in Road projects in Sri Lanka is demonstrated in Figure 4.9 in section 4.4 (Developing a Frame work).

According to the above mentioned summarized research findings, it can be concluded that the intended research aim and objectives have been met precisely. Having a summary on research findings under each objective, the next section will present the recommendations based on the research study carried out.

5.3 Recommendations

Considering the findings of the research, the following can be recommended as an improvement to the Sri Lankan roads construction industry by managing variation disputes.

- Special consideration should be given for contract clauses dealing with variations / extras, disputes, inspections, approvals, payments, and delays. When preparing the Contract document, it is needed to join with the winning bidder also, without only give them to check immediately.
- Maximum usage of the standard document for the Contract documents.
- Contract clauses shall be adjusted or amended to match each project conditions rather than using them as it is
- Owner must allow reasonable time for the design team to produce clear and complete drawings and specifications to minimize the errors and ambiguities in the documents.

- There should be a clearly defined (but simple) variation provision and scope should be defined clearly in the drawings, specifications, etc.
- Reasonable investigation is required from the Employer in choosing consultants.
- Maintain records clearly/accurately and convey all the instructions to top to bottom of the organization
- Provision of a proper mechanism for processing and evaluating variations.
- Developing human resources in the construction industry, through proper training. This calls for developing human resources applicable to construction engineers who lack adequate managerial skills. There is an urgent need for offering training courses in scheduling, time and cost control, information systems, contracting, quantity survey and management of human resources.
- The consultant and contractor act in a professional manner, leaving aside their vested interest to ascertain the true impact of variation adopting the standard methods.
- Having an Early warning system
- Pre-estimating and Value engineering

Then, the next section is discussed on the limitations to the research.

5.4 Research Limitations

The measures that were taken to validate the research have been discussed in a detailed manner in Section 3.3. However, as argued in chapter 3, the generalization of the study is limited to the case study sample population, and, cannot be generalized to a wider population or universe. As this research had targeted the roads construction projects in Sri Lanka, whose construction duration is equal to or more than one year, the research findings can be generalized to the mentioned population with confidence. It is also important to note that accessibility issues to the projects too have been limited to the generalization of the research.

5.5 Further Research Directions

During this research study, the researcher identified some interesting research opportunities that could be subjected to future research. These are briefly mentioned in this section.

- Appropriateness of Contract provision for the variations
- Issues in preparation of Contract documents in Road Projects Sri Lanka
- Construction variations in Engineer's & Contractor's perspective

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APPENDIX A: INTERVIEW GUIDELINES

Overview of the Study

Variation disputes have become a salient feature in the Sri Lankan road construction industry and it is essential to mange those disputes. The aim of the research is to manage the disputes arising from variations in road construction projects in Sri Lanka. Therefore, these guidelines will cover the existing practices of variation disputes, situations, reasons and effects of the variation disputes in road projects Sri Lanka.

Confidentiality Statement

The information from this interview will only be used in the fulfilling requirement dissertation for the awareness of Master of Science degree in Construction Law & Dispute Resolution. Moreover, this research is not a document published to refer by the general public, which is only referred within the university premises. Thus, all the responses will be kept confidential. However, to maintain confidentiality, the actual names of the interviewees will be not revealed in this report or any other document relating to this study.

Interview Procedure

The interviews are conducted with key participants of the road construction projects in each contract partner who is involved in disputes from variations. And the key participants of the selected cases are interviewed. Therefore, mainly three persons are interviewed from each case. Moreover, note taking and tape recording (with permission of the interviewee) will be doing while interviewing to collect data accurately.

Benefits to the Project contract partners

There are many advantages in studying the variation disputes in different contracts. However, by identification of those situations and mitigating the issues and barriers in real industry situation will be eventually beneficial to the organizations especially who are engaged in the projects with variations.

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The selected persons will be interviewed based on the following guidelines.

Designation:

Profession:

No of years of experience:

Date of interview:

Venue:

Duration:

General information about the project and the interviewee

1. What is your role in this Contract?
2. Can you give a brief introduction about the project, including the scope, duration and cost?
3. Can you give a brief introduction about the variations that occur in this project and the Number of variations?
4. Did all variations end up with the disputes?
5. If not what kind of variations ended with disputes?

Overview of existing practice

6. Your opinion of the Contractual provisions for the Variations?
7. Are disputes inter-related with causes for variations/Effects of variations?
8. What are the practical situations which create disputes arising from variation in the road construction projects in Sri Lanka?
9. What are the actual reasons of disputes due to the variations in the road construction projects in Sri Lanka?
10. What do you think as the solutions to minimize the disputes due to variations?

11. Did you identify any of the following causes for variations during this project?

Causes of variations					
	Yes/ No	**Explain the situation**	**Its effects**	**Finally ended with disputes /not? If disputed please explain.**	**How did you manage the situations?**
Owner /Client related issues					
Increasing the Requirement					
Poor/unclear brief by Client					
Change in mind-forced					
Change in mind-choice					
Financial problems					
Replacement of materials or procedures					
Change of schedule by owner					
Obstinate nature of owner					
Impediment in prompt decision making process					

	Yes/ No	**Explain the situation**	**Its effects**	**Finally ended with disputes /not? If disputed please explain.**	**How did you manage the situations?**
Consultant /Engineer related changes					
Design change by consultant					
Errors and omissions in design					
Conflicts between contract documents					
Design complexity					
Inadequate working drawing details					
Consultant's lack of judgment and experience					
Lack of consultant's knowledge of available materials and equipment					
Consultant's lack of required data					
Obstinate nature of consultant					
Inadequate site investigation					

	Yes/ No	**Explain the situation**	**Its effects**	**Finally ended with disputes /not? If disputed please explain.**	**How did you manage the situations?**
Incorrect assessment of brief					
Defects in BOQ and specifications					
Contractor related changes					
Lack of strategic planning					
Contractor's lack of required data					
Lack of modern equipment					
Poor procurement process					
Shortage of skilled manpower					
Contractor's desired profitability					
Long lead procurement					
Lack of communication					
Lack of a specialized construction manager					

	Yes/ No	**Explain the situation**	**Its effects**	**Finally ended with disputes /not? If disputed please explain.**	**How did you manage the situations?**
Unforeseeable Events/ Other changes					
Weather conditions					
Change in government regulations					
Change in economic conditions					
Socio-cultural factors					
Safety considerations					
Restrictions due to existing utility lines					
Floods and landslides					
Shortage of Materials					

12. According to your experience what are the other causes, effects and disputes arising from variations? Please explain.

Industrial view on Variation disputes

13. Do you think is it any project ended without any variation?
14. What are the main reasons of variations among above list in respected to Sri Lankan road construction projects?
15. According to summary of above Q11.answer the main disputes identified as time & cost overruns related to the roads projects. Are they become actual dispute to the project if partners are agreed?
16. When those disputes were created what are the next steps you are adapted to manage them?
17. After those management process do all the partners happy? Do you think finally it was success?
18. Do you think standard forms of contract is required to be changed to minimize the variation disputes? If yes how?

I would like to thank you for the information given and time you have dedicated to this research. If you are interested to know the outcome of this research, it would be my pleasure to share it with you.

Jayathilaka G.R.H.

Post graduate Student
Department of Building Economics
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APPENDIX B: EXAMPLE OF AN INTERVIEW TRANSCRIPT

Overview of the Study

Variation disputes have become a salient feature in the Sri Lankan road construction industry and it is essential to mange those disputes. The aim of the research is to manage the disputes arising from variations in road construction projects in Sri Lanka. Therefore, these guidelines will cover the existing practices of variation disputes, situations, reasons and effects of the variation disputes in road projects Sri Lanka.

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There are many advantages by studying the variation disputes in different contracts. However, by identification of those situations and mitigating the issues and barriers in real industry situation will be eventually beneficial to the organizations especially who are engaged in the projects with variations.

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Ch.QS.(Prof) Mrs.Kanchana Perera
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The selected persons will be interviewed based on the following guidelines.

Designation: *Planning Manager*

Profession: *Ch. Engineer*

No of years of experience: *15*

Date of interview: *05.12.2017*

Venue: *Interviewee Office*

Duration: *45 minutes*

General information about the project and the interviewee

1. What is your role in this Contract?
   All project related planning work

2. Can you give a brief introduction about the project, including the scope, duration and cost?
   Improvements to existing road, asphalt overlay, road sides improvement, landscaping, drainage improvements, road lighting etc.; Original Contract period:18 months, actual duration 2years; Accepted contract sum: Rs. 832Mn, Final Contract sum: Rs.912Mn (without disputed items).

3. Can you give a brief introduction about the variations that occur in this project and the number of variations?
   Adding new items/quantity increase/change in construction method; 148 nr of variations.

4. Did all variations end up with the disputes? *No*

5. If not what kind of variations ended with disputes?
   It's depend on the situations/team.

Overview of existing practice

6. Your opinion of the Contractual provisions for the Variations?
   It's very important clause, since it allows to adapt most suitable way to do the construction as well as to change the requirement according to the situations

7. Are disputes inter-related with causes for variations/Effects of variations?
   Sometime yes

8. What are the practical situations which create disputes arising from variation in the road construction projects in Sri Lanka?
   In rate build up/agreement for variations parties cannot come to a mutual agreement. /Engineer's determination not impartiality/ Contractor claim for high rates

9. What are the actual reasons of disputes due to the variations in the road construction projects in Sri Lanka?
   Poor contract documentation, not clear about the steps to proceeds variations/ ambiguity in Contract Clauses

10. What do you think as the solutions to minimize the disputes due to variations?
    When preparing the Contract document it is needed to join the won bidder also, without only give them to check immediately. Maximum usage of standard document for the Contract documents.

11. Did you identify any of the following causes for variations during this project?

Causes of variations					
	Yes/ No	**Explain the situation**	**Its effects**	**Finally ended with disputes /not? If disputed please explain.**	**How did you manage the situations?**
Owner /Client related issues					
Increasing the Requirement	*yes*	*Road side preparation with heavy landscaping*	*Project delay*	*No*	*Increase labour source & daily working time*
Poor/unclear brief by Client	*yes*	*Un clear specifications*	*Disputes*	*Parties interpretations in ambiguity situations are not agreed by each party to the Contract*	*Works completed with disputes & follow disputes procedures as per the Contract*
Change in mind-forced	*yes*	*Completely change the R/B detailing from the original Contract*	*Time extension required, but could managed, new price proposals agreed*	*No*	*Experience and proper planning & site management*
Change in mind-choice	*yes*	*-do-*	*-do-*	*No*	*-do-*

Financial problems	*yes*	*Local bank funding arrangements change with government change*	*Interest claims proceed for delay payments*	*No*	*Follow delay claims proceedings to accelerate the payments*
Replacement of materials or procedures	*yes*	*Change the tactile material in foot path*	*Rate changed*	*No*	*Engineer's requirement*
Change of schedule by owner	*yes*	*Accelerate the wok for national day function*	*Extra effort*	*No*	*Increase site supervision, labour force*
Obstinate nature of owner	*No*				
Impediment in prompt decision making process	*yes*	*Have to follow all government proceedings*	*Project delay*	*No*	*Accelerated the progress to mitigate the effects*
Consultant /Engineer related changes					
Design change by consultant	*yes*	*Change the R/A and landscaping designs time to time*	*Project delay & nr of financial proposals have to discussd*	*No*	*Time extent granted*
Errors and omissions in design	*No*				
Conflicts between contract documents	*yes*	*Ambiguity between specifications sections*	*Disputed*	*Yes*	*Works completed with disputes & follow disputes*

					procedures as per the Contract
Design complexity	*No*				
Inadequate working drawing details	*yes*	*New item related to pipe connection*	*Rate not agreed by both parties*	*Yes*	*Works completed with disputes & follow disputes procedures as per the Contract*
Consultant's lack of judgment and experience	*yes*	*Due to unavailability of materials to match with spec., Consultants rejected to approve equivalents which was available*	*Delay of Project*	*No*	*Proved that available equivalent materials are suitable and match with the project requirements*
Lack of consultant's knowledge of available materials and equipment	*yes*	*-do-*	*-do-*	*-do-*	*-do-*
Consultant's lack of required data	*No*				
Obstinate nature of consultant	*yes*	*New item related to pipe connection*	*Rate not agreed by both parties*	*Yes*	*Works completed with disputes & follow disputes procedures as per the Contract*

Inadequate site investigation	*yes*	*New item for traffic lighting system in a junction*	*Cost overrun*	*Yes*	*Works completed with disputes & follow disputes procedures as per the Contract*
Incorrect assessment of brief	*yes*	*Nr of new items*	*Time & cost overruns*	*Yes*	*-do-*
Defects in BOQ and specifications	*yes*	*Quantity error in BOQ & unit interpretations*	*Time & cost overruns*	*Yes*	*-do-*
Contractor related changes					
Lack of strategic planning	*Yes*	*Poor strategic planning of Management*	*Delay of Project*	*No*	*Submitted suitable planning Proposals to mitigate the effects*
Contractor's lack of required data	*Yes*	*Poor study of project area*	*Delay of Project*	*No*	*Accelerated the progress to mitigate the effects*
Lack of modern equipment	*No*				
Poor procurement process	*Yes*	*Poor financial management with material suppliers*	*Delay of Project*	*No*	*Accelerated the progress to mitigate the effects*
Shortage of skilled manpower	*Yes*	*Unavailability of skilled manpower due to rural area*	*Delay of Project*	*No*	*Had to recruit skilled people with over payments*

Contractor's desired profitability	*Yes*	*Part of the same item as variation & claim as varied rates*	*Had to arrange nr of discussion and time waste*	*Yes*	*Dispute refer to adjudication*
Long lead procurement	*No*				
Lack of communication	*No*				
Lack of a specialized construction manager	*Yes*	*Delay of appointing a specialized project manager*	*Delay of Project*	*No*	*Performed the Project manager's role until issue was resolved*
Unforeseeable Events/ Other changes					
Weather conditions	*yes*	*Heavy monsoon rain*	*Delay of Project*	*No*	*Time extension granted*
Change in government regulations	*No*				
Change in economic conditions	*No*				
Socio-cultural factors	*No*				
Safety considerations	*No*				
Restrictions due to existing utility lines	*yes*	*There were many existing personal water supply lines across the*	*Public objections*	*No*	*Proposed alternative solutions and obtained authority approvals*

		road to cultivation lands			
Floods and landslides	*No*				
Shortage of Materials	*yes*	*Huge shortage of material due to high demand*	*Delay of Project*	*No*	*Accelerated the progress to mitigate the effects*

12. According to your experience what are the other causes, effects and disputes arising from variations? Please explain.

    Using the Contract conditions as a norm to all the projects

Industrial view on Variation disputes

13. Do you think is it any project ended without any variation? *No*
14. What are the main reasons of variations among above list in respected to Sri Lankan road construction projects?

    Change of schedule by owner, Impediment in prompt decision making process, Errors and omissions in design, Conflicts between contract documents, Consultant's lack of judgment and experience, Poor procurement process, Change in government regulations, Shortage of Materials, Weather conditions
15. According to summary of above Q11.answer the main disputes identified as time & cost overruns related to the roads projects. *Please see the Effect Colum*

    Are they become actual dispute to the project if partners are agreed? *No*
16. When those disputes were created what are the next steps you are adapted to manage them?

    Disputes are resolved by the mutual agreement of both parties
17. After those management process do all the partners happy? Do you think finally it was success? *Yes.*
18. Do you think standard forms of contract is required to be changed to minimize the variation disputes? If yes how?

    Yes. Contract can be used as the guidelines to administrate the projects. However, they must be adjusted or amended based on the nature of each project as required

I would like to thank you for the information given and time you have dedicated to this research. If you are interested to know the outcome of this research, it would be my pleasure to share it with you.

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