INFLUENCE OF DELAY IN UTILITY SHIFTING FOR EXTENSION OF TIME CLAIMS IN ROAD CONSTRUCTION PROJECTS IN SRI LANKA

D. C. Karunarathna

189546A

Degree of Master of Science in Construction Law and Dispute Resolution

Department of Building Economics

University of Moratuwa

Sri Lanka

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Thesis submitted in partial fulfilment of the requirements for the degree Master of Science in Construction Law and Dispute Resolution

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July 2022

DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Masters or Degree 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.

Further, I acknowledge the intellectual contribution of my research supervisor Ch.QS P.A.P.V.D.S. Disaratna for the successful completion of this research dissertation. I affirm that I will not make any publication from this research without the name of my research supervisor as contributing author unless otherwise I have obtained written consent from my supervisor.

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Dissertation Supervisor Date

Ch.QS Mr. P.A.P.V.D.S. Disaratna

ABSTRACT

With the growing of the road construction sector, extension of time claims has been grown significantly due to the various reasons. Utility shifting is critical in road construction since it necessitates the relocation of existing service lines in the site premises without causing public disruption. However, there have been a number of delays in recent years, which will result in the emergence of extension of time claims as a result of these delays in the utility shifting procedure. As a result, utility transfer delays have become a major issue in road construction projects, resulting in time claims being extended. Therefore, the aim of the research is to improve the efficiency of the utility shifting process, which will help to reduce the impact of utility shifting delays on time claims in Sri Lankan Road Construction projects. Content analysis and Relative Important Index (RII) methods were used to analyse the empirical data acquired from preliminary and expert interviews with a questionnaire survey.

The research's findings indicated 10 most severe causes of delay in utility shifting process. These causes have been derived based on the possibility of arising extension of time claims and significance of impact of causes of delay in utility shifting process. Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor, insufficient budget allocation for the Client and procurement issues by the utility Authorities are the top three most severe causes of this study which rapidly leads extension of time claims for delays in utility shifting process in Sri Lankan Road construction projects. In this research, forty-one (41), handling strategies were provided to minimise the effect of the ten most severe causes in utility shifting to reduce the extension of time claims in road construction projects is Sri Lanka.

Finally, it is recommended not to include unfair contractual terms as to utility shifting work, such as transferring complete responsibility to the contractor even if the delay is caused by other parties in utility shifting.

Keywords: Utility Shifting, Extension of Time Claims, Road Construction

DEDICATION

I'd like to dedicate my work to my encouraging parents, wife, daughters and the excellent supervisor, who encouraged me and provided invaluable assistance.

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ABBREVIATIONS

BOO - Built Own Operate

BOT - Built Operate Transfer

CEB - Ceylon Electricity Board

GAO - General Accounting Office

NWSDB - National Water Supply and Drainage Board

RDA - Road Development Authority

RII – Relative Important Index

ROW - Right of Way

UDA – Urban Development Authority

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1. INTRODUCTION CHAPTER 1

1.1 Research Background

The construction industry is one of the fastest installed industries in the world (Beesley, 2012). It has a huge impact on the economy of all countries (Leibing, 2001). The construction industry, especially in Asia, has shown a global trend in recent years (Weddikkara & Devapriya, 2001). However, the Construction industry is a tool for society to achieve its urban and rural development goals (Enshassi et al., 2006). Furthermore, due to the complex nature of the construction procedure itself and the many parties involved in the construction process, namely designers, regulators, customers, contractors, subcontractors, users, suppliers, and consultants, the construction industry has become increasingly complex (Enshassi et al., 2006). Although the construction industry plays a very important role in economic development, construction delays are a major problem facing any developing country (Sivaprakasam et al., 2017).

Construction delays are a common phenomenon in most countries, especially in developing countries (Khair et al., 2016). Further, construction delays can be defined as time overruns beyond the contract date or the date agreed by both parties to deliver the project (Sadi & Sadiq, 2006). Cost, time, and quality have proven to be the main indicators of project success (Mahamid et al., 2012). Hence, Delays adversely affect clients, contractors, and consultants, including the growth of adversarial relationships, distrust, litigation, arbitration, cash flow causes, and general mutual fear (Ahmed et al., 2003). In addition to this, the same authors also described that delaying construction projects is a common phenomenon, usually accompanied by cost overruns. Further, the duration of a construction project from start to completion is considered critical in the construction industry (Pathiranage & Halwathura, 2010). The authors also stated that there are various views on the causes of time delays in engineering and construction projects. Among them, delays in road construction remain a major problem in developing countries (Khair et al., 2016)

In the road construction industry, destructive events hinder the construction process, so prolonged construction time will lead to project delays (Shehob et al., 2012). Furthermore, Perera (2006) pointed out that 80% of Sri Lanka's Road projects have experienced time and cost overruns, thus making them high-risk projects in terms of cost and time. Moreover, Pathiranage and Halwatura (2010) pointed out that 56-88% of road construction projects experience time overruns, which may affect the country's economy in many ways. These construction delays may even become a socio-economic problem in the future (Wijekoon & Attanayake, 2012). However, the causes and effects of these delay factors in the road construction industry vary from country to country, which is caused by the environment and the technology used in the construction process (Khair et al., 2016). Since there may be multiple reasons, it is necessary to accurately determine the root cause and the responsible party before claiming (Arditi & Pattanakitchamroon, 2006).

The National Construction Association of Sri Lanka (2013) pointed out that budget problems, unrealistic time allocation, inaccurate contract terms, and improper late payment, are the key reasons for delays in road projects. In addition to that, Wijenayake (2014) has stated road construction projects were delayed due to causes related to land acquisition, improper design, poor financial management, political interference, and environmental pollution. However, among the above-mentioned factors, utility shifting is one of the main reasons for road construction delays and cost increases (Ellis, 2003).

In the fiscal year 1997-98, about half of federal aid road and bridge projects involved the relocation of public utilities (General Accounting Office (GAO), 1999). Since there is no proper record of underground utilities, such as water supply, sewers, electrical cables, and telephone lines, these utilities are only identified as burdens during the project implementation phase (Chawla, 2010). In addition to that, there are many government agencies involved that require permission/approval before utilities can be transferred or relocated. This takes a lot of time. Involving tedious procedures, sometimes the relevant laws and regulations are not very clear (GAO, 1999). Therefore, the transfer of these public utilities takes a long time, and because the transfer of these public utilities causes difficulties for ordinary people, it needs to be

delayed and appropriate replacement arrangements need to be made (Chawla, 2010). However, because states do not always know about these delays, it is unclear the full extent of road and bridge project delays caused by the relocation of public utilities, and the states have provided us with various causes of delays (GAO, 1999).

1.2 Problem Statement

The construction industry is one of the main sectors that provide important components for economic development, such as sustainability, GDP growth, investments, etc... However, many projects experience significant delays, which exceed initial time and cost estimates (Ahmed, 2016). In terms of time, cost, quality and safety, construction delays are considered one of the failures in construction projects. Further, delays in government construction projects, especially in road projects, have had a major impact on the country's economic activity (Ahmed, 2016). In addition to that, delays in utility shifting activities have a direct impact on construction delays in a road project. Therefore, the above-mentioned delays make a risk to contractors work load. In order for the contractor to succeed, a time extension claim or disruption claim should be fully identified, and assist in proving the expansion of time-related damage directly caused by the delay in utility shifting. Therefore, it is important to study about the delay in utility shifting in road construction projects.

Moreover, there are a number of researches have been carried out on the topic of construction delays (Pathiranage & Halwathura, 2010; Sadi and Sadiq, 2006; Sivaprakasam, Selllakutty, & Jayakumar, 2017; Wijenayake, 2014). Further, there are a number of researches have been done on the topic of extension of time claims in the construction industry. However, researches in influence of delay in utility shifting for Extension of Time claims in Road Construction is a rarely done area. Hence there is a research gap on the Impact of delay in utility shifting for Extension of Time claims in Road Construction in Sri Lanka and there is a need of doing this research.

1.3 Aim

The aim of the study is to investigate the influence of delay in utility shifting for Extension of Time claims in Road Construction projects in Sri Lanka

1.4 Objectives

In order to achieve the above aim, the following objectives are established.

1. Review on the need for utility shifting in road construction projects
2. Identify the causes of delay in utility shifting for road construction projects in Sri Lanka
3. Examine the possibility of arising Extension of Time claims and the significance of impact of the causes of delay in utility shifting in road construction projects in Sri Lanka
4. Identify the most severe causes of delay in utility shifting for Extension of Time claims in Sri Lanka
5. Propose solutions to mitigate Extension of Time claims arising due to delay in utility shifting in road construction projects in Sri Lanka

1.5 Scope and Limitations

This research was focused on identifying the influence of delay in utility shifting for Extension of Time claims in Road Construction projects in Sri Lanka. In order to better demonstrate the road construction environment in Sri Lanka, this study was limited to road projects which are governed by local authorities in the construction industry.

1.6 Research Methodology

1.6.1 Literature review

A comprehensive literature survey was conducted by reading a series of journals, conference papers, books, articles, and dissertations to study the existing knowledge on the research area.

1.6.2 Preliminary Interviews with Experts Validating

Preliminary interviews were conducted with six experts in the construction industry before the questionnaire survey, to identify new causes of delays and validate the causes which were discovered through the literature review on road construction projects.

1.6.3 Questionnaire Survey

A questionnaire survey was carried out to rank the causes according to their significance of impact and possibility of occurrence related to the shifting of utility in road construction projects. Finally, the collected data were analysed using a statistical tool.

1.6.4 Expert Interviews

Expert interviews were conducted with experts in the construction industry after the questionnaire survey, to identify solutions to mitigate Extension of Time claims that arise due to delays in utility shifting in road construction projects.

1.7 Chapter Breakdown

1.7.1 Chapter 01: Introduction

This chapter consists of a brief background for the research with a problem statement, aim and objectives, scope and limitations, and research methodology.

1.7.2 Chapter 02: Literature Review

This chapter consists of a comprehensive literature survey regarding the utility shifting in road construction projects in Sri Lanka.

1.7.3 Chapter 03: Research Methodology

This chapter outlines the research methodology and explains the methods used for data collection and data analysis.

1.7.4 Chapter 04: Data Analysis and Research Findings

This chapter includes findings from expert interviews and questionnaire surveys, and comprehensive analysis of the detailed information gathered from the interviews and questionnaire surveys above.

1.7.5 Chapter 05: Conclusions and Recommendations

This chapter concludes the study with conclusions, recommendations, and further research areas.

2. LITERATURE REVIEW CHAPTER 02

2.1 Chapter introduction

This chapter discusses the existing knowledge on the impact of delaying utility shifting for extension of time claims in road construction projects in Sri Lanka. According to the literature gap identified in the relevant knowledge area; books, journals, research publications, conference papers, and unpublished dissertations were used to obtain the relevant literature for the fulfilment of the research objectives. This chapter is systematically following the existing literature related to this topic and expected to accomplish the all information related to the objectives respectively. The literature review provides the foundation for the research concerning the background study conducted in the preceding chapter. The findings of this chapter are further validated in the third and fourth chapters with appropriate research tools.

2.2 Construction industry

The term "construction" is identified as a complex activity, which relates to creating new buildings, engineered structures, renovation, repair, and maintenance of existing facilities as well as modifications (Sexton et al., 2007). Similarly, Foulkes and Ruddock (2006) maintained that construction is a series of task chains varying with their level of complexity in different stages. Further, on the one hand, widespread stakeholder involvement in different stages can be identified as a core feature in the construction industry, which creates complicated nature in project management (Wang et al., 2020). In contrast, Harikrishnan and Manoharan (2016) argued that, even though the management is difficult, effective improvement of construction productivity is highly dependent on the involvement of multiple stakeholders in certain stages of the construction chain. On the other hand, in any country, construction is a significant sector of the economy, which can be recognised as an essential role contributor to the country's wealth (Hillerbrabdt, 1985). According to Foulkes and Ruddock (2006), the construction industry solely generates a 6% to 20% contribution to the GDP of the country from narrow to broader views respectively. Further, they claimed that due to the dependence on other industries like the manufacturing industry there is a higher possibility to influence the health of the national economy either directly or indirectly.

By the way, while adhering to the trends in globalization, the construction industry changed its environment to meet supply and demand constraints (Weddikkara & Devapriya, 2016). Economic, social, cultural, and political conditions are identified as demand-side criteria that are used as the basis for driving the traditional perception towards the modern construction framework (Foulkes & Ruddock, 2006). As a result, construction projects are diverse into sections featuring difficult attributes within their unique nature (Harikrishnan et al., 2010). According to that, newly classified segments in the construction industry can be sorted into main two separate sections called building and infrastructure construction.

2.2.1 Building construction projects

The building is one of the construction outputs, which satisfies the main requirements of the client in terms of strength, stiffness, durability, and thermal performance (Vishwanadham & Eshwariah, 2018). Further, Sexton et al. (2007) stated that building is a source of generating values such as ensuring the quality of life, protection, stability, as well as durability. One ground factor to ensure the higher performance of functions in a building is using proper materials (Bewick, Boettcher, Bott, & Meredith, 2002). Concerning the above statement, Viswanadham and Eshwariah (2018) also asserted that the material required for the building construction will enhance the efficiency throughout the building's life if the quality is properly examined. Another ground to ensure the functionality of the building in terms of quality and safety is building codes (Bewick et al., 2002). Moreover, statutory provisions were also established to enforce building codes to conduct safety measures in building construction under responsible authorities since it has vital importance due to the ad-hoc nature (Wang et al., 2020).

By the way, time delays and cost overruns are potential causes in building construction that needs to be avoided (Vishwanadham & Eshwariah, 2018). Lack of interaction between consultants and contractors, degree of complexity, unavailability of resources, lack of design information, and delays in drawings are some factors that often affect project outcomes like cost and time overruns (Wang et al., 2020). Risk management, resource planning, effective communication, and coordination among stakeholders are some strategies that can be implemented to minimise delays and cost

increments in building projects (Kasen, Glenn, & Burrus, 2017). According to the research conducted by AlSehaimi et al. (2013) poor planning, procurement problems, and poor site management resulted in 87%, 69%, and 56% problems respectively in building construction projects and they manifested that, the efficiency of project time and cost can be achieved while treating to above causes and also long-term benefits can be addressed with the concept of sustainability. So, modern building construction is nourished with the vision of sustainable development to deliver intended benefits to beneficiaries (Sexton et al., 2007). This concept is further strengthened within the construction industry since it answered the main obstacle which is "scarcity and cost of durable material" by providing an efficient solution "from the point of view of total embodied energy" (Vishwanadham & Eshwariah, 2018).

2.2.2 Civil engineering construction projects

Civil Engineering construction also can be called "Infrastructure" which provides facilities for users such as community, traffic, energy, communication, etc. (Nakamura et al., 2019). Similarly, Foulkes and Ruddock (2006) asserted that infrastructure construction is emerged to seek potential services in the form of roads, railways, airports, power plants, and other public facilities. When compared to building construction, infrastructure has higher demand and contributes a higher portion to the GDP (Nakamura et al., 2019). In general, infrastructure construction helps to achieve the desired outcome in the short term while strengthening the national economy in the long term (Sexton et al., 2007). Further, they argued that a large volume of infrastructure development is required in developing countries to establish a modern built environment, which facilitates socio-economic development through proper community interaction. Boadu et al. (2020) maintain a similar argument that the infrastructure may provide relatively higher economic growth in developing countries when compared to building construction.

Typically, infrastructure constructions are initiated by Government but procured through Build Own Operate (BOO)/ Build Own Transfer (BOT) mechanisms (Bewick, Boettcher, Bott, & Meredith, 2002). So, BOO/BOT models encourage private sector investments in infrastructure construction by changing the demand for finance development while enhancing healthy national economic conditions (Weddikkara &

Devapriya, 2016). Moreover, they claimed that partnerships between private and public sectors provide "the entire project services with horizontal- integration, strategic alliance, joint ventures, or consortia to combine their strengths and to become a single source problem solver for the client" (pg. 98). Finally, demand for infrastructure construction is satisfied with these alternative means while sharing responsibilities and risks and also efficiently maintaining the life cycle of infrastructure projects (Akbiyikli & Eaton, 2005).

2.3 Road construction projects

The road is an improved route or path between two places, which allows for traffic (Qi et al., 2013). Further, a road can be defined as an extensive network system "facilitated the movement of troops and communication, contributing to the economic prosperity" (Nakamura et al., 2019). Based on the traffic requirement, different countries designed their standards and road classification according to the country network (Janseen, 2010). For instance, in Sri Lanka roads are classified as following Figure 2-1,

Type	Class		Description	Administration
Express Ways	E		Connection Major Cities, Ports	Ministry of Highway and RDA
		AA		
		AB		
		AC		
	B		Connecting Urban Areas	
	C		Major Feeder Roads	
	D		Minor Feeder Roads	
Local Authority Roads	E		Local Roads	
Other Roads	Not Classified		Plantation Forest, Irrigation Roads	Ministry of Rural Development, Private Company

Figure 2-1: Road Types

The study is mainly concerned with utility shifting difficulties in E A B C D Roads, as

Figure 2-1- Road Types in Sri Lanka Source: Road Development Authority in Sri Lanka: Road Classification

utility moving has a significant impact on Express, National, and Provincial Roads (Krick & James, 1980). Due to the higher demand for service requirements, road construction became popular in infrastructure construction with the continuous development of technology (Zhao & Wu, 2017). Kumar et al. (2018) also asserted that technology development encourages road construction to address the demand.

However, construction should be implemented to meet the demand while maintaining a high level of quality with proper safety operations and an effective traffic management system (Zhao & Wu, 2017). They further highlighted that; the method of traditional road construction moderates its direction into an integrated framework called smart road construction. Moreover, they further argued that this new concept is the possible answer to address challenges in road network integration. According to the point of view of Kumar, Roa, and Ryntathiang (2018), the smart road concept drags into another similar approach called "Green Road Construction" while adding more natural aesthetically pleasing to the sustainable notion.

2.3.1 Uniqueness of road projects

When compared to building construction significant differences can be identified such as construction mechanism, material usage, life span, and other cost and time-related factors in road construction (Seboru, 2015). As stated by Nazech et al. (2008), the construction process, structural work, and material management are three main constraints where alternations can be identified from building construction. The following factors describe unique features of road construction among other infrastructure and building works.

I. Construction Process
II. Life Span
III. Risks related to road construction
IV. Variations
V. Environmental pollution and construction wastage

2.3.1.1 Construction process

The sequential construction process is followed in road projects (Nakamura et al., 2019). In contrast to building constructions, road-occupied horizontal space has a layered structure that can be identified in either type of construction product (Janseen, 2010). Moreover, a typical road section consists of the subgrade, subbase, base course, and surface course (Nakamura et al., 2019). However, depending on the design and other characteristics such as traffic flow, location, purpose, accessibility, load-bearing

capacity, material usage differs in the depth, width, and other dimensions with the number of layers (Janseen, 2010). The author further stated unlike in building construction road finishes have different codes, standards, and designs. Nakamura et al., (2019) stated the importance of adhering to standards related to services accommodation in road construction as another key feature in road finishes.

2.3.1.2 Life span

Generally, the actual life of road construction is longer and functions effectively throughout the cycle (Nakamura et al., 2019). Huang, Hakin, & Zammataro (2012) identified the four main stages concerning the road life cycle as following Figure 2-2

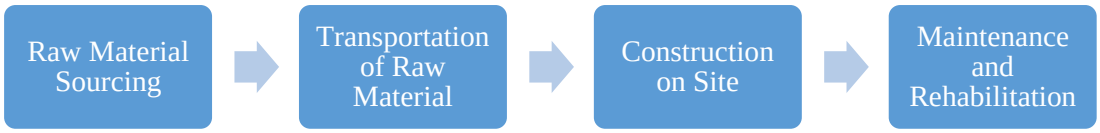

Figure 2-2 - Life Cycle of a Road

Source: International Journal of Pavement Engineering: Measuring the Carbon Footprint of Road Construction

Further, they stated that a strong relationship between user requirement and facilitated services that lasts effectively within its life span is unique to road construction. However, to obtain the intended purpose in road projects “maintenance work during the long service life is essential”. Even though the cost of maintenance remains long-term, Marzouk et al., (2017) denied that sustainable material selection and the latest construction technologies might eliminate unnecessary long-term costs during the road life cycle.

2.3.1.3 Risk related to road construction

In road construction, both internal and external risk factors can be identified (Perera et al., 2009). Other than that, the risk is also divided into preconstruction and post-construction risks throughout the process (Nakamura et al., 2019). Following Figure 2-3 illustrates the types of risks related to road construction in terms of external and internal sectors.

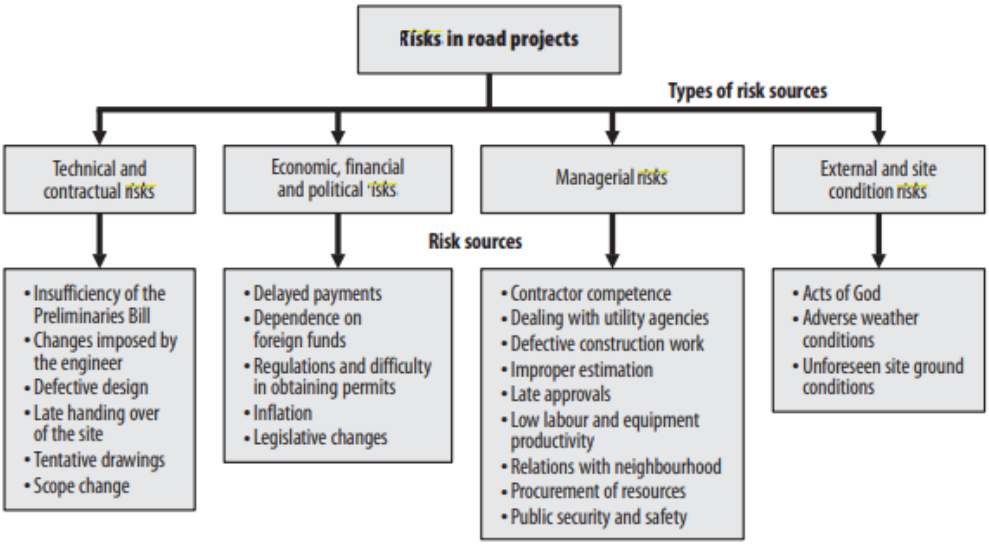

Figure 2-3 - Risks in Road Projects

Source: Risk Management in Road Construction: The Case of Sri Lanka pg. 91

By the way, great magnitude related to road construction creates confusion, especially in time and cost targets (Perera et al., 2009). Further, Pathiranage (2010) claimed that delays in road construction projects directly or indirectly might affect not only the life cycle of the project but also the national economy. Since road, construction contributes a higher percentage to the GDP than other types of construction; poor management of risk can be substantially impacted the growth of the national economy (Perera et al., 2009). Therefore, Pathiranage (2010) emphasised that the identification of probable reasons which caused risks in the delivery of construction output should be properly managed to mitigate direct and indirect confusions related to road construction.

2.3.1.4 Variations

In general, the influence of variations on road construction projects is unique from building projects (Shelu, 2016). Hence, the road spreads in large geographical areas higher unforeseeable nature is a constant factor to arise several variations rather than building construction (Halwatura & Ranasinghe, 2013). However, they further argued that factors that influence variations might differ from one project to another based on the nature of work, complexity, and procurement method. In contrast, Jayawardane and Gunawardana (1998) manifested that, even though the degree of variation is likely to differ, it cannot be completely avoided since industry norms reflect that the variation might result in around 7%-10% cost escalation and around 30% average time extension but can be reduced if cases are identified before origin.

2.3.1.5 Environmental pollution and construction wastage

Especially in road construction amount of environmental pollution associated from inception to demolition is significantly higher than in other construction (Marzouk et al., 2017). Consumption patterns practiced in road construction resulted in considerable stress on the environment (Nakamura et al., 2019). Furthermore, they back up that allegation by claiming that the effect of ecosystem improvement has been harmed as a result of pollution problems produced by a variety of factors such as "air pollution, water pollution, groundwater level decline, and dust generation. Therefore, concerning road construction safety measures should be practiced to mitigate unnecessary construction wastage and environmental pollution.

2.4 Need for utility shifting in road construction projects

The utility is a part of the road network ((James & Anspach, 2010). Water supply and sanitation, drainage facilities, electricity supply, and telecommunication service can be identified as incorporated utilities in a road system (Thorne, Turner, & Lindly, 1993). Moreover, new constructions, reconstructions, or maintenance of existing facilities in road construction require permanent or temporary utility relocating within the road project premises (Michael et al., 2002). Besides, existing utilities either visible on-site or hidden below ground needed to be shifted while minimizing impacts with proper coordination and design consideration (James & Anspach, 2010). Further, one

of the core functions in utility relocation can be identified as utility coordination (RDA, 2009). Proper coordination of utilities benefited the relocation process since it is essential to have a consistent road network (James & Anspach, 2010). Other than that, design decisions made in road construction require utility shifting. From time to time with the development, traditional road designs advance into new models (RDA, 2011). Hence, outdated designs require utility shifting to consolidate with the road network while moderating its features with novel technologies (Thilakaratne et al., 2009).

As a part of road projects utility survey has been carried out during the design stage to operate and relocate utilities in a safe as well as an efficient manner (Baril et al., 2008). Furthermore, problems arose as a result of utility relocation during road construction, which resulted in system enhancements and upgrades (Ralph et al., 2005). Similarly, Michael et al., (2002) argued that, while treating to urbanization, utility relocation needed to be addressed to integrate with the modern road network.

2.4.1 Types of Laying Utilities in Road Construction

Underground utility installation is often carried out using traditional excavation techniques, and trenchless installation techniques are now being commonly employed (Baril et al., 2008). Further, the classic method for drilling which is used for utility shifting use a common procedure, consisting of four steps: site preparation, pilot hole drilling, prereaming, and pullback (Patel et al., 2021). However, depending on services provided by authorities' the main types of utility shifting mechanisms can be identified as follows,

I. Water Supply and Sewer/Drainage System
II. Electricity
III. Tele-communication

2.4.1.1 Water supply and sewerage/ drainage system

An extensive network of water supply and drainage systems across the country should be properly investigated before conducting shifting (James & Anspach, 2010). The primary needs for relocating water, sewer, or drainage lines are site surveying and obtaining approvals from National Water Supply and Drainage Board (NWSDB) in

the Sri Lankan context (RDA, 2016). Moreover, they asserted that negative impacts such as floods, storms, and stream flows should be addressed in the design stage since those causes can be expected during the relocation of water supply pipelines. Besides, Thorne, Turner, and Lindly (1993) maintained a similar argument asserting that the existing and revised pattern in drainage systems based on landscaping also have vital importance during the utility relocation design process.

RDA (2009) stated that shifting water, sewer, or drainage lines may impact on nearby settlements and make a disturbance to habitats due to connection losses and can experience higher traffic volume. Therefore, recent projects initiated by RDA analyse impacts regarding the above matters through feasibility studies as mentioned in the Proposed Central Expressway Project report (2016). Another ground factor in pipe relocating is culvert designs which are integrated with road construction (Perera, Dhanasinghe, & Rameezdeen, 2009). For instance, appropriate measures adopted in Proposed Central Expressway Project deal with the above matter using novel technologies while introducing strategies to reduce traffic congestion (RDA, 2016).

2.4.1.2 Electricity

Electricity is generally transmitted through both above and underground transmission lines (Thorne et al., 1993). Similarly, Thilakaratne et al. (2009) also argued that to meet the demand, electricity supply lines draw a complex network both above and below ground in Sri Lanka. According to the research conducted in the Proposed Central Expressway Project by RDA (2009), “98% of households are connected to the National Grid for lighting and other purposes” (pg. 83). Therefore, they demonstrated the importance of proper management in electricity line shifting, while minimizing disturbance to the neighbourhood. On one hand, the existing facility should be accounted and the following aspects also should be examined while planning electrical utility relocation (Thorne et al., 1993). They are,

- Present and future demand for electricity service
- Operating characteristics
- Physical barriers
- Safety considerations and design policies according to CEB standards

Reasonable and consistent planning may enable an effective approach to shifting electrical transmission lines. Moreover, Reinke (2010) claimed that other countries progressed with efficient planning and estimating techniques under a ranking system in utility relocation, especially for electricity supply. Further, Reinke (2010) asserted that the involvement of field expertise is essential, and it is the responsibility of the Contractor. If the Contractor channelled with professional supports in relocating process, a cost-effective shorter planning period can be obtained and will help to ensure safety within the site at a higher level (Thorne et al., 1993). They further posited that the cost benefits are reliable with professional involvement, since mistakes, faults and breakages can be reduced (Brown , 2000).

2.4.1.3 Telecommunication

Telecommunication is a highly demanded service, which facilitates signal transmission via "metal cable, fibre optic cable, or some combination through the use of electronics" (Throne et al., 1993). In contrast, in the Sri Lankan context, the report of the Proposed Central Expressway Project (2009) claimed that some areas might not have serious causes regarding telecommunication utility shifting, since they are connected with postal services. However, the need for shifting telecommunication lines has similar importance with other types of utility shifting methods in Sri Lanka (RDA, 2011). For instance, when considering the Baseline Road Project details, the risk associated with improper administration and service mapping during re-accommodating and shifting of telecommunication lines were discussed (Kawakami, 2005). While operating telecommunication lines, authority approval should be taken from Sri Lanka Telecom as well as should adhere to rules governed by Telecommunication Act when crossing provincial boundaries and acquiring lands (RDA, 2009) Other than that, the contractor should be aware of the restrictions stated in the Act such as right-of-way when planning utility shifting programs (Quiroga & Cesar, 2006). Moreover, Canadian construction also claimed the requirement of governing rules when altering or accommodating telecommunication services in road construction projects (Baril et al., 2008).

2.4.2 Utility shifting in Sri Lankan Road projects

In Sri Lanka as a part of road construction projects utility shifting has been carried out according to the rules and standards stipulated by legal bodies and government authorities (Perera et al., 2009). For instance, the Proposed Central Expressway Project report mentioned the process to be followed while shifting utilities as required (RDA, 2016). Further, they stated that published standards and methodologies govern the entire picture of the relocation process and avoid unnecessary conflicts during implementation. Identification of existing artifacts, which are significant to road corridor in terms of utilities, location mapping, identification of possible impacts, and addressing suitable recommendations as mitigation measures for potential conflicts, are mainly focused on the general methodology developed by authorities in Sri Lanka for utility shifting (RDA, 2009). In addition to that, physical integration between service utilities and traffic carrying ability also should be accounted for in the utility shifting process (Wijekoon & Attanayake, 2012).

By the way in Sri Lankan Road construction projects, utility shifting may suffer from several causes from the external environment such as social, cultural, and ecological (RDA, 2016). For instance, problems may arise from the above sides of external sources when acquiring lands to relocate utilities (Wijekoon & Attanayake, 2012).

In contrast, when considering about utility shifting process, approval to relocate utilities from the respective supply authority should be obtained before shifting utilities (RDA, 2016). In addition to that, other countries have developed their provisions to regulate utility shifting under local government authorities to mitigate causes between parties (Michael et al., 2002). Reasons for approvals required for utility shifting in Sri Lanka are summarised in Table 2-1.

Table 2-1 - Summary of Approvals required for the Project.

Institution/ Department	Reasons for Required Approvals	Status of Concern
Ceylon Electricity Board	As the alignment will intersect/ affect transmission lines	

Sri Lanka Telecom	Telecommunication networks that may need shifting	
National Water Supply and Drainage Board	Water supply networks may need shifting	

Source: RDA, Proposed Central Expressway Project, 2016, pg. 21

2.5 Causes of delay in utility shifting for road projects

An array of causes in utility shifting in road construction is identified through studies in the construction context (Thilakaratne, Buhar, Zhao, Senga, & Vokes, 2009). According to previous studies following causes have been identified in Utility Shifting.

Table 2-2: Summary of Causes of Delay in Utility Shifting

No	Causes	RDA, 2016	RDA, 2009	Kawakami, 2005	Sturgill et al, 2104	Michael et al, 2002	Reinke, 2010	Thilakaratne et al, 2009	Baril et al, 2008	RDA, 2011	Krick & James, 1980	Highway/Utility Guide (1993	Jeyakanthan & Jayawardane, 2012)
1	Lack of coordination		x			x							
2	Less priority	x	x					x					
3	Improper joint planning		x			x							
4	Selection of Procurement Contractors								x	x			
5	Scheduling delays							x	x				
6	Limited resources		x				x						
7	Phasing of construction and working out of sequence			x			x						
8	Insufficient budget allocation and inadequate personnel			x	x								
9	Weather Patterns	x								x	x		
10	Planning and Coordination issues											x	
11	Design issues			x								x	
12	Permits issues											x	
13	Information management and mapping issues					x			x			x	
14	Notification procedure issues											x	
15	Legal aspects issues	x										x	
16	Safety concerns issues			x								x	
17	Traffic volume issues											x	
18	Poor Communication pattern between parties											x	
19	Procurement issues									x		x	

No	Causes	RDA, 2016	RDA, 2009	Kawakami, 2005	Sturgill et al, 2104	Michael et al, 2002	Reinke, 2010	Thilakaratne et al, 2009	Baril et al, 2008	RDA, 2011	Krick & James, 1980	Highway/Utility Guide (1993	Jeyakanthan & Jayawardane, 2012)
20	Management of Right of way			x									x
21	Poor Drawings												x

2.6 Delay claims in road construction projects

Achievement of the three parameters of a project namely, time, cost, and quality have been used to measure the effectiveness of a project in the construction industry where project teams aim to achieve these objectives through numerous measures (Frimpong, Oluwoye, & Crawford, 2003). Among these parameters, Remon & Asmaa (2016) emphasise that a delay in the completion time can affect both time and cost, especially in road construction projects where timely completion is considered a critical success factor affecting the economic system of countries. However, delays in road construction can be identified as inevitable without proper planning due to numerous reasons including location-specific factors, project budget, and project specifications (Sullivan & Harris, 1986). Accordingly, as illustrated by Chabota, Muya, & Mumba (2009), the detrimental impacts of project delays can be higher in developing countries where the economies are highly dependent upon the infrastructure projects which compose a major aspect of the economy.

Accordingly, Alkass et al. (1995) stated that due to the inevitable nature of delays in a construction project, various claims emerged while some of these claims led up to litigation proceedings. Further, a delay in the completion time and disruption to cost targets can be difficult aspects to prove when obtaining a claim, especially in complex projects such as road construction with many supporting activities and stakeholder involvement (Alnaas et al., 2014). Therefore, delays in construction projects require time extension and cost overrun claims in terms of both the client and the contractor since the absence of these claims can prove the projects to become unprofitable without an option to claim for damages (Kamanga & Stewen, 2013).

From a different perspective, based on the causes and effects of delays, they can be identified and categorised separately where different claims have been developed to address these categories (Keane & Calettka, 2008). However, Alkass et al., (1996) categorised delay claims based on the party responsible for the delays under excusable, non-excusable and concurrent delays. As a further argument on the point, Enshassi et al. (2009) developed a categorization based on the compensation ability of delays leading to claims as compensable and non-compensable delays. Thus, for the ease of identification of the ability to claim, a standardised claims management system along with proper documentation needs to be initiated following any incident which can lead to a claim (Mehany & Grigg, 2016). Accordingly, the impact, timing, and causes that contributed to the delay need to be evaluated properly to identify the responsible party when pursuing negotiations or court actions on different claims, hence, proper identification of these factors can result in successful claim settlements (Kartam, 1999). Furthermore, Braimah (2013) states that contractors are required to submit delay claim submissions along with supporting documents to assist the employer in adjusting the contract price or time of the project to obtain Extension of Time (EOT) and cost overrun claims, respectively.

Moreover, Murdoch & Hughes (1992) explained that contractors erroneously presume that extension of time claims are associated with additional payments, thus, many contractors fail to pursue payment claims in addition to time extensions. Therefore, it must be apprehended that while many of the causes of time extensions entitle additional payments and reimbursements, these cost claims must be claimed using different provisions provided in standard forms of contracts (Thomas, 1993). Besides, Dok & Odoom (2020) stated that among many variable factors affecting the time extensions and cost overrun claims in road construction projects, adverse weather conditions, changes to contract scope, suspension of work especially due to delays in utility shifting can be identified as severe factors contributing to higher claims and disputes between the stakeholders of projects.

Further, there are particular conditions in the contract that ensure the contractor has the right to make a claim for delays in the construction process. Sub clause 20.1 of the FIDIC (1999) stated that if the contractor considered he was entitled to any extension

of time for completion or any further payments under any clause of these conditions or otherwise in connection with the contract, contractor has liability to claim for the delays. The foregoing statement was approved in SBD 2 (2007) Sub Clause 19.1, which indicated that the contractor can claim for the above-mentioned claims due to delays in construction operations that were not under his control.

However, the conditions which are entitled to claim extension of time were described in the Sub Clause 8.4 in SBD 2 and FIDIC 1999 Red Book under Extension of Time for Completion.

2.6.1 Extension of time claims

Delays in construction projects influence parties involved in a construction project in various manners where the owner and the contractor can be identified as the parties severely affected in terms of completion time, thus, Extension of Time claims have been developed to address the causes related to delays (Remon & Asmaa, 2016). Besides, Wallace (1986) emphasises that claims for time extension have been a recurring dispute source where civil engineering projects are majorly associated with these claims due to the uncertain nature surpassing the building construction by a higher margin.

Accordingly, time extension claims are utilised by contractors to reduce or to avoid liquidated damages owed to them and to claim for extra payments to which they are entitled due to the extended period outside of their control (Yogeswaran, Kumaraswamy, & Miller, 1998). Furthermore, in discussing the need for time extensions claims, Yusuwan & Adnan (2013) stated that standard forms of contracts used by different segments in the world have provided adequate clauses allowing the contractor to claim for time extensions due to acceptable reasons during project execution. Simultaneously, the employer gains benefit from time extension claims where he retains the entitlement to claim liquidated damages in the event that the contractor fails to meet the contractual obligations within the extended, stipulated time (Yogeswaran et al., 1998).

Consequently, Alnaas et al. (2014) emphasised the relevance of the contractor to retain adequate documentation to exonerate him from the responsibility behind the delay and

to provide evidence indicating the responsibility of other parties for the delay which is being claimed. However, for a time extension claim to be enacted, it must be accompanied by a thorough analysis of the quantification of the delay and its impact on the critical path of the project which is approved as the project program by the employer (Yusuwan & Adnan, 2013).

Apart from the contractual provisions in the standard forms of contracts, the practical application needs to be focused upon in deciding the proper approach to claiming a time extension in a construction project (Alnaas et al., 2014). Therefore, Haider & Barnes (2011) proposed a practical approach that can be utilised as a guideline in preparing a comprehensive extension of time claim, consisting of proper program updates and revisions by introducing updates to the construction program and defining relevant contractual claims to apply for time extensions.

Furthermore, as previously stated, the contractor is liable to make a claim for delays under FIDIC 1999 Red Book Sub Clause 20.1 and SBD 2 Sub Clause 19.1 (FIDIC, 1999 & SBD 2, 2007). Furthermore, there are a series of conditions that must be fulfilled in order to get an extension of time claim, as described in Sub Clause 8.4 of the Condition of Contracts. Contractors are given EOT under Sub-Clause 8.4 Extension of Time for Completion for the completion of the project based on the conditions stated in Sub Clause 8.4; (a), (b), (c), (d) and (e) (1999, FIDIC).

Furthermore, there are various Sub Clause that are subject to Sub Clause 8.4 in terms of claiming time extensions in delays for the contractor. For instance, Extension of time claims can be made under Sub Clause 8.5; Delay Caused by the Authorities, as the delay is covered under Sub Clause 8.4. (b).

2.6.2 Cost Overruns and Other Cost Related Claims

Cost overruns can arise based on a cumulative result of different factors; however, a major contributory factor can be identified as the delay-cause claims, especially in infrastructure projects that raise the necessity for effective management systems to mitigate cost overruns in the construction industry (Mehany & Grigg, 2016). Furthermore, Schexnayder et al. (2003) categorised the causes leading to cost escalation and overruns based on two broader parameters: uncontrollable and

controllable factors contributing to cost overruns. Therefore, different contractual provisions were introduced by the standard forms of contracts to address the cost overrun claims by the contractor, based mainly upon uncontrollable factors (Merewitz, 1973). Further, Al-Momani (2000) stated that due to the complexity and the highly volatile nature of the civil engineering projects, it can be concluded that all the projects are subjected to delays and subjected to the occurrence of variations in the construction phase where this factor resulted in the addition of variation and time escalation claims in the standard forms of contracts globally. Based on the conditions of contract, Cost overruns are also addressed under Contractor's Claim in Sub Clause 20.1 (FIDIC 1999) and Sub Clause 19.1 (SBD 2, 2007).

2.7 Extension of time (EOT) claims due to utility shifting for road projects

Delays in construction projects leading to EOT claims can be caused by the contractor as well as the owner based on numerous factors (Chaphalkar & Iyer, 2014). According to Vilventhan & Kalidindi (2016), these factors can be mainly identified during the pre-construction activities where delays in land acquisition and utility shifting are major issues of time extensions. Among these factors, delays caused by the client can be used to claim for extension of time by the contractor (Goodrum, Smith, Slaughter, & Kari, 2008). Subsequently, Rayes et al. (2017) stated that issues including work disruptions, conflicts in utility shifting, changes in the design, issues in right of way and permits along with weather conditions can be identified as issues leading to EOT claims under traditional contracting methods. Accordingly, Vilventhan & Kalidindi (2016) emphasised that major delays and EOT claims are caused due to issues over utility relocation in road construction projects. Similarly, Vilventhan & Kalidindi (2018) stated that the most common causes of EOT claims can be identified as delays in utility shifting. Further, Thomas, Ellis, & Sinha (2006) identified utility-related causes as leading causes of delays in the construction phase of highways and other civil engineering projects.

Due to the increasing demand for services, enlarging and renewing utilities along with roadways have been conducted in every region (Torngren, 1972). Therefore, Booth (1963) stated that with the increased roadway construction, the need to relocate utilities along the road lines has been increased. This can be identified as a common issue in

construction projects since most contracts are awarded to the contractor before finalizing the lands for the project (Vilventhan & Kalidindi, 2016). Based on this premise, Goodrum et al. (2008) stated that most utility relocations happen without the knowledge of transport agencies as well. Similarly, Thomas et al. (2006) elaborated that utility relocation is a common incident since uncoordinated utility placings have resulted in EOT claims in numerous civil engineering projects. Since underground utilities are not properly mapped on drawings or any other sources, most of the utility lines can only be identified during the implementation phase resulting in time extension claims (Vilventhan & Kalidindi, 2016). Further, Goodrum et al. (2008) stated that many delays related to utility shifting occurs as a result of failure to determine whether utility lines are active or abandoned. Further, delays in obtaining construction permits and other legal requirements can lead to EOT claims (Stojadinovic, 2018).

Contractors need to quantify time delays and impacts of the disruptions to the project program to ease the process of extension claims and to support different contractual claims (Stojadinovic, 2018). Since utility shifting often leads to schedule and cost overruns in road construction projects, proper planning is required to avoid these claims (Vilventhan & Kalidindi, 2016). Moreover, Booth (1963) stated that legislative claims are enabled for the contractor to be reimbursed for the cost incurred in relocating services by relevant authorities. However, diverse problems including design and layout changes to the project can arise due to heavy relocation work involvement in road construction projects (Vilventhan & Kalidindi, 2016). Accordingly, the need for revised drawings leads to further delays and EOT claims when executing the project (Chaphalkar & Iyer, 2014). However, contractual claims are only permitted based on the impact on the remaining activities especially on critical path activities (Stojadinovic, 2018). According to Vilventhan & Kalidindi (2018), EOT claims on utility-related causes are given only when the delays happen extensively due to relocation work. Since most cost items incurred with relocation work are calculated daily, the number of days claimed for the time extension is considered an important factor (Stojadinovic, 2018). According to The Local Assistance Procedures Manual (2013), many highway contracts contain bid items to

cover utility relocation costs. Therefore, compensable delays can be exploited by the contractor when claiming for time extensions along with additional costs incurred due to the delay using concise contractual provisions (Zech, Crowley, & Bailey, 2008).

Moreover, according to the conditions of contract, Utility shifting delays are covered by Sub Clause 8.4; Delay Caused by Authorities and as a result, time extensions can only be granted under Sub Clause 8.5, which is linked to Sub Clause 8.4 (b) Time Extension Claims (FIDIC, 1999 & SBD 2, 2007).

2.7.1 Requirements for Concise Contractual Provisions for EOT due to Delays in Utility Shifting

The decision of granting an extension of time claims through contractual provisions depends on identifying the responsibility of delay through proper investigations and analysis (Shabbar et al., 2017). As illustrated by Quiroga et al. (2008), only basic requirements are covered by the utility accommodation policies in practice, thus, additional specifications and special provisions in the contract documents have been used to address a wide range of utility-related causes. According to the contractual provisions, the Court would decide whether the relevant authorities or the employer has to reimburse the contractor for the work (Stokes, 2011). However, the request to claim for time extensions will only be granted if they are approved based on a verbal or a written preliminary authorization (Manual, 2013). Moreover, delays can lead to liquidated damages, time extension claims, or monetary compensation to the contractor, thus, must be avoided whenever possible (Shabbar et al., 2017). As elaborated by Mohsin (2012), different contractual claims are inevitable in construction projects, especially in road construction where these claims can affect vertically to all the activities in a project.

Delays due to utility shifting can be identified as a unique problem associated with road construction projects where limited literature can be found addressing this specific area (Vilventhan & Kalidindi, 2016). However, Goodrum et al. (2008) have identified utility-related causes as one of the leading sources of construction delays in many roadway projects. Accordingly, utility-related causes need to be addressed in a contractual manner where they need to be identified whether they are within the

control of the stakeholders (Shabbar et al., 2017). Further, they identified that contractual claims can be considered under force majeure or excusable or non-excusable factors to determine their ability to claim. Accordingly, under excusable delays, contractors are granted additional time provisions based on different contractual terms (Zech et al., 2008). As a controversial argument, Quiroga, Ford, Taylor, Kranc, & Kraus (2008) stated that a combined strategy is preferred over the conventional method since allowing the contractor to be held accountable for the relocations through the contractual provisions can mitigate many causes related to utility shifting. However, Chaphalkar & Iyer (2014) elaborated that contractual claim are inevitable due to the volatile nature of the construction industry. Therefore, the lack of contractual claims in the contract regarding utility shifting will require all the stakeholders to follow different protocols (Quiroga et al., 2008). Moreover, the consequences of delays of a project including EOT and cost overruns are supported by different tools, techniques, and provisions in contracts to safeguard stakeholders of a project (Shabbar et al., 2017). As a solution to the extensive amounts of claims due to numerous factors such as utility shifting, different project delivery methods have been suggested as being effective such as the design and build method of construction (Martin & Najafi, 2007). Accordingly, it was identified by Shabbar et al. (2017) that the construction industry is moving towards better contractual practices hence, in Sri Lanka, contractors need to be knowledgeable on the use of SBD 02, FIDIC, and NEC documents to obtain proper claims to avoid losses (Perera et al., 2009).

2.7.2 Application of Standard Forms of Contracts in EOT Claims due to Delays in Utility Shifting

Delays in construction projects can be identified and addressed with the use of Standard Forms of Contracts by applying different contractual provisions as applicable (Amarathunga et al., 2016). Among these different standard forms of contracts used throughout the world, FIDIC Conditions of Contracts for Construction can be identified as a globally applied standard form of contracts where ICTAD SBD 02 is used in the Sri Lankan context (Baduge & Jayasena, 2012). They further stated that these two documents provide relatively similar applications to address different contractual causes. Accordingly, the main reasons for delays and EOT claims were

identified as providing provisions that are inadequate in dispute resolution in different contract clauses (Mishra et al., 2018). According to Goonaratne (2014), FIDIC contracts are intended to act as guidance in operating in the construction project rather than being a contractual document. Therefore, the Contractor is expected to inform the Engineer whether the works are likely to be delayed due to causes of the client (Robinson, 2011). Accordingly, based on the standard forms of contract, the basic requirement is that the Contractor needs to submit the intention to claim within 28 days after the contractor becomes aware of the claim (Goonaratne, 2014).

According to the FIDIC clauses, the contract exists between the Contractor and the Employer where subsequent agreements can exist between the Employer and the Engineer (Goonaratne, 2014). However, the utility lines and other public works are owned and executed by public agencies and authorities who are incidental to relocation works (Torngren, 1972). Accordingly, Zech et al. (2008) stated that many disputes and delays causing EOT claims to arise due to lack of coordination among these stakeholders. Therefore, proper contractual provisions are mandatory to resolve disputes which can lead to different claims where a party failing to comply with the terms specified in clauses will be held accountable for damages (Goonaratne, 2014).

2.8 Impact of EOT due to delay in utility shifting for Sri Lankan Road projects

Delaying the original completion date due to time extension claims can be identified as a frequent practice in road construction projects where the volatile nature of the projects leading to dire consequences for all the stakeholders of a project including the road users (Perera et al., 2009). Similarly, Faridi & El-Sayegh (2007) stated that the impacts of extension of time claims are not limited to the client, contractor, or the consulting party, rather it can have considerable consequences to the economy of the country where higher consequences can arise to developing countries due to their dependency of civil engineering construction work to the GD.

2.8.1 Cost Impacts of EOT due to Delay in Utility Shifting

Further, time extension claims can result in subsequent cost overrun claims through increased workload leading to overhead costs based on the extensions arising due to delays in road construction works (Mansfield, Ugwu, & Doran, 1994). Subsequently,

Odeh & Battaineh (2002) linked the cost overruns with the accrued interest charges on borrowings made for the project due to time extension claims where many developing countries depend on foreign loans to develop infrastructure. Therefore, Odeh & Battaineh (2002) further emphasised that extension of time claims can delay the completion time allowing a higher interest build-up for both the client and the contractor. Even though, there is no additional cost granted for the contractor due to the delay in Utility Shifting process as the sole responsibility of the process is declared to the utility agencies and the relevant authorities (Ralph et al., 2005).

2.8.2 Other Impacts of EOT Claims due to Delay in Utility Shifting

Apart from the cost overrun claims resulting from time extensions due to utility relocations, it can incur income losses for the country due to the opportunity cost of operating the road since the original completion date (Kazaz et al., 2012). Therefore, Semple, Hartman, & Jergeas (1994) stated that disputes can arise between contractors and utility agencies due to the causes of utility relocation work. They further elaborated that disputes could lead to litigation procedures which can incur additional cost and time to all the stakeholders involved. Further, Aibinu & Jagboro (2002) stated that the extension of time claims due to utility shifting delays can ultimately result in project abandonments.

A different perspective on the impacts of time extension claims due to relocation works and other reasons were discussed by Al-Kharashi & Skitmore (2009) where these EOT claims can lead to delays in public development, disturbances to the execution of budgetary plans of governments, public inconveniences, and other political causes. They further emphasised the importance of road construction for the economy of developing countries, thus, emphasizing the need to complete projects on time without EOT claims. Moreover, Hasan et al. (2014) elaborated that claiming EOT due to utility shifting can cause disruptions to the traffic movement and inconveniences to utility users since these services need to be halted due to the relocation work. Subsequently, Hasan et al. (2014) stated that road construction projects can have impacts on other recreational and investment projects where these roads act as access links between them, thus, increasing the need for road projects to be completed on time without claiming for time extensions.

Furthermore, delays in road projects due to EOT claims caused by utility shifting can result in loss of productivity of the laborers since causes in relocation work can disrupt the continuous workflow (Akomah & Jackson, 2016). Further, they elaborated that the productivity and efficiency of laborers will always be affected due to projects delays and halts resulting from time extension claims and issues in relocation work.

2.9 Methods of mitigating the arise of EOT claims due to delay in road projects.

Extension of time claims can arise in road construction due to numerous factors including delays in utility shifting where it affects negatively the timely completion of the project (Dok & Odoom, 2020). Therefore, the need for methods to mitigate critical factors that contribute to the extension of time claims has been investigated by contractors where principles of project management were mainly used to develop mitigation methods (Alotaibi et al., 2016). Accordingly, Bordoli & Baldwin (1998) emphasised that mitigation actions need to be developed to reduce the potential delay to the critical path of the project by network reanalysis and simulations. However, Bordoli & Baldwin (1998) further stated that mitigation actions should not be taken to accelerate the project, rather, they must be focused upon preventing the delays whenever practicable. Accordingly, Federal Highway Administration (2002) developed strategies based on technological aspects and coordination aspects to mitigate the occurrence in the extension of time claims in road construction projects due to delays in utility shifting and other factors.

2.9.1 Technical Strategies used in Reducing Delays in Utility Shifting

According to Lo, Fung, & Tung (2006), technical strategies used in mitigating utility shifting delays can begin with a comprehensive and in-depth site investigation before the construction phase where it facilitates the development of technical strategies which can reduce the impact of unforeseen ground conditions. By conducting a prior investigation, the contractor can identify and remove abandoned utilities during the early stages of the project and reduce complications during relocations (Federal Highway Administration, 2002). This mitigation strategy was further supported by the Federal Highway Administration (2002) stating that a considerable amount of time is wasted in every road project due to discrepancies in deciding whether the service lines are functioning or out-of-service. Further, avoiding utility shifting through design

changes in the early stages of a road project can reduce the need for relocation work (Sturgill, Taylor, Ghorashinezhud, & Zhang, 2014). In their study, they have further elaborated that this strategy can increase the design time and cost while saving time and cost in construction stages due to fewer relocation works.

Furthermore, Oyegoke & Al Kiyumi (2017) stated that the use of advanced technologies such as Building Information Modelling (BIM) can assist the design team to identify and design the road construction layout avoiding unnecessary relocation of utilities to reduce the possibility of time extensions to arise. Another technical strategy was proposed by Leuderalbert (1999), where utility authorities can consider the usage of joint trenching or joint utility corridors to combine facilities to utilise a single line to facilitate construction work since this can reduce conflicts between utility authorities and contractors or project owners.

2.9.2 Coordinating Strategies used in Reducing Delays in Utility Shifting

Quiroga, et al. (2012) elaborated that coordination strategies can be used to reduce delays in utility shifting where these strategies are aimed at coordinating activities in the construction phase in a manner that assist the smooth functioning of the relocation process. They further emphasised that conducting periodic planning or coordinating meetings on a monthly or quarterly basis can be identified as one of the most important strategies to undertake during the construction phase. Adding more to the similar argument, Federal Highway Administration (2002) stated that if all the parties involved with the utility shifting process including the utility agencies and the relevant authorities participated in these coordination meetings, it can assist in resolving all the causes and improve communication among different parties to reduce delays. Further, conducting these meetings more frequently in the early stages of a project to coordinate the relocation process can eliminate the need to halt the construction process due to unresolved causes on utility shifting and to achieve efficient road design, economical utility shifting process, and reduced cost and time on construction (GAO, 1999).

According to Federal Highway Administration (2002), another coordinating strategy can be identified as the initiation of a project-level monitoring committee for the utility shifting work where different case studies further proved that utility shifting was

properly coordinated, and the relocation work was done without delays in projects with project-level monitoring committee. As a supporting argument, Sturgill et al. (2014) stated that employing a utility coordinator for projects with high relocation work involvements can assist the utility shifting work where a utility coordinator retains the responsibility in acting as a resource person for the work and manage communications between parties from the identification stage of utilities to the completion of shifting work.

Apart from the above-mentioned coordinating strategies which can be implemented during the construction stage, numerous steps can be undertaken during the initial stages of a project where the contractor can negotiate a realistic contract period with the client based on the amount of utility shifting work associated with the project (Oyegoke & Al Kiyumi, 2017). Further, they elaborated that the contractor could conduct capacity planning to increase work shifts between laborers to increase productivity to match the excessive work involved with the utility shifting process.

Accordingly, the above mitigation strategies assist the project team to understand and eliminate the delays from arising due to utility shifting where it allows buffering the projects to overcome negative impacts to the overall completion time of the project (Chou, Caldas, Connor, Sroka, & Goldman, 2009). Therefore, Osman & El-Diraby (2007) stated that reducing delays in utility relocation can be identified as a universal issue that needs to be addressed using appropriate strategies.

2.10 Chapter summary

This chapter fulfilled the first and second objectives of the research partially with the support of the existing literature review. These objectives were achieved with the collaboration of journals, books and conference papers. It was highlighted that there is a lack of existing literature related to utility shifting in the local and international context. Further highlighted that limited literate findings were extracted from previous studies concerning the contractual provisions of the utility shifting and its delays. In order to push the acquired data through primary evaluation, it is necessary to extend the time claims in road construction in Sri Lanka. The fourth chapter of this study goes into great detail about a data analysis approach for achieving the research goals.

3. METHODOLOGY CHAPTER 03

3.1 Introduction

This chapter describes how the research is conducted. This chapter includes research methods, research design, data collection and analysis techniques, and research process. The mixed approach has been selected as the research method, and the reasons for the choice are discussed in the research method. According to the research strategy, the survey was selected and the reasons for the selection were explained. In the data collection part, literature review, questionnaire survey and expert interviews were discussed. In the same part, content analysis, RII and severity index methods are also discussed as data analysis techniques. Through a detailed description of these three stages, the research process is discussed.

3.2 Research Design

The research design can be referred as the structure of the research and it is the "glue" that combines all the elements of the research project. In short, this is the plan of the proposed research work (Akhtar, 2016). Further, the research design aims to provide an appropriate framework for research (Jilica , 2019). However, a very important decision in the research design process is to choose the research method, because it determines how to obtain the relevant information of the research. However, the research design process involves many interrelated decisions (Aaker et al., 2000). This is a step-by-step process and before the data collection and analysis process begins, researchers will use this process to effectively achieve the research goals (Asenahabi, 2019). Jongbo (2014) pointed out that if researchers must collect data before considering study design questions and the information required to answer the research questions, the results reached are more likely to be powerful and convincing and therefore ultimately unable to achieve the research goals.

Further, the Research design is necessary because it enables various research procedures to proceed smoothly, so that the research work is as professional as possible, so as to generate the greatest information with the least energy, time and money (Akhtar, 2016). This was supported by Asenahabi (2019) and stated that, the essence of research design is to transform research questions into data for analysis, so

as to provide relevant answers to research questions and reduce costs. However, Research design must include strategies for interpreting and analysing data to provide sufficient research results and conclusions so that researchers can make recommendations (Vogt et al., 2012).

3.3 Research Approach

A research approach is an action plan that can provide guidance for systematic and effective research (Mohajan, 2017). According to Creswell (2009), there are three main approaches of researches; qualitative, quantitative and mixed.

3.3.1 Quantitative Approach

The purpose of quantitative research is to examine the relationship between variables, such as dependent variables, independent variables and irrelevant variables (Creswell, 2009). Further, quantitative research design is a technique and measure that produces quantifiable/discrete values (Kothari, 2004). The data collected comes from empirical observation and measurement. These methods require a lot of time and planning, and they always tend to be closed responses (Asenahabi, 2019). However, quantitative research is considered an analytical method of research. Usually, in quantitative research, researchers collect more than one type of data in order to get a better and more comprehensive picture of what is happening in the field (Elkatwneh, 2016). As stated by Rovia, Baker and Ponton (2014), quantitative researchers see the world as a world outside of themselves, and there is an objective reality independent of any observation.

3.3.2 Qualitative Approach

Qualitative research emphasises exploring and understanding the meaning of a person or group of people attributed to social or human problems (Creswell, 2014). Qualitative research is an exploratory nature, so qualitative research usually begins with words such as "What" or "How". Since these words mean discovering your exploration, since qualitative research is exploratory, there is usually no hypothesis, and hypothesis is essentially a predicate, and qualitative research tries to explore rather than predict the opinions of participants (Elkatwneh, 2016). However, the data generated by the qualitative research design cannot be quantified using open-ended

questions. In this way, researchers can conduct investigations based on their specific circumstances and the meaning they bring to them in order to understand the problem (Denzin & Lincoln, 2005). However, its main focus is to generate meaning, purpose or reality from the perspectives and experiences of the participants (Merriam, 2009).

3.3.3 Mixed Approach

Mixed method research design is the integration of qualitative research and quantitative research, as well as data in research (Asenahabi, 2019). Further, researchers combine the elements of qualitative and quantitative research methods to achieve a wide range of purposes, understanding and confirmation purposes (Burke-Johnson et al., 2007). In mixed method research design, qualitative research introduces open data without a predetermined response, while quantitative research introduces closed data (Cresswell, 2014).

3.3.4 Selected Approach for this Study

Because of the research gap, there were fewer researches had been conducted in this field, and the scarcity of literature was one of the most significant factors to consider while deciding on an appropriate technique. However, up to objective 2 could be partially determined through a literature review. As a result, interviews were used to fill up the research vacuum. In addition, a questionnaire poll was conducted in order to rank the causes of delay based on the possibility of arising extension of time claims and the significance level. As a result, this approach, which included both interviews and questionnaires, was approved for use in the Mixed Research Approach. The first part of the research included a series of preliminary interviews with experts in Road Construction Industry prop to the questionnaire survey. In addition, another set of interviews was carried out after the questionnaire survey.

3.4 Data Collection Techniques

Once the research methods and strategies are selected, appropriate research techniques must be found. According to the study of Creswell (2014), the purpose of survey research is determined, survey instructions are the preferred type of data collection procedure, and data collection is designated as an important design step of survey design. Telephone, email, Internet, group management and personal interviews are the

main forms of data collection forms in survey design (Elkatwneh, 2016). The success of the research depends on the accuracy of the data. Therefore, choosing the right data collection method is crucial.

3.4.1 Literature Review

It is important to consider the literature review of research projects in advance (Snyder, 2014). In order to assess the research background, problems, and determine goals and objectives, it is important to address the facts that have been discussed in previous studies. Therefore, a very comprehensive literature review has been carried out by covering all the relevant and necessary areas under review on the need for utility shifting in road construction projects, the causes of delay in utility shifting for road construction projects and the possibility of arising Extension of Time claims due to delay in utility shifting. In addition to that, objective 1 have been fully discovered through literature review while the objective 2 was partially discussed and identified through the literature review.

3.4.2 Preliminary Interviews with expert validation

After finding out the causes of delay in utility shifting for road construction projects through the literature review, six number preliminary interviews were carried out to identify new causes which were not discovered from the literature review and to validate the causes of delay in Utility Shifting to the Sri Lankan context.

3.4.3 Questionnaire Survey

Questionnaire survey is usually conducted using some form of questionnaire (Young, 2016). These questionnaires also include checklists, tests, scales, surveys, timetables, indexes and checklists (Dörnyei, 2007). In this study, mainly the objective 3 and 4 were accomplished through the questionnaire survey. In order to identify the most severe causes of delay in utility shifting, questionnaires were distributed to the professionals in the road construction projects.

3.4.4 Expert Interviews

In order to identify and discuss the main findings of objective 5, expert interviews were conducted. During the interview, experts who are familiar with the transfer of public

utilities in road construction projects were selected. The expert group was composed of eight experts with knowledge of related fields. In addition to that, the most suitable solutions to mitigate the most severe causes of delay in utility shifting were achieved through expert interviews. Therefore, under the qualitative method, this technique was used as the most suitable technique to achieve the ultimate goal.

3.5 Data Analysis Techniques

Data analysis is the process of transforming collected data into orderly structured information. This is an ambiguous, time-consuming, resource-rich and interesting process (Kapur, 2018). In another term, data analysis is called searching for answers to the relationships between various data categories (Snyder, 2014). This research is based on a mixed-method, so qualitative and quantitative analysis should be performed for proper data analysis.

3.5.1 Quantitative Analysis – Relative Importance Index (RII)

RII can be used to evaluate the criticality of the problem, the importance of the solution, and the suitability of the criteria in order to avoid the problem (Mahamid, 2011).

$$\text{RII} = \frac{\sum_{i=1}^{5} fi}{FN}$$

RII= Relative Importance Index; fi= Frequency of responses for an attribute (ranging from 1-5); N= Number of responses; F=Maximum Value for a Response (Kassem et al., 2021)

3.5.2 Qualitative Analysis – Content Analysis

Content analysis can be regarded as a scientific exploration of content. Its purpose is to create a systematic citation and inference of the meaning, context and goals contained in the text, messages and other forms of communication, so as to provide effective and reproducible information for further research (Prasad, 2008). It analyses the content by breaking it down into conceptual blocks, and then code or name these blocks. Qualitative analysis will develop categories as the analysis progresses. The result is used to infer the message in the text.

3.5.3 Quantitative Analysis – Severity Index

In order to analyse the survey results of the two scales, the severity index of each cause was calculated. The main purpose of calculating the severity is to identify most severe causes of delay in utility shifting. Calculation have been done using the RII values of possibility of occurrence and significance of impact. The following formula shows the calculation of the severity index of risk factors (Source: Severity Index user Guide, 2020).

$$\mathbf{SI=}\alpha_j^j \beta_j^j + \Gamma$$

Where,

SI = Evaluation of risk severity of cause

α_j^j = Evaluation of frequency level of cause occurrence

β_j^j = Evaluation of significance of cause impact

Γ = Complexity of cause

However, since the complexity is taken into account when rating the significance of impact in the study, the complexity of the delay causes was not calculated in this research. Therefore, in the formula, complexity of the cause has been disregarded.

3.6 Data Validation

3.6.1 Internal Consistency of Sample - Cronbach Alpha Calculation

Cronbach Alpha was created by Lee Cronbach in 1951 to assess a test's or scale's internal consistency. A number between 0 and 1 is used to describe it. Internal consistency refers to the degree to which all test items measure the same notion or structure, and it is linked to the test's interconnectedness (Tavakol & Dennick, 2011). The following formula can be used to calculate the contract alpha of a sample,

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum V_i}{V_t}\right)$$

K = Number of Factors

Vi = Sum of the Risk Factors Variances

Vt = Variance of Total Scores in Severity Index

Using the above formula, the Cronbach Alpha of the severity index sample was calculated and determined the appearance of internal consistency of the sample. As mentioned above, the following scale is used to determine the accuracy of the internal consistency of the sample (Stephanie, 2014).

$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 \geq \alpha$	Unacceptable

Figure 3.1: Thumb rule of Cronbach Alpha Results
(Stephanie, 2014)

3.7 Research Process

The research process is the process of determining what information is currently contained in the literature, how the data is collected, and the techniques that can be used to analyse these findings.

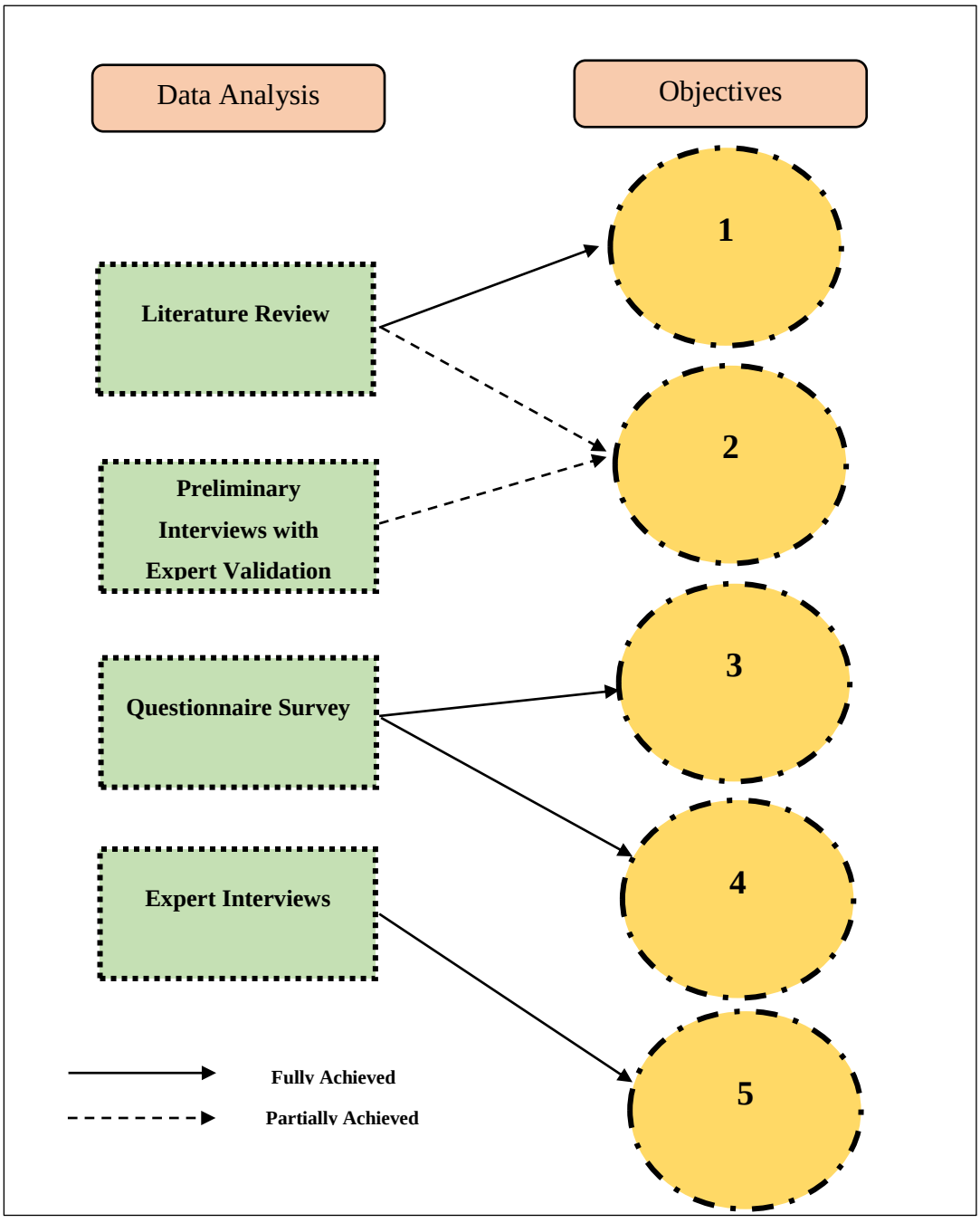

Figure 3-2: Research Process

3.8 Summary

This chapter explains the reasons for choosing the mixed method as the research method and explains the reason for the mixed method as the research strategy for the research. In addition, preliminary interviews were conducted to identify new actors, questionnaire surveys were carried out to rank the samples and semi-structured interviews were conducted to achieve the ultimate goal. To analyse the collected data, content analysis, RII and severity index method were used.

4. DATA ANALYSIS CHAPTER 04

4.1 Introduction

In the prior chapter, the research process and methodology were discussed. This chapter goes into the preliminary interview analysis and outcomes, as well as the structured questionnaire and semi-structured interviews, all of which were conducted using the technique outlined in methodology chapter. This chapter aims to investigate the most significant causes in delay in utility shifting and the possibility of generating extension of time claims due to utility shifting delays and identify the most severe causes of delay in utility shifting for Extension of Time claims in Sri Lanka. Further, proposed strategies will be identified as the last part of the analysis. The overall analysis was divided into the following three phases: phase I focused on the preliminary interview, phase II analysed the questionnaire round, and phase III analysed the expert interviews.

4.2 Phase I - Preliminary Interviews with Expert Validation

The research mainly outlines the causes of delaying utility shifting, and the literature review discovered a number of causes for general road construction projects. However, when it comes to road construction in Sri Lanka, the detected causes may alter, and a number of new causes may need to be found for further investigation. As a result, a preliminary interview round was undertaken with six of the most experienced road construction experts in order to identify new causes and notable changes in causes identified in the literature review that was relevant to the Sri Lankan context.

4.2.1 Phase I - Main Objectives of Preliminary Interviews

The preliminary interviews were conducted with six number experts in road construction projects in Sri Lanka. The main objective was to find new causes involving utility shifting that had not been identified by the literature review. In addition, a number of causes were modified to fit the Sri Lankan context, and existing components were validated for the Sri Lankan setting.

4.2.2 Phase I – Respondents of Preliminary Interview

Based on their experience in road construction projects, six experts were selected for preliminary interviews. The selected respondents had vast knowledge and experience in utility shifting in Road construction and all the respondents were Engineers with high technical skills. The details of the respondents are listed as follows.

Table 4.1: respondents of Preliminary Interview

No	Interview Code	Designation	Experience in Construction Industry	Experience in Road Construction Industry
1	A1	Project Director	29	29
2	A2	Deputy Project Director	29	29
3	A3	Deputy Director	30	30
4	A4	Project Manager	17	12
5	A5	Deputy Project Manager	15	10
6	A6	Resident Engineer	13	13

4.2.3 Phase I - Findings of Preliminary Interview

Twenty-one causes of delay in utility shifting were identified through the literature review and brought forwarded to the expert validation. Among them, eight factors were amalgamated and altered to seven causes. In addition to that, ten number causes were changed to ten causes without an amalgamation. The remaining three factors were carried forward as the same and additional four causes were added based on the opinions of experts. Amalgamated causes can be described as follows.

Table 4.2: Amalgamated Causes

Amalgamated Causes and Derived new causes	
Causes identified in Literature Review	**Modified Causes After Preliminary Interviews**
Lack of coordination Poor Communication patterns between parties Notification procedure issues	Lack of coordination by the Contractor with the other relevant utility Authorities and/or the Consultant/client Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor Lack of coordination among different utility Authorities
poor drawings Design issues	Design issues for which the Contractor is responsible Design issues for which the Contractor is not responsible
Scheduling delays Improper joint planning Planning and Coordination issues	

Based on table 4.2, Interviewees A1, A3 and A4 suggested that the causes; Lack of coordination, and Poor Communication patterns between parties have similar conditional issues in utility shifting. In addition to that, A4 explained that the notification procedure issues are a part of the coordination problem and should come under the coordination problems. Therefore, the three causes were amalgamated and derived as three new causes; Lack of coordination by the Contractor with the other relevant utility Authorities and/or the Consultant/client, Lack of coordination by the Client/the Engineer and utility Authorities except for the Contractor and Lack of coordination among different utility Authorities.

Furthermore, according to the opinions of A4, A5 and A6, poor drawing issues and design issues were the causes with similar meaning and amalgamated them as one factor. In most of the road construction projects drawings related to the utility shifting are made at the design stage. Therefore, both the causes are derived at the same stage of the process with similar meanings. Hence, these causes were amalgamated and divided into two causes as Design issues for which the Contractor is responsible and Design issues for which the Contractor is not responsible.

Moreover, Scheduling delays, Improper joint planning, and Planning and Coordination issues are part of the planning process. Hence, these factors were connected together

as same based on the opinions of A1, A4, A5 and A6. In addition to that, two causes were derived from the above three factors; Issues related to Scheduling and Planning of utility shifting by the Contractor, Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor.

In addition to amalgamated causes, ten number causes were amended according to the Sri Lankan context and can be explained as follows,

Table 4.3: Non amalgamated Causes

Non-Amalgamated Causes	
Causes identified in Literature Review	**Modified Causes After Preliminary Interviews**
Less priority	Less priority is given by the utility Authorities
Selection of Procurement Contractors	Utility Authorities' and contractors' issues
Procurement issues	Procurement issues by the utility Authorities
Limited resources	Limited resources allocated to the utility Authorities
Insufficient budget allocation and inadequate personnel	Insufficient budget allocation for the Client
Permits issues	Issues related to getting permission from utility Authorities
Phasing of construction and working out of sequence	Phasing of construction
Safety concerns issues	Safety Concerns by the utility Authorities
	Traffic congestion issues for which the contractor is not responsible
	Traffic congestion issues for which the contractor is responsible
Management of Right of way	Management of Right of Way including Land acquisition

According to the table, Interviewee A2 suggested that the causes; less priority and the procurement issues should be allocated to a responsible party in this context. Therefore, the above-mentioned causes were changed as Less priority given by the utility Authorities and Procurement issues by the utility Authorities.

Similarly, Limited resources, permits issues and Safety concerns issues were also allocated to utility authorities and the amended causes were derived as Limited resources allocated to the utility Authorities, Issues related to getting permission from utility Authorities and Safety Concerns by the utility Authorities.

Furthermore, procurement contractors are chosen for the entire construction procedure. Utility relocation, on the other hand, is a necessary aspect of the

construction process. Meanwhile, there's a chance that the road project and utility relocation will be split between two contractors. As a result, using the entire contactor's perspective as a source of utility shifting delay is not appropriate. Therefore, based on the comments provided by A2 and A3, the factor; selection of procurement contractors was changed to Utility Authorities' and contractors' issues.

Furthermore, the precise limits of the cause had not been delineated in the Insufficient budget allocation and inadequate personnel. As a result, Interviewee A3 changed the cause to Inadequate budget allocation for the Client, as the budget allocation is always subject to the client's party.

Another key cause, which interviewee A6 divided into two groups, was traffic congestion. Utility relocation can cause traffic congestion for a variety of reasons. The majority of traffic cases, however, are the responsibility of the contractor. Even though there are small traffic incidents in the utility relocation project that are not subjected to the contractor. Therefore, the above mentioned caused changed into two causes; Traffic congestion issues for which the contractor is not responsible and Traffic congestion issues for which the contractor is responsible.

Furthermore, interviewee A2 narrowed down Phasing of construction and working out of sequence to Phasing of construction. In addition to that, interviewee A2 stated that most of the time, right-of-way management is associated with land acquisition issues. Therefore, the cause changed as Management of Right of way including Land acquisition.

Moreover, there were three causes which had no amalgamation or alteration and brought forwarded to the next phase of the analysis. In addition to that, four number new causes were identified from the experts of the preliminary interview round.

New Causes Identified from the Preliminary Interviews

During the preliminary interviews, experts were also asked to suggest new causes for delay in Utility Shifting in Sri Lankan Road construction projects. According to their opinions, four new causes added to the study and have been described as follows.

Space Issues for utility Shifting

One of the major problems in the utility shifting is the space issue. When the services line shift to another location, there are number of difficulties will meet due to space problem of the location. Further, utility company needs and shared with utilities only if space is available, or the public road right-of-way be kept to the minimum width and expense required to accommodate the roadway and shared with utilities only if space is available. Therefore, space issue has become one of the main causes of delay in utility shifting.

Public influences

Utility shifting has wide range of impact on the public because the number of problems may occur for the public due to the utility shifting. Utility shifting takes up space and can have negative consequences for natural water supplies and discharge areas. Furthermore, one of the most harmful aspects of utility shifting is that it causes public disruption. During the procedure, noise, dust, and vibrations occur, and they can also occur to a lesser extent during maintenance activities. During the digging process, dust is produced. Excess dust can be reduced by a variety of methods, including watering, the use of alternative materials, and the use of dust binders near homes. In addition to that, process can produce vibration, which can have serious consequences and cause problems for homes near the source. In this situation, public pressure could cause a delay in the process as the people tend to protests and create hurdles to the process in various ways.

Unexpected site conditions found by the utility Agencies

Unexpected site circumstances discovered by utility agencies were another new reason of utility relocation delay. The majority of the time, the utility relocation procedure does not include a thorough ground study during the design phase. As a result, unforeseen site circumstances may arise during the procedure, delaying the process in numerous ways.

Pandemic Issues

Consider to the COVID 19 pandemic, this is one of the most pressing reasons for many construction projects. Due to the pandemic crisis, a number of ongoing projects were put on hold for an extended length of time. The pandemic scenario had an impact on utility transfer activities as well. Furthermore, there were a variety of material and labour shortages as a result of the pandemic scenario. The delay in utility shifting in the road construction project was caused by both labour and material shortages. In addition to that, all of the interviewees from A1 through A6 cited this as a new cause for the utility shifting delays in Sri Lanka.

Considering all the causes, twenty-two number causes were validated by preliminary interviews, and three new causes provided by respondents were added to the causes and passed to the analysis II questionnaire round for further investigation.

4.3 Phase II – Questionnaire Round

After a successful preliminary interview round, the causes of utility shifting delays were forwarded to be investigated further. The respondents were asked to rank the factors in order of the possibility of arising extension of time claims and the significant level of the causes during the questionnaire round. Finally, scores with high values based on quantitative data were chosen as most severe causes of the study.

4.3.1 Phase II - Main Objectives of Questionnaire Round

The key objective of the questionnaire is to rank the causes of delay in utility shifting by possibility of occurrence and significance level. The causes with the highest values of both chances of emerging and significance level were chosen as the most severe causes of utility shifting delay based on the two rankings.

4.3.2 Phase II – Respondents of Questionnaire Round

The first phase of the questionnaire was based on a rating of the causes of utility switching delays. The study's main sample consisted of construction specialists who had worked on road construction projects and had knowledge of utility transfer techniques. The table below summarises the most important experiences and quantitative details from the questionnaire round's responses.

Table 4.4: Respondents of Questionnaire Round

No	Profession	Number	Experience in Construction Industry	Number	Experience in Road Construction Industry	Number
			1-5 Years	1	1-5 Years	1
			6-10 Years	5	6-10 Years	5
			11-15 Years	5	11-15 Years	5
			16-20 Years	2	16-20 Years	2
			21AboveYears	2	21AboveYears	2
			1-5 Years	-	1-5 Years	-
			6-10 Years	4	6-10 Years	5
			11-15 Years	2	11-15 Years	1
			16-20 Years	1	16-20 Years	1
			21AboveYears	-	21AboveYears	
			1-5 Years	-	1-5 Years	-
			6-10 Years	-	6-10 Years	1
			11-15 Years	5	11-15 Years	4
			16-20 Years	3	16-20 Years	3
			21AboveYears	-	21AboveYears	-

In addition, 42 number questionnaires were issued among the experts based on the table, and 30 responses were obtained. The response rate is more than 60%, as can be seen in the chart below.

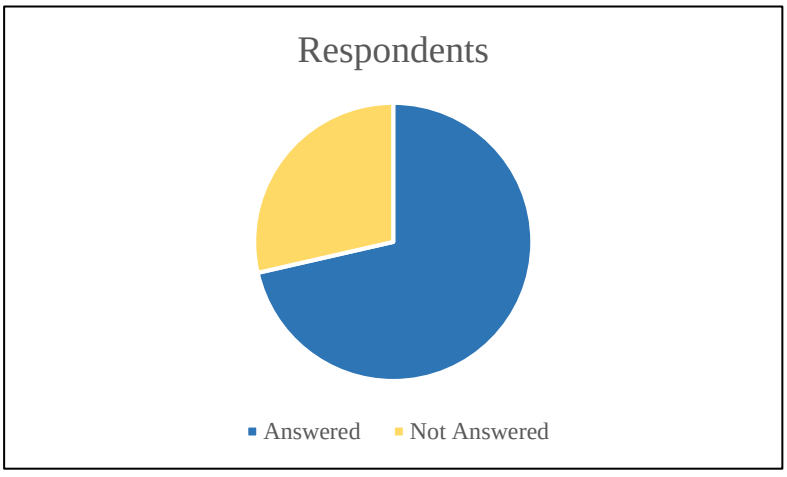

Figure 4.1: Responses Percentages

4.3.3 Phase II - Findings of Questionnaire Round

Phase II was completed in order to meet the study's objectives 3 and 4. As a result, the analyses' principal findings were divided into three categories. To begin, it looks into the possibility of time extension claims developing as a result of utility shifting delays. Following that, the significance of the causes of delay was explored, and by combining these two factors, the most severe causes of utility shifting delay were identified and carried out for further investigation.

Investigate Possibility of Arising Extension of Time claims due to the causes of delay in utility shifting

Following the preliminary interviews, twenty-five number causes were discovered and forwarded to the questionnaire round. In the questionnaire round, respondents were asked to rank the possibility of each cause resulting in an extension of time claim. The scale was set at 0-5, with 0 denoting causes with no chance of arising extension of time claims and 5 denoting causes with the greatest chance of arising extension of time claims in road construction projects. Scores greater than 0.8 were chosen as causes with a greater possibility of emerging extension of time claims based on the RII values of the outcomes. The first findings of the study are shown in the table below.

Table 4.5: Investigate Possibility of Arising Extension of Time claims due to the causes of delay in utility shifting

No	Causes for Delay in Utility Shifting	Possibility of occurrence RII Values
1	Insufficient budget allocation of the Client	0.841
2	Issues related to getting permission from utility Authorities	0.832
3	Design issues which the Contractor is not responsible	0.825
4	Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor	0.823
5	Limited resources allocated to the utility Authorities	0.814
6	Space issues for utility shifting	0.814
7	Less priority given by the utility Authorities	0.813
8	Public influences	0.811
9	Information management and mapping issues	0.806
10	Management of Right of way including Land acquisition	0.806

No	Causes for Delay in Utility Shifting	Possibility of occurrence RII Values
11	**Unexpected site conditions found by the utility Agencies**	**0.801**
12	Procurement issues by the utility Authorities	0.798
13	Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor	0.795
14	Phasing of construction	0.785
15	Legal aspects issues	0.742
16	Lack of coordination among different utility Authorities	0.698
17	Utility Authorities' contractors' issues	0.681
18	Weather Patterns	0.658
19	Pandemic Condition Issues	0.645
20	Safety Concerns by the utility Authorities	0.637
21	Traffic congestion issues for which the contractor is not responsible	0.625
22	Lack of coordination by the Contractor with the other relevant utility Authorities and/or the Consultant/client	0.021
23	Design issues for which the Contractor is responsible	0.069
24	Issues related to Scheduling and Planning of utility shifting by the Contractor	0.051
25	Traffic congestion issues for which the contractor is responsible	0.027

In consideration of the table's outcomes, the most frequent cause of study delays is the Client's insufficient budget allocation. Most road projects have experienced delays as a result of a lack of sufficient consideration provided in the budgeting of utility shifting, and as a result of these delays, extension of time claims have arisen. There have been a number of events involving this issue, and in the majority of them, the authority did not give sufficient funds, particularly for the external variables impacted by utility transfer. Hence, it is a common cause of utility relocation delays in road construction projects.

Another factor that could create delays in utility relocation in a road construction project is issues in obtaining approval from utility authorities. This cause is also subjected to conditions of contract in both SBD and FIDIC papers, which is a delay caused by authorities. In this situation, difficulties have been subjected to a delay caused by authorities, with no responsibility was placed on the contractors. The

majority of the delays are attributable to government delays in road construction projects.

Furthermore, design concerns for which the Contractor is not liable are a common subjective cause in road construction projects. The consultant party with the client finalise utility relocation drawings in the majority of the road construction projects. As a result, the contractor is not liable for these plans. However, the significant issue is that when they prepare the drawing, they do not take into account the actual concerns and underground soil conditions of the property. As a result, when the real process begins, a number of delays may develop, and the contractor will need to work with the client to resolve these design issues. Therefore, it takes time, and the need for a time extension claim can be raised.

Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor is another common cause with high possibility of arising. Design issues mentioned above are also subjected here and a variety of external factors such as public perception, pollution, and effects on neighbouring properties have an impact on these difficulties. All of these challenges are the result of a lack of coordination between the customer and the utility authority, which has a significant impact on utility switching delays.

The utility relocation procedure is halted in most road construction projects due to a lack of resources allocated to authorities. The provisional sum allotted for resources in utility shifting is not sufficient to complete the work in the majority of utility shifting delay cases. For instance, shifting electric cables that are underground on the site necessitated a significantly larger financial allocation to the necessary authorities in order to change the lines. Even though, in the vast majority of cases, the funds allotted for shifting these electrical services are insufficient. Furthermore, since the necessary parties have not planned the works before they begin, delivering relevant supplies and machineries to the place takes much longer. Hence, these issues creating an extension time claims most of the cases in road construction projects. As a result, limited resources allotted to utility authorities is another prevalent problem, with a significant possibility of utility transfer delays.

Furthermore, space issues for utility shifting are another cause of delay that has a high likelihood of resulting in time claims being extended. In most cases, the services lines that are scheduled to change are relocated to adjacent land. Even if the bordering land does not have enough space for the essential moving, the authorities will experience difficulties, which will cause the work to be delayed. As a result, it might be considered a cause with a high likelihood in a road construction projects.

The authority in charge of utility shifting plays a crucial part in the utility shifting procedure. However, they should give this process adequate priority, as the majority of delays have happened as a result of the authorities' lack of attention. Therefore, the authority must play a vital part in this process, and if they are unable to do so, time extension demands may arise, with high chances of success.

Public pressure has become a common cause of delay in most utility shifting processes. Vibrations, noises, and damage to adjacent land may all be part of the process. However, due to these challenges, the general public frequently exerts influence upon the authorities by complaining about the difficulties they have experienced as a result of the shifting processes. Hence, this has become one of the study's most common causes, and the respondents concurred.

There are no effective information management mechanisms in most road construction projects. As a result of these issues, a number of delays may occur on a regular basis, affecting the utility transfer process as well. In addition, mapping is critical in the utility shifting process. However, due to the inability of key parties to appropriately conduct these mapping activities, a lot of delays have occurred in many previous projects. Issues with data management and mapping are critical components in road construction project planning and administration. However, in the majority of cases, the authority failed to maintain effective information management and mapping in the premises, resulting in numerous delays.

Right-of-way management including land acquisition is another common cause of utility relocation delays is land acquisition. As previously stated, in the majority of utility relocation situations, the services lines that are being relocated are transferred to adjacent areas, and complications may occur as a result of the acquisition of these

adjacent lands. In the interview, the respondent A2 and A3 also mentioned a few situations involving the acquisition of relevant required lands in utility relocation. As a result, respondents to the questionnaire survey accepted this as one of the most common causes of delay. Further, according to the conditions of contract, contractor can ensure the extension of time claims from Sub Clause no 2.1 of FIDIC Red Book/ Clause no 2.1 of SBD 2 - Right to the Access to the site, and it can be entitled for both Cost-plus reasonable profit and the EOT

Finally, as previously said, a thorough site study is one of the most important activities that must be completed prior to the utility relocation procedure. In this situation, the authorities may encounter challenges relating to unexpected site conditions discovered by utility agencies due to the lack of consideration given to site study, particularly in adjacent lands. Most road construction projects do not do proper site studies in adjacent properties where utilities are moved, and as a result, this has become a widespread cause. Further, according to the conditions of contract, contractor can ensures the extension of time claims from Sub Clause no 4.12 of FIDIC Red Book/ clause no 4.11 of SBD 2 - Unforeseeable physical condition and can be entitled for both Cost and the EOT claims.

According to the findings of the study, eleven causes have been identified as having a high possibility of causing delays in utility transfer in road construction projects. The remaining causes had the potential to result in time extension claims as well. The causes with a score of less than 0.1, on the other hand, can be considered causes with no possibility of obtaining an extension of time claim in road construction projects.

Due to the contractor is rarely liable for the utility shifting handed processes, issues relating to scheduling and planning of utility shifting by the contractor are unlikely to cause delays. The utility authority and the client party are solely responsible. As a result, there is no possibility for this cause to occur a delay in utility shifting.

As mentioned above, due to the contractor has no liable responsibilities for the utility moving process, traffic congestion issues for which the contractor is responsible and Design issues which the Contractor is responsible are also vulnerable to the above argument. Furthermore, there is a very small chance that delays in utility switching

will occur owing to legal issues. As a result, legal difficulties can likewise be deemed a cause, with no chance of utility shifting.

In addition to that, Issues related to Scheduling and Planning of utility shifting by the Contractor also have very rare possibility of arising extension of time claims due to the contractor responsibility is very limited in utility shifting process.

Investigate Significance of Impact of the causes of delay in utility shifting

Following to the investigation of possibility of arising, the level significance is another key drive to measure the impact of causes for delay in utility shifting in order to get the most severe causes of delay in utility shifting in road construction project. Following analysis provide the set of causes which have high significance level in utility shifting towards the arising of extension of time claims. The scale was set at 1-5, with 1 denoting causes with very low significance and 5 denoting causes with the greatest significance level towards utility shifting in the road construction projects. Scores greater than 0.8 were chosen as causes with a greater significance level based on the RII values of the outcomes. The first findings of the study are shown in the table below.

Table 4.6: Significance of causes of delay in utility shifting

No	Causes for Delay in Utility Shifting	Level of Significance of Impact RII Values
1	**Procurement issues by the utility Authorities**	**0.863**
2	**Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor**	**0.857**
3	**Insufficient budget allocation of the Client**	**0.832**
4	**Unexpected site conditions found by the utility Agencies**	**0.831**
5	**Traffic congestion issues which are the contractor is not responsible**	**0.831**
6	**Safety Concerns by the utility Authorities**	**0.825**
7	**Limited resources allocated to the utility Authorities**	**0.824**
8	**Lack of coordination among different utility Authorities**	**0.824**
9	**Less priority given by the utility Authorities**	**0.811**
10	**Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor**	**0.811**
11	**Pandemic Issues**	**0.800**
12	Legal aspects issues	0.799
13	Utility Authorities' contractors' issues	0.797

No	Causes for Delay in Utility Shifting	Level of Significance of Impact RII Values
14	Information management and mapping issues	0.795
15	Management of Right of way including Land acquisition	0.795
16	Issues related to getting permission from utility Authorities	0.781
17	Weather Patterns	0.758
18	Space issues for utility shifting	0.741
19	Design issues which the Contractor is not responsible	0.642
20	Phasing of construction	0.641
21	Public influences	0.638
22	Lack of coordination by the Contractor with the other relevant utility Authorities and/or the Consultant/client	0.237
23	Issues related to Scheduling and Planning of utility shifting by the Contractor	0.235
24	Design issues which the Contractor is responsible	0.225
25	traffic congestion issues which are the contractor is responsible	0.287

According to the findings of the table, procurement issues by utility authorities the most significant cause of utility relocation. The procurement process is critical in utility shifting, since it permits road construction projects to be completed effectively and efficiently. If the procurement is done inefficiently, it will have an impact on the entire utility shifting process and may result in a scope modification in the utility shifting process. Extensions of time claims may be necessary as a result of these changes. Therefore, it might be regarded a major cause in utility shifting delays.

The proper cooperation between the client/engineer and the utility authority guarantees that the unity shifting process is effectively planned without delay. However, if coordination is weak, it can have a variety of effects on the utility shifting process. Furthermore, a lot of acquisition concerns have occurred in road construction projects as a result of coordination issues. Furthermore, permitting complications may arise as a result of a lack of coordination between stakeholders. As a result, lack of cooperation by the Client/Engineer and utility authorities other than the Contractor is a significant coordination cause of study, which has been accepted by the respondents as well.

Furthermore, budget allocation is an important factor to consider while switching utilities. Appropriate budgeting always ensures that the procedure is on track to be completed on time. Utility authorities may face delays in completing the process if the client has allotted an insufficient money. Due to a lack of resources, scopes of work may be changed, materials may be replaced, and the quality of work may be deteriorated. These effects will not manifest themselves until the road project is completed. However, as time passes, these concerns may occur, and there is a high risk of the moved services line being harmed owing to poor workmanship caused by insufficient budget allocation. Hence, Insufficient budget allocation of the Client can be taken as a significant cause of delay in utility shifting process.

As previously said, proper site investigation in utility relocation locations is a mandatory activity that must be completed prior to the start of the project to verify that the ground and site conditions are in compliance with the requirements of transferring services lines. Furthermore, if any obstacles are discovered during the site assessment, they can take a number of safeguards to ensure that the work will be completed on time and without additional cost increases as a result of the poor site circumstances. Failure to do a thorough site investigation, on the other hand, might result in unforeseen site conditions, the majority of which can be discovered after work begins.

Therefore, it has an impact on the project by postponing the utility transfer process. Hence Unexpected site conditions found by the utility Agencies is another important cause to be considered in the study.

In addition to that, another important aspect to consider in the utility switching process is traffic congestion. In comparison to rural areas, this problem is more prevalent in cities. However, traffic congestion can be divided into two categories. There are two types of contractors: those who are responsible for their work and those who are not. The contractor is only partially accountable for traffic congestion as the utility authorities are solely responsible. However, if traffic congestion occurs, it has a significant impact on the utility shifting process, as it extends the project's time and causes a variety of negative consequences. As previously said, the majority of these incidents occur in metropolitan and city settings as opposed to rural locations.

Therefore, traffic congestion issues for which the contractor is not responsible can be taken as a significant cause of delay in utility shifting process.

When it comes to the electrical service transfer procedure, safety is the most important factor to consider, as high-tension power lines contain a large load of energy that can cause serious injury to living beings. Due to these concerns, the utility authority must conduct a thorough investigation into this move in order to obtain the best possible solution with the least amount of damage and risk. In this scenario, safety concerns of the utility authorities have had a substantial impact on delaying the process, as the safety condition of process is a crucial factor to consider in minimising the damages to people. As a result of the survey findings, it has been recognised as a significant cause of utility shifting delays.

Moreover, another important issue to consider in the utility shifting process is resource allocation. Utility shifting is always delayed due to a lack of resources allotted to utility authorities. Most road construction projects do not do a proper feasibility assessment on utility shifting regions, and as a result, resources allotted for the operation are always insufficient, necessitating the allocation of additional resources for the premises. In this situation, the new additional resources could be a variation or an additional work that takes a several time to obtain approval from the authorities. The utility moving process is delayed as a result of this issue, which may have an influence on contractor extension of time claims. Hence, proper resource allocation is critical in the utility shifting process, and it can be considered a significant cause of study delay.

In addition to the resources, another important factor in every road construction project is coordination. The utility shifting process is affected in a similar way by effective coordination. To transfer the services lines without any failures, the entire procedure must be meticulously coordinated. For instance, If the authority switches a water line, the contractor should have been advised of the days and dates they planned to transfer the lines. In that instance, the contractor can set up the site and put barriers to the work near the process, allowing the process to run smoothly. On the other hand, authorities in charge of shifting water lines should have notified other authorities in order to avoid the chance of two shifting procedures overlapping in the site premises. Therefore, there

is a lack of coordination among various utility authorities. Authorities may be a significant contributing factor in the lengthening of time claims in utility relocation in road construction projects.

Another major cause of utility relocation delays is lack of prioritisation by the utility authorities. The majority of these occurrences have arisen as a result of the feasibility stages being given less priority. As previously stated, the majority of the budgets given for utility shifting are contracted sums that are added as a provisional sum for the contract. If the right priority is not supplied in this scenario, there is a significant risk of generating extension of time claims as a result of the lower priority granted. Therefore, it has become foremost significant cause to be considered in the study based on the opinion responses.

Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor is also subjected to less priority given in the feasibility stage. Therefore, it has derived as another significant cause of delay in study according to the opinions of the experts who responded to the questionnaire.

Furthermore, pandemic issues are also significant, especially given the current state of road construction projects. Due to the COVID 19 epidemic, a number of road construction projects were halted for an extended period of time, severely affecting the projects. First, due to the country's safety circumstances, workers in road construction projects were unable to complete their responsibilities, resulting in an unpredictably extended wait period. Second, the pandemic resulted in a number of material price rises and shortages. These concerns have had a negative influence on all road-building projects in Sri Lanka. Utility moving operations were delayed as a result of these challenges, which resulted in significant time extensions in road construction projects. Furthermore, several utility relocation procedures that were in progress at the time the pandemic began had to be halted without warning, thus impacting road construction in a number of ways. These challenges were exacerbated by material price rises, which rendered utility authorities unable to continue or complete their tasks in accordance with the contract provisional sums. As a result, additional expenses and time were incurred in utility shifting during this time period, and some of the shifting procedure

scopes were also amended as a result of the excessive price rises. Therefore, pandemic difficulties might be considered the most significant cause of utility shifting delays, as confirmed by the respondents.

Finally, according to the findings of the study, eleven causes of utility transfer delays in road construction projects have been recognised as having a high level of significance. The remaining causes have a considerable level of significance of resulting time extension in utility shifting. However, for this study, reasons with a score of greater than 0.8 have considered as significant causes of utility shifting delays and the occurrence of a time extension claim in road construction projects is comparatively high in these causes.

Most Severe causes of delay in Utility shifting in road construction projects.

The most severe causes of utility shifting delays were determined by using the values of severity index which is the best known and simplest technique for analyse two scales, taking into account both the possibility of arising extension of time claims and the level of significance. Severity index was calculated by multiplying the values from two scales (Ex: Severity Index of Cause 'Insufficient budget allocation for the Client = 0.841 x 0.832 = 0.700). However, the possibility of occurrence and significance of impact cut-off for this research were set at 0.8, and as a result, factors with scores of higher than 0.640 (0.800 x 0.800= 0.640) were chosen as the most severe causes of delay in the utility shifting procedure in road construction. The values that are subjected to each cause of delay are shown in the table below, which were finalised following the preliminary interviews.

Table 4.7: most severe causes of delay in utility shifting

No	Causes for Utility Shifting	Possibility	Significance	SI
1	**Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor**	**0.823**	**0.857**	**0.705**
2	**Insufficient budget allocation for the Client**	**0.841**	**0.832**	**0.700**
3	**Procurement issues by the utility Authorities**	**0.798**	**0.863**	**0.689**
4	**Limited resources allocated to the utility Authorities**	**0.814**	**0.824**	**0.671**
5	**Unexpected site conditions found by the utility Agencies**	**0.801**	**0.831**	**0.666**

No	Causes for Utility Shifting	Possibility	Significance	SI
6	**Less priority given by the utility Authorities**	**0.813**	**0.811**	**0.659**
7	**Issues related to getting permission from utility Authorities**	**0.832**	**0.781**	**0.650**
8	**Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor**	**0.795**	**0.811**	**0.645**
9	**Information management and mapping issues**	**0.806**	**0.795**	**0.641**
10	**Management of Right of way including Land acquisition**	**0.806**	**0.795**	**0.641**
11	Legal aspects issues	0.742	0.801	0.594
12	Utility Authorities' contractors' issues	0.681	0.797	0.543
13	Design issues which the Contractor is not responsible	0.825	0.642	0.530
14	Safety Concerns by the utility Authorities	0.637	0.825	0.526
15	Traffic congestion issues which are the contractor is not responsible	0.625	0.831	0.519
16	Space issues for utility shifting	0.814	0.637	0.519
17	Public influences	0.811	0.638	0.517
18	Pandemic Condition Issues	0.645	0.8	0.516
19	Lack of coordination among different utility Authorities	0.621	0.824	0.512
20	Phasing of construction	0.785	0.635	0.498
21	Weather Patterns	0.658	0.758	0.499
22	Traffic congestion issues which are the contractor is responsible	0.027	0.287	0.008
23	Design issues which the Contractor is responsible	0.069	0.225	0.016
24	Issues related to Scheduling and Planning of utility shifting by the Contractor	0.051	0.235	0.012
25	Lack of coordination by the Contractor with the other relevant utility Authorities and/or the Consultant/client	0.021	0.237	0.005

Based on the outcomes of the table, Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor can be considered as the most sever cause of delay in utility shifting in road construction projects. This reason has been determined to be the most serious cause in the study since both the probability of emerging extension of time claims and the level of significance are rather high.

The second most severe cause of delay is Insufficient budget allocation for the Client. As previously stated, there is a strong possibility of arising time extension claims as a result of this circumstance, and the level of significance is rather high based on the

responses given by the respondents as a result, it can be regarded a major cause of utility relocation delays in road construction projects.

Procurement issues by the utility Authorities is the third most severe cause of delay in utility shifting according to the finding of the study. However, compared to the other factors, the possibility of developing extension of time claims is relatively low in this cause. Nonetheless, due to the high degree of significance, this factor has been identified as one of the most serious causes of delay in the study.

The fourth most severe cause of delay is Limited resources allocated to the utility Authorities. As previously said, the level of significance is rather high since resources play a critical part in the utility shifting process, as insufficient resources might have a negative impact on the efficacy of utility shifting process. Furthermore, the possibility of generating extension of time claims is rather significant due to adjustments and additional work that occurred as a result of insufficient resource allocation. As a result, this cause has become as the fourth most severe cause of utility relocation delays in road construction projects.

Unexpected site conditions found by the utility Agencies can be regarded as the fifth most severe cause of delay in the study. In this case, the possibility of arising time extension claims is rather high when compared to previous experiences of the respondents. Furthermore, the level of significance is high in comparison, which has led to this cause being ranked as the fifth most serious cause in the study.

In addition to that, less priority given by the utility Authorities can be taken as the sixth most severe cause of delay in Utility shifting in road construction projects. This cause has been classified as a severe cause in the study due to the possibility of occurrence and the high level of significance. The importance of the priority and the reasons for the possibility of arising extension of time claims have already been discussed, and this cause can be regarded as the sixth most severe cause of this study involving road construction projects due to the above-mentioned reasons.

The next most severe cause which was derived from the finding is Issues related to getting permission from utility Authorities. Due to utility transfer delays, this cause has a considerable impact on generating extension of time claims. However, when

compared to causes with a high degree of significance, the level of significance is rather low. However, despite the fact that this cause has been derived as a serious cause of this investigation due to the high frequency of occurrence.

Further, Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor has been derived as the eighth most severe cause of the study. Even though, in comparison to causes having a high possibility of developing extension of time claims, this cause has a relatively low likelihood of arising extension of time claims. However, due to the degree of significance is rather high, this factor can be deemed as a most sever cause of delay in the study based on the findings of the analysis.

Information management and mapping issues is the ninth most severe cause of the study which has high possibility of arising extension of time claims. However, as compared to causes with a high degree of significance, the level of significance is comparatively modest. Despite the level of significance, according to the results of the questionnaire survey, possibility of arising extension of time claims has impacted the cause to become the most severe cause of the study.

Further, the tenth most severe cause; Management of Right of way including Land acquisition also has a low level of significance compared to the high significant causes. Despite the fact that this is a fairly prevalent cause, there is a high possibility of extension of time claims deriving from this cause due to the utility shifting delays based on the findings of the questionnaire survey. As a result of the high likelihood of generating extension of time claims have caused it to become as a most severe cause in the study.

According to the findings of the study, the overall analysis of the questionnaire round revealed ten severe causes of utility shifting delays in road construction projects, and the results of the analysis were forwarded to the interview round in order to obtain strategies to minimise these causes of delay in road construction projects. The most severe causes of delay, on the other hand, can be summarised as follows:

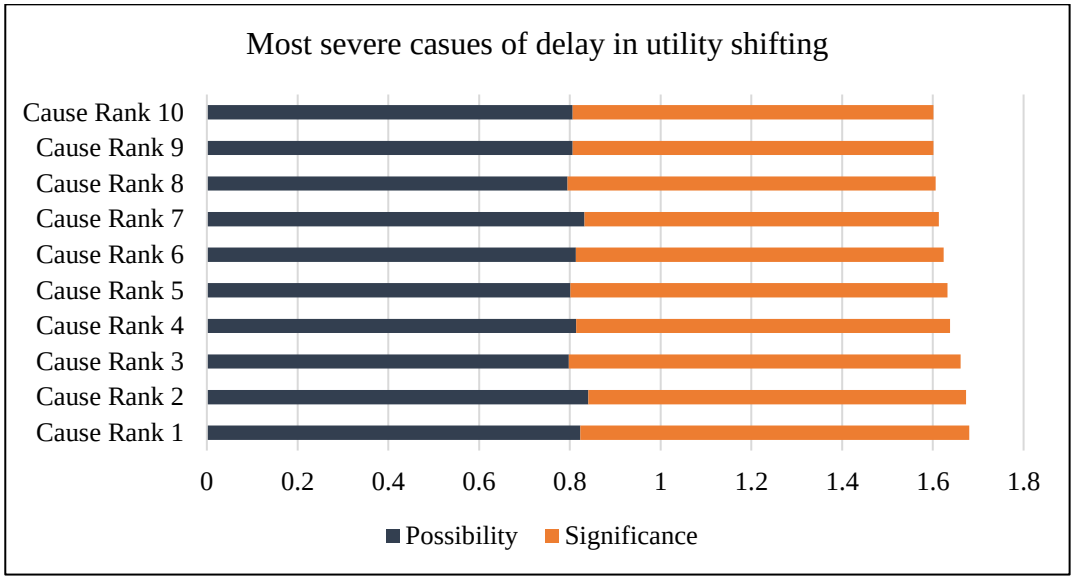

Figure 4.2: Chart of Most Severe Causes of Delay

Cause Rank 1	Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor	Cause Rank 6	Less priority given by the utility Authorities
Cause Rank 2	Insufficient budget allocation for the Client	Cause Rank 7	Issues related to getting permission from utility Authorities
Cause Rank 3	Procurement issues by the utility Authorities	Cause Rank 8	Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor
Cause Rank 4	Limited resources allocated to the utility Authorities	Cause Rank 9	Information management and mapping issues
Cause Rank 5	Unexpected site conditions found by the utility Agencies	Course Rank 10	Management of Right of way including Land acquisition

Comparison of Causes with High possibility and High Significance towards the most severe causes of study

Based on the outcomes of the study, eleven number causes were selected as the causes with high possibility of arising extension of time claims due to delay in utility shifting process. In addition to that, another eleven number causes were identified as the causes of delay with high level of significance in utility shifting process. Combining these two variables, most severe ten causes were derived and carried forward to the interview round. However, there are some causes which have high possibility of arising

extension of time claims and not derived as severe causes of delay. Moreover, there are some causes with high level of significance and not derived as severe causes of delay. These causes can be shown in table below.

Table 4.8; Comparison table of causes with high possibility and high significance but not derived as severe causes of study

Causes with high possibility of arising extension of time claims but not derived as severe causes of delay	**Causes with high level of significance but not derived as severe causes of delay**
Design issues which the Contractor is not responsible	Traffic congestion issues which are the contractor is not responsible
Space issues for utility shifting	Safety Concerns by the utility Authorities
Public influences	Lack of coordination among different utility Authorities
	Pandemic Issues

Based on the table, causes; Design issues which the Contractor is not responsible, Space issues for utility shifting and public influences have a high possibility of arising extension of time claims due to the delay in utility shifting process. Even though, the level of significance is relatively low in these causes and that has resulted them to eliminate from the most sever causes of the study.

Similarly, the causes; Traffic congestion issues which are the contractor is not responsible, Safety Concerns by the utility Authorities, Lack of coordination among different utility Authorities and pandemic issues have high level of significance. Even though, due to the lower possibility of arising time claims, these causes also have eliminated from the most severe causes of the study.

4.3.4 Phase II – Data Validation - Internal Consistency of Sample - Cronbach Alpha Calculation

The study's findings are based on two variables. The possibility of arising extension of time claims was initially investigated. Considering the responses given to this phase,

the internal consistency of the sample was calculated. The Cronbach Alpha score of was 0.9357, indicating excellent internal consistency of the sample.

In addition to that, secondly, the level of significance was analysed from the findings of the questionnaire round. The Cronbach Alpha value relevant to the level of significant part was 0.8791, indicating good internal consistency.

Therefore, considering both values, the responses given to the questionnaire and the overall sample of the study have good internal consistency and it can be accepted that the accuracy of the data is very high in the study.

4.4 Phase III – Expert Interviews

Following to the questionnaire round, set of expert interviews were carried out to achieve last objective of the study. Interviewees were asked to give their opinions about the most severe causes of delay in utility shifting and provide the suitable handling strategies to minimise these critical causes of delay in utility shifting.

4.4.1 Phase III - Main Objectives of Expert Interviews

Following to the questionnaire round, ten number most severe causes of delay in utility shifting were identified. However, due to the lack of literature review, the strategies for minimise these causes were difficult to discover from the literature review. Therefore, the main objective of the expert interview round was to identify the most suitable handling strategies to minimise the severe causes of delay in utility shifting.

4.4.2 Phase III – Respondents of Expert Interviews

Based on the experience in the road construction projects, eight number of experts were selected for preliminary interviews. The selected respondents had vast knowledge and experience in utility shifting in Road construction and all the respondents were Engineers and Quantity Surveyors with high technical skills. The details of the respondents are listed as follow.

Table 4.9: respondents of Expert Interview

No	Interview Code	Designation	Experience in Construction Industry	Experience in Road Construction Industry
1	AA1	Project Director	29	29
2	AA2	Deputy Project Director	29	29
3	AA3	Deputy Director	30	30
4	AA4	Project Manager	17	12
5	AA5	Deputy Project Manager	15	10
6	AA6	Resident Engineer	13	13
7	AA7	Quantity Surveyor	10	8
8	AA8	Quantity Surveyor	7	5

4.4.3 Phase III - Findings of Expert Interviews

Expert interviewees were asked to identify the best strategies for minimising the most severe causes of utility shifting delays found in analysis II. Respondents offered a variety of perspectives and solutions for reducing the most severe causes of the study. However, the strategies proposed by two or more respondents were chosen as the handling strategies for this research. The handling strategies proposed by respondents for each severe cause are shown in the table below.

Table 4.10: Suitable Strategies to minimise most severe causes of delay in utility shifting

No	Most Severe Causes of Delay in Utility Shifting	Suitable Handling Strategies	Respondents							
			AA1	AA2	AA3	AA4	AA5	AA6	AA7	AA8
		Find the exact parties to be contacted before award the contract	x		x					x
		Finalise the coordination channel between all parties	x	x				x		
		Schedule the works and preliminary activities according to a proper work plan and work under the plan		x		x		x		x
		Keep a good communication between parties	x		x	x	x		x	x
		Get the finalised estimated value from the utility agencies in the planning stage	x			x				
		Ensure adequate budget allocation for the utility shifting work by client before award the contract		x		x			x	
		Prepare the estimated allocation requirement for each quarter and inform the treasury regarding that requirement and make sure that allocation is received	x		x					
		Provide a budget allocation for paying to the agencies in the BOQ and pay through the Contractor		x			x	x		
		Make an agreement with utility agencies indicating the milestone with a timeframe	x				x		x	
		According to the timeframe agreed, payment to be done to the utility agency	x		x			x	x	

No	Most Severe Causes of Delay in Utility Shifting	Suitable Handling Strategies	Respondents							
			AA1	AA2	AA3	AA4	AA5	AA6	AA7	AA8
		Allow adequate time period for procurement work for utility agencies	x				x			
		Schedule the activities according to a work plan	x		x	x		x		x
		Agree for a programme including sufficient resource allocation with utility agencies	x					x		
		Provide necessary resources by the client		x		x		x		x
		Provide necessary resources through the Contractor by the client under variation	x				x			
		Carry out a proper feasibility study about the resource allocation for utility shifting before commencement of work				x			x	
		Carry out proper site investigation before start of the work	x		x	x	x			x
		Get the Contractors support for the Agencies to overcome the issue		x			x			x
		Carry out a proper underground soil investigation in adjacent lands where the services line shift to		x			x	x		
		Prepare and work with a proper programme with utility agencies			x					x
		Convey the importance of the shifting utilities according to the agreed programme to the agencies.		x				x		
		Make national policy to avoid these delays	x			x				
		Get the permission on planning stage from agencies.	x	x	x	x		x	x	

No	Most Severe Causes of Delay in Utility Shifting	Suitable Handling Strategies	Respondents							
			AA1	AA2	AA3	AA4	AA5	AA6	AA7	AA8
		Follow up the permission process by the client if it getting delayed.	x			x				
		Make sure that all conditions put by the Agencies can be fulfilled. If not negotiate them.	x		x					x
		Make sure that the given permission covered the actual requirement.		x			x			
		Follow a proper guideline when getting permission	x			x	x		x	x
		Ensure Proper planning process by the Client	x	x	x	x	x	x	x	x
		Make agreements with utility agencies according to the plan	x			x				x
		Get the finalised programme for utility shifting from the Agencies			x		x			
		Monitor the agreed programme.		x	x					
		Coordinate all required utility agencies	x			x		x	x	x
		Share the agreed shifting work programme with all utility agencies in order to avoid struggle amount agencies.	x			x				
		Carry out proper data monitoring process	x		x					
		Make compulsory arrangements to maintain the as-built drawings for the utility agencies by the government				x		x		
		Map existing lines and proposed line to be built via a user-friendly software like google earth		x			x			
		Carry out proper surveys by the client before awarding the contract			x	x			x	

No	Most Severe Causes of Delay in Utility Shifting	Suitable Handling Strategies	Respondents							
			AA1	AA2	AA3	AA4	AA5	AA6	AA7	AA8
		regarding the issues may arise during the mapping								
		Complete Land acquisition before handing over the site according to the contract	x	x			x	x		x
		Make sure that space is adequate for shifting work according to the design	x		x	x			x	
		If the site is partially handed over, make sure that the non-handing over site would not be affected to the shifting programmes	x					x		
		Make sure that contractors work programme does not affect to the agencies programs			x					x

Based on the findings, Lack of coordination by the Client/Engineer and utility authorities other than the Contractor can be addressed by establishing the specific parties who must be contacted before the contract is awarded. Respondents AA1 and AA3 highlighted that, it allows the utility authorities to quickly contact the appropriate parties and coordinate with them. Furthermore, prior to the start of the project, a coordination channel must be developed, allowing for effective collaboration between partners. In addition to that, respondents AA3, AA4, AA6 and AA8 stated, by arranging the works and preliminary activities according to a comprehensive work plan, a variety of coordination concerns can be addressed. Finally, effective communication is critical to proper coordination. As a result, maintaining successful coordination throughout the process necessitates good communication between partners.

Insufficient budget allocation for the Client is another severe cause of delay which can be mitigated from getting the finalised estimated value from the utility agencies in the planning stage. However, respondent AA1 additionally mentioned, if any concerns develop during the process, a proper variation method should be in place to change the finalised value, and the work will be flexible to complete. Ensure proper budget allocation for utility shifting work by the client before awarding the contract, on the other hand, is more effective in minimising insufficient budget allocation. Furthermore, the budget allocation procedure can be made more flexible by creating an estimated allocation requirement for each quarter and informing Treasury about it, as well as ensuring that the allocation is received. Finally, it can be handled by allocating a budget for paying the agencies in the BOQ and making payments through the Contractor.

Based on the opinions of respondents AA1 to AA7, procurement issues by the utility Authorities can be handled by establishing milestone planning for the process. It will be made easier by reaching an agreement with utility authorities that specifies the milestone and a timeframe for completion. Furthermore, making payments within the agreed-upon date guarantees that the process runs smoothly with no procurement complications. On the other hand, the authority must be given due consideration in order to provide appropriate time for utility agencies to complete procurement work.

Allowing sufficient time allows utility agencies to plan for work with the appropriate requirements, allowing the procurement process to flow successfully and efficiently. Finally, the majority of the respondents except AA2, AA5 and AA7, agreed that the severe causes indicated above can also be mitigated by making a proper work plan and schedule the activities according to the work plan.

Limited resources allocated to the utility Authorities is another critical cause of delay in utility shifting according the outcomes of the questionnaire round. The above problem can be effectively addressed by agreeing on a programme that includes adequate resource allocation from utility agencies. Further, respondents AA1 and AA6 specially highlighted the above programme ensures that adequate resources have been assigned, and if they are insufficient, the authorities can make appropriate adjustments to overcome these challenges and complete the task. Furthermore, it is the client's primary responsibility to provide the agencies with the resources they require. If the client is unable to furnish those resources on his own, a mechanism should be established for the client to hire those services through the Contractor under variation. Furthermore, the constrained resource allocation can be alleviated at the feasibility stage by conducting a thorough feasibility analysis on resource allocation for utility shifting prior to construction beginning.

Unexpected site conditions found by the utility Agencies can be ultimately handled by carrying out proper site investigation before start of the work. In addition, the contractor party performs work at the site premises. Therefore, the authorities can enlist the Contractor's assistance in overcoming the unanticipated challenges at site. However, responded AA2, AA5 and AA6 mentioned, the majority of the unexpected site conditions are caused by soil concerns. As a result, doing a proper subsurface soil analysis in adjacent lands where the services line shift will always help to discover these difficulties before work begins and always help to catch these issues before work begins.

Another serious factor is the lack of priority given by the utility authorities, which may be minimised by developing a good work plan that is aligned with the required work to be done with utility agencies. It is always willing to assist in reducing issues that

develop during the procedure and removing roadblocks. It can also be minimised by informing the agencies about the importance of moving utilities according to the agreed-upon schedule. Furthermore, policies can play an important role in addressing priority issues in the utility shifting process. As a result, the government should make it as a national policy to avoid delays in the process.

Issues related to getting permission from utility Authorities can be mitigated from getting relevant permission on planning stage from agencies. Respondent AA1 specially highlighted, if the agencies are unable to issue permissions, there should be another mechanism for the customer to follow up on the permission procedure if it is being delayed by the agencies. On the other hand, AA1 and AA3 also mentioned that the parties should discuss the opportunities and challenges and ensure that all of the Agencies' requirements can be met. If it cannot be met, a thorough procedure should be followed to negotiate with them and complete the work with minimal concerns. Furthermore, it is the primary responsibility to ensure that the permission granted covers the actual requirement, and if it does not, it should be amended prior to the start of work, and appropriate steps taken to resolve the permission issue. Furthermore, when obtaining authorisation, the authorities can follow a correct guideline, which will allow them to gain permission in a shorter period of time.

Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor is another critical cause of study which can be ultimately handled by ensuring a proper planning process by the Client. In this situation, the primary responsibility of the client is to reach agreements with utility agencies in accordance with the plan and get the Agencies' finalised utility shifting programme. Furthermore, as the work is being done, it should be inspected to see if it is following the agreed-upon plan or if it is deviating from it. If any problems arise, the client has the primary responsibility for coordinating with all appropriate utility agencies and resolving the issues. Finally, all utility agencies should be informed of the agreed-upon plan in order to avoid struggle amount agencies.

Information management and mapping issue can be handled by making compulsory arrangements to maintain the as-built drawings for the utility agencies by the

government. Furthermore, based on the opinions of respondents AA1 and AA3, in comparison to construction technologies in the previous decade, people have developed a number of new technologies that can be used to address mapping concerns and avoid utility moving issues. It can be done by using a user-friendly software like Google Earth to map current lines and planned lines to be developed. Furthermore, conducting thorough surveys by the client prior to awarding the contract regarding issues that may develop during the mapping can help to mitigate mapping and information management issues. However, the information management can be handled by performing a proper data monitoring process throughout the utility shifting period.

Management of Right of way including Land acquisition can be handled at the early stage by completing Land acquisition before handing over the site according to the contract. Furthermore, the majority of the respondents except AA2, AA5 and AA6, suggested that, a thorough verification process to guarantee that the available space is sufficient for shifting work in accordance with the design will ensure the management of right-of-way issues during the utility relocation process. However, if the site is only partially handed over, it is the responsibility of the non-handing over site to ensure that the shifting programmes are not disrupted. Finally, there must be no overlap between contractor and utility authority activities. As a result, it is critical to ensure that contractors' work schedules do not interfere with agency initiatives.

Moreover, to avoid claims, entire responsibility for management, coordination, and execution of all actions linked with the survey, recording, relocation, removal, and protection of public utilities is transferred to the contractor in some projects. As a result, even if a delay is caused by authorities or the client, the contractor has no choice but to bear full responsibility. This is, however, at first glance a condition of the contract that the contractor will have to agree to, even if reluctantly there is no alternative. However, such conditions can be challenged under the Unfair Contract Act No. 26 of 1997 in Sri Lanka.

Furthermore, in many roads construction projects it is very important to complete the utility shifting process in a timely manner. Therefore, the efficiency of this process can

be improved by creating a system of incentives for officers who work in the utility agencies involved in the project utility shifting work, thereby enabling work to be completed on time. For example, officials involved in the land acquisition process for projects are receiving incentives based on timely completion of work.

The contractual parties' understanding of the utility shifting procedure should also be improved in order to prevent delays. This can be implemented as a general handling method to lessen the impact of the delay. Various programmes that are instructed by industry professionals in utility shifting might enhance awareness.

From the results of expert interviews, forty-one number-handing strategies were generated. The handling tactics can be utilised to reduce the ten most severe causes of utility shifting delays in road construction projects in Sri Lanka, and they will help the operation run smoothly and efficiently.

4.5 Summary

This chapter describes the overall analysis of the data gathered throughout the data collection of the study. The analysis has been carried into three phases to achieve each remaining objective precisely and the collected data have been analysed using the methods described in chapter 3. Based on a thorough analysis of the data gathered, the chapter completely addressed the objective 2 remaining areas and concluded that all of remaining objectives 3, 4, and 5 have been accomplished successfully.

5. CONCLUSIONS AND RECOMMENDATIONS CHAPTER 05

5.1 Introduction

The fourth chapter analysed and described study findings as well as findings from the literature. In order to establish conclusions and recommendations, the important findings are described in this chapter. This chapter explains how the research objectives have been achieved throughout the research. First and foremost, the results of the analysis have been briefly presented objectively in the conclusion. Following that, recommendations are made based on the outcomes of this study in order to reduce the extension of time claims are extended due to utility shifting delays. This research could serve as a model for other academics who want to investigate Utility Shifting delay analysis further. As a result, the potential research directions that could result from this research are outlined.

5.2 Conclusion

In Sri Lanka, a roadway project, whether new construction, reconstruction, or improvement of an existing infrastructure, frequently entails utilities shifting inside the project area, either temporarily or permanently. The utility authority and the local government planning the roadway project must all work together to ensure that utility relocation is completed on schedule and within the allocated budget. The ineffective handling of the utility shifting procedure might lead to delays and it can be a major reason for extension of time claims in Road construction projects. Therefore, it is critical to manage this utility shifting procedure in road construction, particularly in a country like Sri Lanka, where road construction projects contribute significantly to the country's GDP. However, when it comes to the stated aims of the study, the causes of utility shifting delays are the most focusable part of this research toward reducing utility shifting delays. As a result, establishing handling strategies to minimise these most severe causes of utility shifting delay will ensure that the operation is finished on time and that no extensions of time claims are made. The objectives which were achieved from this research can be elaborated as follows,

5.2.1 Objective 1 - Review on the need for utility shifting in road construction projects

Objective 1 is fully achieved through the literature review of the research based on the previous research which have been conducted about the road construction projects. By reviewing the authors opinions related to the Utility shifting process, the objective was achieved. Utility shifting is one of the most important tasks in road construction projects, and it has a direct impact on the extension of time claims. Since a continuous road network is necessary, proper utility coordination assisted the relocation process. Aside from that, road construction design decisions need utility relocation, which is one of the most common causes for utility relocation in road construction projects. As a result, utility moving is an important component of road construction that must be closely monitored in order to avoid the extension of time claims.

5.2.2 Objective 2 - Identify the causes of delay in utility shifting for road construction projects in Sri Lanka

Objective 2 was partially achieved through the literature review where it discovered twenty-one causes of delay in utility shifting related to road construction projects. The causes identified from the literature review, was validated to the Sri Lankan context from the preliminary interview round. During the preliminary interview, eight causes were amalgamated and altered to seven causes., ten number causes were changed without an amalgamation. The remaining three causes were carried forward as the same and additional four causes were added based on the opinions of experts.

5.2.3 Objective 3 - Examine the possibility of arising Extension of Time claims and the significance of impact of the causes of delay in utility shifting in road construction projects in Sri Lanka

Questionnaire Round was carried out to rank the possibilities of arising extension of time claims and significant of impact in each cause of delay which were finalised from the preliminary interviews. 11 number causes were selected as the causes with high possibility of arising Extension of Time claims due to causes of delay in utility shifting. The causes are; insufficient budget allocation of the Client, issues related to getting

permission from utility Authorities, design issues which the Contractor is not responsible, lack of coordination by the client/the engineer and utility authorities except the contractor, limited resources allocated to the utility authorities, space issues for utility shifting, less priority given by the utility authorities ,public influences, information management and mapping issues, management of right of way including land acquisition and unexpected site conditions found by the utility agencies

Further, 11 number causes were selected as the causes with high significance of impact for delay the utility shifting in road construction projects in Sri Lanka. The causes are; procurement issues by the utility Authorities, lack of coordination by the client/the engineer and utility authorities except the contractor, insufficient budget allocation of the client, unexpected site conditions found by the utility agencies, traffic congestion issues which are the contractor is not responsible, safety concerns by the utility authorities, limited resources allocated to the utility authorities, lack of coordination among different utility authorities, less priority given by the utility authorities, issues related to scheduling and planning by the other parties and/or utility authorities except the contractor and pandemic issues.

5.2.4 Objective 4 - Identify the most severe causes of delay in utility shifting for Extension of Time claims in Sri Lanka

Considering the values of possibility of arising and Significance of impact in each cause of delay, most severe causes of delay in utility shifting for extension of time claims were derived as an ultimate finding of the research in order to provide handling strategies in expert interview round following to the questionnaire survey. The most severe causes of delay in utility shifting are; lack of coordination by the client/the engineer and utility authorities except the contractor, insufficient budget allocation for the client , procurement issues by the utility authorities, limited resources allocated to the utility authorities, unexpected site conditions found by the utility agencies, less priority given by the utility authorities, issues related to getting permission from utility authorities, issues related to scheduling and planning by the other parties and/or utility authorities except the contractor, information management and mapping issues and management of right of way including land acquisition

5.2.5 Objective 5 - Propose solutions to mitigate Extension of Time claims arising due to delay in utility shifting in road construction projects in Sri Lanka

Following to the questionnaire round, expert interviews were conducted to identify most suitable handling strategies to avoid most severe causes of delay in utility shifting in road construction projects in Sri Lanka. Forty-one number-handing strategies were derived from this research to minimise causes of delay for above most severe causes. The majority of the respondents suggested some of the very common and critical strategies such as: keep a good communication between parties, schedule the activities according to a work plan, carry out proper site investigation before start of the work, get the permission on planning stage from agencies, ensure proper planning process by the Client, coordinate all required utility agencies, complete land acquisition before handing over the site according to the contract and make sure that space is adequate for shifting work according to the design.

5.3 Recommendations

Utility shifting is an important part of road construction, and the client and relevant utility authorities should pay close coordination to it in order to reduce Extension of Time claims. As a result, throughout the utility shifting process in road construction, the assigned budget and schedule must be effectively managed to increase the process' efficacy. Furthermore, if the likelihood of causes is extremely high in that particular site's conditions, adequate risk allocation should be carried out to decrease the impact of these causes.

Further, this research provides a set of handing strategies to minimise the delays in Utility shifting process and it can be used for every type of road construction works where the utility shifting involves. Handling the causes and minimise the effects of delay will ensure the process of utility shifting are aligned with the schedule with no time extensions.

It is recommended that an incentive system to be implemented to reward officers who work in utility agencies involved in the project utility shifting work, which can improve the efficiency of this process and enables work to be completed on time.

Moreover, awareness programmes and Carrier Professional Development (CPD) sessions relating to the delay management in Utility Shifting process in road construction projects in Sri Lanka should be implemented, as this will help to raise awareness and how to deal with problems in utility shifting process in road construction.

Finally, it is recommended not to include unfair contractual terms as to utility shifting work, such as transferring complete responsibility to the contractor even if the delay is caused by other parties, because it is unfair and may lead to litigation.

5.4 Further Research Areas

- Investigate the cost incurred by the contractor due to delay in utility shifting work in road construction projects in Sri Lanka
- Possibility to avoid unfair contractual terms with respect to the utility shifting process in Road Construction projects in Sri Lanka
- Risk management in utility shifting process in Sri Lankan Road Construction
- Effectiveness of usage the handing strategies discussed in this research to minimise the delays in Utility shifting process

5.5 Summary

This chapter begins by outlining how the objectives from earlier chapters were met and how the research requirements were satisfied. These key objectives have been outlined in order to demonstrate that the primary goal of the study has been attained by the research findings. In addition, the study's recommendations have offered other ways to enhance utility shifting practises and prevent delays. Furthermore, this study might serve as a benchmark for subsequent investigations. In order to fill the research gap in the future, additional research areas have been suggested.

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ANNEX I –PRELIMINARY INTERVIEW GUIDELINE

Research topic

Influence of Delay in Utility Shifting for Extension of Time Claims in Road Construction Projects in Sri Lanka.

Aim of the study

The aim of the study is to investigate the influence of delay in utility shifting for Extension of Time claims in Road Construction in Sri Lanka

Objectives of the study

- Review on the need for utility shifting in road construction projects
- Investigate the causes of delay in utility shifting for road construction projects in Sri Lanka
- Investigate the possibility of arising Extension of Time claims due to causes of delay in utility shifting and identify the significance of causes for delay the utility shifting in road construction projects in Sri Lanka
- Identify the most severe causes of delay in utility shifting for Extension of Time claims in Sri Lanka
- Propose solutions to mitigate Extension of Time claims arising due to delay in utility shifting in road construction projects in Sri Lanka

Designation	
Profession	
Experience in Construction Industry	☐1-5 ☐5-10 ☐10-15 ☒15-20 ☐20-25 ☐ more than 25
Experience in Road Construction Projects	☐1-5 ☐5-10 ☒10-15 ☐15-20 ☐20-25 ☐ more than 25

1. Identify the **issues surrounding utility shifting for road construction projects to Sri Lankan Context (**Please mention Additional issues to be added and remarks**)**

No	Causes of Delay	Applicability to the Sri Lankan Context		Remarks
		Yes	No	
1	Lack of coordination			• *Lack of coordination by the Contractor with the other relevant utility Authorities and/or the Consultant/client* • *Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor* • *Lack of coordination among different utility Authorities*
2	Less priority	*Yes*		• *Less priority given by the utility Authorities*
3	Improper joint planning			• *Issues related to Scheduling and Planning of utility shifting by the Contractor* • *Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor*
4	Selection of Procurement Contractors	*Yes*		• *Utility Authorities' contractors' issues*
5	Scheduling delays			• *Issues related to Scheduling and Planning of utility shifting by the Contractor* • *Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor*
6	Limited resources	*Yes*		• *Limited resources allocated to the utility Authorities*
7	Phasing of construction and working out of sequence	*Yes*		• *Phasing of construction*
8	Insufficient budget allocation and inadequate personnel	*Yes*		• *Limited resources allocated to the utility Authorities*
9	Weather Patterns	*Yes*		
10	Planning and Coordination issues			• *Issues related to Scheduling and Planning of utility shifting by the Contractor* • *Issues related to Scheduling and Planning by the other parties and/or*

No	Causes of Delay	Applicability to the Sri Lankan Context		Remarks
		Yes	No	
				utility Authorities except the Contractor
11	Design issues			• *Design issues which the Contractor is responsible* • *Design issues which the Contractor is not responsible*
12	Permits issues	*Yes*		• *Issues related to getting permission from utility Authorities*
13	Information management and mapping issues	*Yes*		
14	Notification procedure issues	*Yes*		
15	Legal aspects issues	*Yes*		
16	Safety concerns issues	*Yes*		• *Safety Concerns by the utility Authorities*
17	Traffic volume issues			• *Traffic volume issues which are the contractor is not responsible* • *Traffic volume issues which are the contractor is responsible*
18	Poor Communication pattern between parties	*Yes*		
19	Procurement issues	*Yes*		• *Procurement issues by the utility Authorities*
20	Management of Right of way	*Yes*		• *Management of Right of way including Land acquisition*
21	Poor Drawings			• *Design issues which the Contractor is responsible* • *Design issues which the Contractor is not responsible*
	Additional Causes			
22	*Space issues for utility shifting*			
23	*Public influences*			
24	*Unexpected site conditions found by the utility Agencies*			

Thank you.

DC Karunarathna

Department of Building Economics,

University of Moratuwa,

ANNEX II – QUESTIONNAIRE ROUND

Research topic

Influence of Delay in Utility Shifting for Extension of Time Claims in Road Construction Projects in Sri Lanka.

Aim of the study

The aim of the study is to investigate the influence of delay in utility shifting for Extension of Time claims in Road Construction in Sri Lanka

Objectives of the study

- Review on the need for utility shifting in road construction projects
- Investigate the causes of delay in utility shifting for road construction projects in Sri Lanka
- Investigate the possibility of arising Extension of Time claims due to causes of delay in utility shifting and identify the significance of causes for delay the utility shifting in road construction projects in Sri Lanka
- Identify the most severe causes of delay in utility shifting for Extension of Time claims in Sri Lanka
- Propose solutions to mitigate Extension of Time claims arising due to delay in utility shifting in road construction projects in Sri Lanka

Designation	
Profession	
Experience in Construction Industry	☐1-5 ☐5-10 ☐10-15 ☒15-20 ☐20-25 ☐ more than 25
Experience in Road Construction Projects	☐1-5 ☐5-10 ☒10-15 ☐15-20 ☐20-25 ☐ more than 25

1. Rank each cause of delay in Utility Shifting based on the Possibility of occurrence and Significance of Impact

   Use the scale given below

   0 – No Possibility of Occurrence

   1 – Very Low Possibility of Occurrence/ Significance of Impact

   2 – Low Possibility of Occurrence/ Significance of Impact

   3 – Average Possibility of Occurrence/ Significance of Impact

   4 – High Possibility of Occurrence/ Significance of Impact

   5 – Vey High Possibility of Occurrence/ Significance of Impact

No	Causes of Delay	Possibility of Occurrence						Significance of Impact				
		⓪	①	②	③	④	⑤	①	②	③	④	⑤
1	Lack of coordination by the Contractor with the other relevant utility Authorities and/or the Consultant/client	⓪	①	②	③	④	⑤	①	②	③	④	⑤
2	Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor	⓪	①	②	③	④	⑤	①	②	③	④	⑤
3	Lack of coordination among different utility Authorities	⓪	①	②	③	④	⑤	①	②	③	④	⑤
4	Less priority given by the utility Authorities	⓪	①	②	③	④	⑤	①	②	③	④	⑤
5	Utility Authorities' contractors' issues	⓪	①	②	③	④	⑤	①	②	③	④	⑤
6	Procurement issues by the utility Authorities	⓪	①	②	③	④	⑤	①	②	③	④	⑤
7	Limited resources allocated to the utility Authorities	⓪	①	②	③	④	⑤	①	②	③	④	⑤
8	Insufficient budget allocation for the Client	⓪	①	②	③	④	⑤	①	②	③	④	⑤
9	Design issues which the Contractor is responsible	⓪	①	②	③	④	⑤	①	②	③	④	⑤
10	Design issues which the Contractor is not responsible	⓪	①	②	③	④	⑤	①	②	③	④	⑤
11	Issues related to getting permission from utility Authorities	⓪	①	②	③	④	⑤	①	②	③	④	⑤
12	Issues related to Scheduling and Planning of utility shifting by the Contractor	⓪	①	②	③	④	⑤	①	②	③	④	⑤

No	Causes of Delay	Possibility of Occurrence						Significance of Impact				
		⓪	①	②	③	④	⑤	①	②	③	④	⑤
13	Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor	⓪	①	②	③	④	⑤	①	②	③	④	⑤
14	Phasing of construction	⓪	①	②	③	④	⑤	①	②	③	④	⑤
15	Weather Patterns	⓪	①	②	③	④	⑤	①	②	③	④	⑤
16	Information management and mapping issues	⓪	①	②	③	④	⑤	①	②	③	④	⑤
17	Legal aspects issues	⓪	①	②	③	④	⑤	①	②	③	④	⑤
18	Safety Concerns by the utility Authorities	⓪	①	②	③	④	⑤	①	②	③	④	⑤
19	Traffic volume issues which are the contractor is not responsible	⓪	①	②	③	④	⑤	①	②	③	④	⑤
20	Traffic volume issues which are the contractor is responsible	⓪	①	②	③	④	⑤	①	②	③	④	⑤
21	Management of Right of way including Land acquisition	⓪	①	②	③	④	⑤	①	②	③	④	⑤
22	Space issues for utility shifting	⓪	①	②	③	④	⑤	①	②	③	④	⑤
23	Public influences	⓪	①	②	③	④	⑤	①	②	③	④	⑤
24	Unexpected site conditions found by the utility Agencies	⓪	①	②	③	④	⑤	①	②	③	④	⑤
25	Pandemic Condition Issues	⓪	①	②	③	④	⑤	①	②	③	④	⑤

Thank you.

DC Karunarathna

Department of Building Economics,

University of Moratuwa,

ANNEX III – EXPERT INTERVIEW

Research topic

Influence of Delay in Utility Shifting for Extension of Time Claims in Road Construction Projects in Sri Lanka.

Aim of the study

The aim of the study is to investigate the influence of delay in utility shifting for Extension of Time claims in Road Construction in Sri Lanka

Objectives of the study

- Review on the need for utility shifting in road construction projects
- Investigate the causes of delay in utility shifting for road construction projects in Sri Lanka
- Investigate the possibility of arising Extension of Time claims due to causes of delay in utility shifting and identify the significance of causes for delay the utility shifting in road construction projects in Sri Lanka
- Identify the most severe causes of delay in utility shifting for Extension of Time claims in Sri Lanka
- Propose solutions to mitigate Extension of Time claims arising due to delay in utility shifting in road construction projects in Sri Lanka

Designation	
Profession	
Experience in Construction Industry	☐1-5 ☐5-10 ☐10-15 ☒15-20 ☐20-25 ☐ more than 25
Experience in Road Construction Projects	☐1-5 ☐5-10 ☒10-15 ☐15-20 ☐20-25 ☐ more than 25

What are the solutions to mitigate Extension of Time claims arise due to causes of delay in utility shifting in road construction projects in Sri Lanka?

No	Causes for Utility Shifting	Proposed Solution to Minimse of handle These issues
1	Lack of coordination by the Client/the Engineer and utility Authorities except the Contractor	1. *Find the exact parties to be contact before award the contract* 2. *.Finalise the coordination channel between all parties*
2	Insufficient budget allocation for the Client	1. *Getting the estimated value from the utility agencies in the planning stage* 2. *Getting adequate budget allocation for the utility shifting work by client before award the contract* 3. *Prepare the estimated allocation requirement for each quarter and inform the treasury regarding that requirement and make sure that allocation is received* 4. *Provide allocation for paying to the agencies in the BOQ and pay through the Contractor*
3	Procurement issues by the utility Authorities	1. *Make an agreement with utility agencies indicating the milestone with a timeframe* 2. *According to the timeframe agreed, payment to be done to the utility agency* 3. *Allow adequate time period for procurement work for utility agencies*
4	Limited resources allocated to the utility Authorities	1. *To agree for a programme with a utility agency* 2. *Provide necessary resources by the client (eg. Taking over the Civil Works)* 3. *Provide necessary resources through the Contractor by the client under variation*
5	Unexpected site conditions found by the utility Agencies	1. *1.to do the maximum possible surveys before procurement process.* 2. *Giving the Contractors support to the Agency to overcome the issue*

No	Causes for Utility Shifting	Proposed Solution to Minimse of handle These issues
6	Less priority given by the utility Authorities	1. *To agree for a programme with a utility agency* 2. *Convey the importance of the shifting utilities according to the agreed programme to the agencies.* 3. *Make national policy to avoid these delays*
7	Issues related to getting permission from utility Authorities	1. *Getting permission on planning stage from agencies.* *2. Follow up the permission process by the client if it getting delayed.* *3.Make sure that all conditions put by the Agencies can be fulfilled. If not negotiate them.* *4. Make sure that the given permission is covered the actual requirement.*
8	Issues related to Scheduling and Planning by the other parties and/or utility Authorities except the Contractor	1. *Proper planning by the Client* *2.According to the plan, make agreements with utility agencies* *3. Getting the programme for utility shifting from the Agencies* *4.monitor the agreed programme.* *5. Coordinate all required utility agencies* 5. *Share the agreed shifting work programme with all utility agencies in order to avoid struggle amount agencies.*
9	Information management and mapping issues	1. *Make compulsory to maintain the as build drawings to the utility agencies by the goverment* *2. Existing lines and proposed line to be mapped in a user friendly softwares like google earth* *3. If there is a doubt of a utility map, doing a surveys by the client before awarding the contract* *4.* *5.*
10	Management of Right of way including Land acquisition	1. *Land acquisition to be completed before handing over the site according to the contract* 2. *Make sure that space is adequate for shifting work according to the design* *2. If the site is partially hand over, make sure that the non handing over site would not be affected to the shifting programmes* *3. Make sure that contractors work*

No	Causes for Utility Shifting	Proposed Solution to Minimse of handle These issues
		programme does not affect to the the agencies programs

Additional Solutions to mitigate claims due to delay in Utility Shifting more than above

In some project, full responsibility is given to the contractor in the contract for management, Coordination and execution of all activities associated with the survey, recording, relocation, removal and protection of public utilities in order to avoid claims. Accordingly, even if there is a delay due to authorities, the contractor has taken whole responsibility. However, this is unfair since one party is forced to compensate without his default.

Introducing a mechanism to pay some incentive to the offices who are involving to the utility shifting work of a project if the shifting work has timely been done which is similar to the payment is being done to the officers who are involving to the land acquisition process.

Thank you.

DC Karunarathna
Department of Building Economics,
University of Moratuwa,