

**FACTORS AFFECTING TO THE DELAY IN
ROAD CONSTRUCTION PROJECTS OF LOCAL
BANK FUNDING**

**MASTER OF SCIENCE
IN
CONSTRUCTION PROJECT MANAGEMENT**

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BANK FUNDING**

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“This dissertation was submitted to the Department of Civil Engineering of the University of Moratuwa in partial fulfilment of the requirements for the Master of Science in Construction Project Management”

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DECLARATION

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ABSTRACT

This study attempts to identify the delay causes factors affect to the delay of road construction projects in Sri Lanka. Road sector infrastructure developments plays major role within the development of country. Therefore, identification of delay causes factors is very crucial for the development of country. In addition to the identification of delay causes factors, ranking them according to the severity level is very important to prioritize the mitigation measures.

Thirty number of sample projects were selected from the road construction projects under the Local Bank Funded Project Division for this study. Delay causes factors were identified through literature survey analysis, contractors' claim documents and interviewing of project engineers of those projects. Identified delay causes factors from the contractors' claim documents were analyzed according to the actual delay contribution of the individual delay factors. Then identified all the delay causes factors were evaluate quantitatively by questionnaire survey analysis with Likert scale.

As per the results of the study, average time over run of the project duration due to various reasons in the Local Bank Funded Projects goes up to the 40% -68% compared to the original project duration. According to the both analysis methods Variation and scope changes, delaying of relocating utilities and Delay due to land acquisition were selected as a top three significant delay causes respectively. Above three delay causes factors represent the client's responsibility category.

In addition to above three delay causes factors Ineffective project planning and scheduling by contractor, Deficiency of some material in the country, Poor site management of contractor, less qualified persons in contractor's key staff, Design changes, Unavailability of required number of staff in contractor's organization and Improper availability of funds with client were selected in the top ten delay causes factors respectively according to the questionnaire survey analysis.

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1. INTRODUCTION

Highly considerable amount of average percentage time delays reported in the local road construction projects in Sri Lanka (Pathirana & Halwatura, 2010). Unnecessary extension of project durations directly affect on the delay of transport facilities of the day today road users. Idling of countries work force due to the above delay of public transport negatively affects on the development of the country. Therefore, it is very important to identify the causes of delays to take mitigation measures to minimize the negative impact of the road construction delays. As a Developing country, Sri Lanka needs to attract more investments to achieve the development goals. Success of the development investment projects depends on the transport facilities around the investment project area. Investors hesitate to start their projects due to the uncertainty of time frame for the completion of their transportation infrastructures. Therefore, timely completion of road construction is a must for the development of the country.

One of the major problems in the construction firms is a delay of their projects. This delay affects negatively to the legal binding of owner and contractor according to their contract. In addition to that delay will lead to cost increment, productivity and revenue loss and up to contract termination. Construction companies all over the world suffer from the delaying problems significantly. Construction delay can be defined as a time overrun or an extension of time to finish the project works. When the delay is occurred, actual progress of construction project is lagged from the initial plan. (Behind the schedule).

However, analyzing of delays are very complex because the various types of delays can be occurred concurrently due to the various causes related to the main parties of the project or any other external reasons. Delay of one work item can affect to the formation of any other delays. Larger and complex projects have a lot of activities. Therefore, the analyzing process of these projects is very complex. To reduce the complexity of analyze, delays are analyzed only based on the two major parameters (Time and cost). Infrastructure development projects are directly affected to the economy of the related country. Therefore, it is very important to complete these infrastructure projects within the planned schedule without cost overrun. (Ram & Paul, 2015).

According to the delay factors identified by early research authors from their studies, land acquisition is one of the major delay causing factors to the road development projects. These land acquisition problems are occurred due to the land ownership problems and the valuation of lands. In addition to that redesigning and haphazard underground utilities (utility lines) are other main contributing factors to the delay of construction projects. Mainly the delays were occurred due to the causes from owner's side rather than the consultant, contractors or any other project stake holders. (Elawi, Algahtany, & Kashiwagi, 2016). The time overrun of the road projects directly affected to the inconvenience of the public users of the road. Therefore, the project duration shouldn't be extended longer than the actual schedule unnecessarily. (Ellis, 2003).

Projects under Local Bank Funded project division were selected as the sample of this study. These projects mainly focused on the wellbeing of the local contractors in the road construction industry. According to the conditions of Local bank funded projects, local contractor should prepare the road construction project proposal including the strategically importance of the development of selected road. In addition to the above-mentioned project report contractor should introduce the loan provider among local banks in Sri Lanka. Then above technical as well as financial reports should be approved through the cabinet paper. Main two advantages of this project type are wellbeing of local contractors and reduction of foreign loans for the road development works.

1.1. Objectives

1. Review the delay factors identified from the past research works.
2. To establish delay factors based on contractors' claim submissions and rank them according to the level of significance for the delay.
3. To establish level of significance of delay causes factors found from contractors claim submissions and project engineer's opinions through the quantitative analysis method and compare them with the above level of significance results of contractors' claim submission analysis.
4. To establish lessons learned from the delay factor analysis and establish recommendations for future road construction works.

1.2. Methodology

To achieve above objectives, past research works related to the delay causes factors of construction projects are analyzed under the literature review. Then actual project details included in the contractors' claim documents regarding the delay of sample projects under the Local Bank Funded projects are gathered. Additional delay causes affected to the above projects are gathered through the interview methods from the related project engineers of the selected sample project.

Above delay causes found from the contractors' claim documents are analyzed quantitatively using the actual delay details to rank them according to the severity of the delay causes factors. All the delay causes found from the contractors' claim documents and interview with project engineers are used to prepare the questionnaire. Above questionnaire survey is sent to the project engineers of selected sample projects to gather significance level of delay causes factors affected to those projects. Questionnaire survey results are used to the quantitative ranking of identified delay causes factors using the Likert scale.

Both ranking results of actual project data analysis and quantitative analyses of questionnaire survey are compared each other to validate the ranking analysis of data included in contractors' claim documents. Highly ranked delay causes factors in severity order are discussed and proposed the recommendation for the mitigation of those delays.

2. LITERATURE REVIEW

2.1. Introduction to the Delay of Construction Projects

The project construction delay is considered as most common global phenomenon of the construction industry (Manarvi, Gardezi, & Gardezi, 2014). Delay has more definitions, few of them are something not happened at the expected time, something completed later than planned schedule or not timely works. At the beginning of the project, project schedule is used to plan the works including deadlines and milestone. Delay of the project is the achievement of deadlines and milestone inside the schedule at late. Delay of the actual progress is not rare incident in the projects (Trauner, 2009). Project delay can be identified according to the behavior of the actual present progress of the construction project is slower than the scheduled project plan or completion date of the project is not achieved as per the planned completion date of the project (Ram & Paul, 2015). When the resources are tied up in delayed projects, cost overruns, loss of profits, stress, and acrimony between parties, litigation and loss of opportunities are the main consequence of that delay. (Kamanga & Steyn, 2013).

Broad understanding of the general delay types is very important to analyze the delay causes and their consequences. Delay causes are divided in to four basic categories by (Trauner, 2009) name as,

1. Critical or non-critical
2. Concurrent or non-concurrent.
3. Excusable or non-excusable.
4. Compensable or non-compensable.

2.1.1. Critical or Non-Critical Delays

It is very important to identify the delays which are critical or not. If delay cause affected to the delay of project completion or milestone dates. It is called as critical delay cause. On the other hand, if the delay cause not affected to the delay of project completion date or milestone dates. It is called as non- critical delay cause. The word “Critical” delays coming from the critical path method in the project scheduling. Irrespective of the project type, any project scheduling has critical activities and the delay of that critical activities end up with the delay of project completion date or milestone date (Trauner, 2009). In the finding of delay causes scenario, non- critical delays can be omitted from the analysis. Therefore, critical delays should be identified to the exploring of actual delay causes affected to the delay of construction projects.

2.1.2. Concurrent or Non-concurrent Delays

Explanation of the concurrent delays mentioned in the Recommended Practice 10S-90, Cost Engineering Terminology published by Association for the Advancement of Cost Engineering as below,

1. Two or more delays have occurred in same time period and each individual delay affect to the ultimate project completion date. When the above delays are occurred due to the responsibility of contractor and client, it is very difficult to divide the total delay damage into the contractor and client respectively as per their delay responsibility.
2. If two or more absolute causes of delays occur at the same time period, concurrent delay will arise. The time period of “Concurrency” of the delay can be connected by incident even though the incident may not have occurred during the exactly the same time period.

Concurrent delay analysis is not just simply identifying the critical delays of the project, it has a defining of delay responsibility in connection with delay damages to the critical path. Frequently client tends to assign the responsibility of the concurrent delay to the contractor side for avoiding of payment of additional compensation with the extension of time approval. On the other hand, contractor tends to assign the responsibility of the concurrent delay to the client side for the avoiding of the deduction of liquidated

damages. Less number of contract specifications mention the conditions regarding the evaluation method of concurrent delay responsibility to identify that the contractor entitle additional compensation with extension of time or liable for the deduction of liquidated damages. (Trauner, 2009)

Construction project delay is a very complex scenario due to the concurrent behavior of some delays. These delays can be occurred due to the effect of one or more principle parties of the project or none of the principal parties. According to the concurrent delay behavior, one delay may affect to the formation of additional delays in the same or various activities. Normally delays of the projects are analyzed using the two major parameters named as time and cost rather than considering many more parameters to reduce the complexity of the evaluation. (Ram & Paul, 2015)

2.1.3. Excusable or Non-Excusable Delays.

Delay of the project happened due to the delay factor which is unpredictable and beyond the control of contractor. That delay is called as an excusable delay. Usual delay factors which are considered as the excusable delay factors are presented by (Trauner, 2009) as below.

- Trade union actions of the labors.
- Unexpected floods.
- Act of Gods.
- Changes of the given direction by client.
- Newly empowered regulations of other external authorities.
- Delay of governmental approvals.
- Unusual weather condition
- Errors and deletion of existing plans & specifications.

When some delay is happened in the project due to above reasons, Decision of the excusable or non-excusable may vary according to the contract document specifically prepared for that project.

Any delay happened due to the cause related to the contractor or contractor's side stake holder. It is called as a non- excusable delay. If non excusable delay occurred in the construction project, contractor is not entitled for the extension of time or additional

compensation for the cost of delay. (Hamzah.N, 2011) In addition to that contractor has to pay liquidated damages to the client according to their contractual agreement.

2.1.4. Compensable or Non-Compensable Delays

If Compensable delay is happened, contractor is entitled for the extension of time and additional compensation for the cost of delay. Compensable or non-compensable of the delay cause factors mainly depend on the excusable or non-excusable condition. If delay causes factor is non-excusable event, absolutely it is a non-compensable event for the project and contractor isn't entitled for the extension of time or additional compensation for cost of delay. (Trauner, 2009). On the other hand, each and every excusable delay is not a compensable delay. Compensable of the excusable delay depends on the specific condition under the contract or the preference of client. In the excusable non-compensable event, it may have an extension of time without any additional financial compensation for the contractor. This type of delay arises without any delay causes of contractor or client.

If the delay is occurred, objective of the project is going into the trouble and it is led to the extension of time of the project. That extension of time is caused to the additional overhead of the project and increases the cost of the project. Exceed of project cost in the construction project due to the delay of project affects badly to the contractual obligation of relevant parties. Therefore, project completion on time is a healthier situation for the both contractor and client. Early identification of delay causes is an essential action in the construction projects to take proactive actions to avoid such delay activities in the project.

Therefore, knowledge and understanding of risk of delay is important to help identify and manage effectively and systematically to achieve the project objective of time, cost, quality. (Manarvi, Gardezi, & Gardezi, 2014).

Risk management is a main managerial process of the construction projects. It involves planning, identifying, analyzing, improving risk handling strategies, monitoring and control. According to the roles of clients, consultants and contractors in the project, they should eliminate or mitigate the project delays using their risk management procedures (Kikwasi, 2012). (Dolage & Pathmarajah, 2015) explained that construction projects are often get abandoned or terminated due to the construction delays.

2.2. Delay Causes Factors and Their Classifications in Literature

(Aziz & Abdel-Hakam, 2016) analyzed the two hundred ninety-three factors causing to the delay in road construction projects in Egypt. Two hundred ninety causes were gathered from the literature review and other three were taken through the discussion and interview with experts. Then above two hundred ninety-three delay causes were divided in to fifteen major groups as financial related, owner related, contractor related, labour related, design related, site related contractual relationship related, contract related, project related, external related, equipment related, Rules & regulations related, consultant related, scheduling and controlling related, material related according to the cause relationships. (Dolage & Pathmarajah, 2015) selected twenty-four numbers of potential causes of delay in the Sri Lankan construction industry for their research works and divide them in to three categories as Management related causes, Finance related causes and Construction related causes for the evaluation process. Author verified above twenty-four potential delay causes by discussing with the senior engineers who involved in the construction projects implemented by three Sri Lankan government owned construction organizations namely as Building Department, Road Development Authority and National Water Supply & Drainage Board.

(Elawi, Algahtany, & Kashiwagi, 2016) found ten most critical delay factors of the infrastructure projects in the Gulf region using the results of ten previous research studies as literature survey. Authors categorized above ten critical delay factors according to the delay factors relationship as Owner related, Contractor related, consultant related and other related for their questionnaire survey. (Jeyakanthan & Jayawardana, 2012) collected thirty-six numbers of delays causing factors in donor funded road projects in Sri Lanka and categorized them in to the five groups according to the project life cycle stage of that delay causing factors. Those grouping stages are Inception and feasibility stage, Project design and tendering stage, project implementation stage, project monitoring and controlling stage and project closing stage. (Kamanga & Steyn, 2013) included seventy-two number of delay causes related to the Malawi road construction industry to their research analysis. (Pathirana & Halwatura, 2010) found well recognized thirty-one number of delay causing factors for their research works using the literature review and categorized them into four major

groups namely as Contractor's responsibility, Consultant's responsibility, owner's responsibility and external factors.

(Ibrahim, 2013) analyzed forty-one number of delay causing factors related to the Palestine road construction industry from the literature survey and classified them in to six groups namely as Project, Managerial, Consultant, External, Construction items and Financial according to the source of delay causing factor. (Manarvi, Gardezi, & Gardezi, 2014) reviewed the extension of time evaluation reports of almost fifty number of projects in leading construction organizations in Pakistan. From the real time data of that organizations, author extract twenty-seven number of most affected delay causing factors for his research study. Above twenty-seven number of delay causing factors categorized in to seven major groups as Client related factors, Contractor related factors, Consultant related factors, Material related factors, Labor and equipment related factors, Contract related factors, External factors for the easiness of results evaluation.

(Niazai & Gidado) extracted eighty-three number of delay causing factors related to the Afghanistan construction industry from the in depth literature survey. For the easiness of evaluation, author categorized the above eighty-three number of delay causing factors in to nine groups such as Project itself, Client, Contractor, Consultant, Designer, Materials, Equipment, Labor and external factors.

As per the above literature review results, majority of the researchers decided to categorize their delay causes into a few categories according to various specific parameters of the delay causes as delay responsibility, delay relativity and delay occurring stage etc. Considering above all categorization of delay causes, simple and reasonable delay categorization is five number of delay groups namely as Client related, Contractor related, Consultant related, and Designer related and other related factors. From the above classification, Responsible parties for the delay causes can be separated clearly as per their effect to the delay of construction projects.

2.2.1. Client Related Delay Factors

Client related delays are occurred due to the issues related to the owner of the project. Therefore, contractor has an authority to request the extension of time for the client related delay period and additional financial compensation for the cost of delay.

According to the literature review analysis, researchers found that the client related delay cause factors comes into the most critical delay factors category. Majority of client related delay cause factors out of top ten critical delay cause factors were identified by (Elawi, Algahtany, & Kashiwagi, 2016). Author found Land acquisition delay, shifting of line services (Utilities and underground services), clashes with other ministers, design conflict between owners, variation in estimated quantities between & General contractor, differences in opinion from the ministry of traffic and change of consultant during project execution as the most critical client related delay cause factors in Saudi Arabia. (Kikwasi, 2012) found five client related critical delay causing factors among top ten critical delays namely as delays in payments to contractor, information delays, funding problems, compensation issues and project schedule changes.

As per the research analysis of the (Ram & Paul, 2015), Client related delay cause factors such as delay of land acquisition, delay in progress payments, delay in approving design documents, poor coordination between owner and the other parties, financial closure, change order by client were resulted as critical delay causes among top ten critical delay causes factors. (Manarvi, Gardezi, & Gardezi, 2014) identified three critical delay causes factors related to the client namely as improper availability of funds with client, payment delays and unrealistic time duration among top ten critical delay factors found in his research. (Aziz & Abdel-Hakam, 2016) recognized three client related delay cause factors inside the selected top critical ten delay factors namely as owner financial problems/client finance/economic ability for the project, equipment failure and rework due to change of design or deviation order.

Too many change orders from owner, slow decision making from owner and delay in progress payment by the owner were selected as the critical delay cause factors with in top ten delay cause factors in his research by (Sweis, 2013). Slow payment procedures adopted by the client in making progress payment, delaying in relocating utilities and delay in paying compensation to land owners were only three number of client related

factors among top ten number of critical delay factors concluded by (Kamanga & Steyn, 2013). (Niazai & Gidado) also found two client related delay cause factors among top ten delay factors namely as delay in progress payment by owner, type of project bidding and award (negotiation, lowest price and etc.). (Ibrahim, 2013) recognized only single client related delay cause “payment delay by the owner” among most critical six delay cause factors.

Among thirty-six number of delay cause factors identified from the donor funded road development projects in Sri Lanka, (Jeyakanthan & Jayawardana, 2012) shortlisted nine most critical delay cause factors including six client related factors namely as inadequate feasibility study, improperly harmonized procurement documents, shortcoming of contract documents, stakeholder identification and management issues and variation and scope changes. (Pathirana & Halwatura, 2010) selected thirty-one number of delay cause factors to his research. According to the authors ranking three client related delay causes factors were included in the top ten critical factors namely as financial problems (delayed payments, financial difficulties and economic problems), contract modifications (replacement and addition of new work to the project and change in specification) and slowness in making decisions of project.

2.2.2. Contractor Related Delay Factors

Contractor related delays are occurred due to the failures of the project contractors. These types of delays are non- excusable and non -compensable delays. On the other hand, contractor has to pay liquidated damage compensation to the client according to the delay period as per the contract documents of the project.

As per the literature review analysis, researchers found that the contractor related delay causes factors comes into the identified most critical delay factors category. (Dolage & Pathmarajah, 2015) researched only the delay cause factors attributable to the contractor. Among contractor related delay factors identified by (Dolage & Pathmarajah, 2015), Top ten delay causes factors are Poor project planning & Scheduling, low profit margin, inadequate cash flow management, handling too many projects at a given time, incompetence of key staff, poor decision making by management, insufficient quality control, insufficient availability of equipment, poor supervision of work and delay in material supply. More than half of the top ten critical

delay causes factors found by the (Niazai & Gidado) are contractor related delay cause factors. They are poor qualifications of the contractor's technical staff, poor communication and coordination by contractor with other parties, poor site management and supervision by contractor, ineffective planning and scheduling of project by contractor, difficulties in financing project by contractor and frequent change of subcontractors because of their inefficient work.

Among two hundred ninety-three delay causes factors found by the (Aziz & Abdel-Hakam, 2016), There are four contractor related delay causes factors coming to the top ten delay cause factors namely as shortage in equipment /insufficient numbers, inadequate contractor experience(work) causing error, poor subcontractor or performance /delay and poor site management and supervision by contractor. (Odeh & Battaineh, 2002) conducted separate questionnaire survey with hundred numbers of contractors and fifty numbers of consultants in Jordan construction industry to rank the delay causing factors according to the delaying power. Contractor related delay cause factors namely as inadequate contractor experience, subcontractor's delay, improper planning of contractor, lack of equipment and equipment failure and less labor productivity were included in the top ten critical delay cause factors in both contractor and consultant point of view. In addition to above delay causes poor construction methods and poor site management were identified as contractor related delay cause factors as per the contractor's point of view.

(Sweis, 2013) shortlisted top ten critical delay cause factors including four contractor related delay factors which are poor planning and scheduling of the project by contractor, improper technical study by the contractor during the bidding stage, presence of unskilled labors and shortage of technical professionals in the contractor's organization. (Kamanga & Steyn, 2013) recognized three number of contractor related delay causes factors name as insufficient contractor cash flow, insufficient equipment and delay in site mobilization inside his research results of top ten critical delay cause factors.

(Ram & Paul, 2015) shortlisted three no of contractor related delay causes factors namely as ineffective project planning scheduling, poor site management and supervision and rework due to errors among the top ten delay cause factor as per his research results. (Elawi, Algahtany, & Kashiwagi, 2016), found only two contractor

related delay causes factors name as contractor's lack of expertise and deliberate delay in construction by general contractor within the final results of top ten critical delay causes in his research study.

In Sri Lankan context, only three contractor related critical delay cause factors namely as poor site management, financial problems and shortage of site labors were identified in the top ten delay cause factors by (Pathiranage & Halwatura, 2010) in his research study.

2.2.3. Consultant Related Delay Factors

Comparing to the client related and contractor related delay cause factors, consultant related delay causes factors happened in the lesser frequency. According to the top delay causes factors found in the literature review, there are a few numbers of consultant related delay causes factors included. (Pathiranage & Halwatura, 2010) highlighted three consultant related delay cause factors among top ten delay cause factors in his research results as incomplete documents, Delayed and slow supervision in making decisions and Slowness of giving instructions.

(Aziz & Abdel-Hakam, 2016), (Kikwasi, 2012), (Ibrahim, 2013), (Manarvi, Gardezi, & Gardezi, 2014) and (Sweis, 2013) found only one consultant related delay cause factors each among their selected top critical delay cause factors namely as mistakes in soil investigation, disagreement on the valuation work done, poor communication between construction parties, discrepancies b/w drawings and specifications and poor qualifications of consultants, engineers and staff assigned to the project respectively.

2.2.4. Designer Related Delay Factors

(Aziz & Abdel-Hakam, 2016), (Kikwasi, 2012), (Sweis, 2013), (Manarvi, Gardezi, & Gardezi, 2014), (Jeyakanthan & Jayawardana, 2012) and (Elawi, Algahtany, & Kashiwagi, 2016) found only one designer related delay cause factors each among their selected top critical delay cause factors namely as design errors made by designers, design changes, ambiguities and mistakes in specifications and drawings, design changes, errors and omissions in detail design and redesigning respectively.

2.2.5. External Related Delay Factors

If the delay is happened due to the reason out of the responsibility of client, contractor, consultant or designer. That type of delay causes factors are categorized as an external related delay cause factor. Most probably these types of delay causes are excusable delays and contractor received the extension of time for their delay period. Eligibility of extra compensation of contractor for the cost of delay depends on the conditions mentioned in the specific contract documents related to the individual project. In the Pakistan context, (Manarvi, Gardezi, & Gardezi, 2014) identified four number of external related delay causes factors namely as Law and order situation, War & Terrorism, inflation of local currency and Political/Bureaucratic influences among top ten delay factors of his research results.

2.3. Top Ranked Delay Causes Factors in Past Researches.

According to the in-depth analysis of early researches done by authors all over the world, they shortlisted most critical delay causes factors using selected ranking methods from the identified total number of delay causes factors. Some of them are not related to our construction industry environment and some of them are very specific to the geographical locations of the construction sites. Top critical delay causes found in the literature survey were tabulated with their authors in Table 1 below.

Table 1- Details of Top Most Delay Causing Factors According to the Past Research Results.

Author	Country	Findings of Analysis
(Aziz & Abdel-Hakam, 2016)	Egypt	<p>Top ten delay causes are,</p> <ol style="list-style-type: none"> 1. Owner financial problems/client finance /economic ability for the project. 2. Shortage in equipment/insufficient numbers. 3. Inadequate contractor experience (work) causing error. 4. Shortage in construction materials. 5. Equipment failure. 6. Design errors made by designers. 7. Poor subcontractor or performance /delay 8. Mistakes in soil investigations. 9. Rework due to change of design or deviation order. 10. Poor site management and supervision by contractor.
(Kamanga & Steyn, 2013)	Malawi	<p>Top Ten delay causes are,</p> <ol style="list-style-type: none"> 1. Shortage of fuel. 2. Insufficient contractor cash flow. 3. Shortage of foreign currency for importation of materials and equipment. 4. Slow payment procedures adopted by the client in making progress payment. 5. Insufficient equipment. 6. Delaying in relocating utilities. 7. Shortage of construction materials. 8. Delay in paying compensation to land owners. 9. Shortage of technical personnel. 10. Delay in site mobilization.

Author	Country	Findings of Analysis
(Kikwasi, 2012)	Tanzania	<p>Top ten delay causes are,</p> <ol style="list-style-type: none"> 1. Design Changes. 2. Delays in payment to contractors. 3. Information delays. 4. Funding problems. 5. Poor project management. 6. Compensation issues. 7. Disagreement on the valuation of work done. 8. Conflicts among the involved parties. 9. Project schedule changes. 10. Supply/procurement problems.
(Ibrahim, 2013)	Palestine	<p>Top six delay factors are,</p> <ol style="list-style-type: none"> 1. Financial status of the contractor. 2. Payment delay by the owner. 3. Political situation. 4. Segmentation of the west bank. 5. Poor communication between construction parties. 6. High competition in bids.
(Manarvi, Gardezi, & Gardezi, 2014)	Pakistan	<p>Top ten delay factors are,</p> <ol style="list-style-type: none"> 1. Law and order situation. 2. Design changes. 3. Improper availability of funds with client. 4. War and terrorism. 5. Poor site management. 6. Discrepancies b/w drawings and specifications. 7. Payment delays. 8. Inflation of local currency. 9. Unrealistic time duration. 10. Political /bureaucratic influences.

Author	Country	Findings of Analysis
(Niazai & Gidado)	Afghanistan	<p>Top ten delay factors are,</p> <ol style="list-style-type: none"> 1. Security. 2. Corruption. 3. Poor qualifications of the contractor's technical staff. 4. Delay in progress payment by owner. 5. Poor site management and supervision by contractor. 6. Ineffective planning and scheduling of project by contractor. 7. Type of project bidding and award (Negotiation, lowest price and etc.) 8. Difficulties in financing project by contractor. 9. Poor communication and coordination by contractor with other parties. 10. Frequent change of subcontractors because of their inefficient work.
(Ram & Paul, 2015)	India	<p>Top ten delay factors are,</p> <ol style="list-style-type: none"> 1. Delay due to land acquisition. 2. Environmental issues. 3. Delay in progress payments. 4. Ineffective project planning scheduling. 5. Poor site management and supervision. 6. Rework due to errors. 7. Delay in approving design documents. 8. Poor coordination between the owner and other parties. 9. Financial closure. 10. Change order by client.

Author	Country	Findings of Analysis
(Sweis, 2013)	Jordan	<p>Top ten delay factors are,</p> <ol style="list-style-type: none"> 1. Too many change orders from owner. 2. Poor planning and scheduling of the project by contractor. 3. Ambiguities and mistakes in specifications and drawings. 4. Slow decision making from owner. 5. Poor qualification of consultants, engineers and staff assigned to the project. 6. Improper technical study by the contractor during the bidding stage. 7. Delay in progress payments by the owner. 8. Severe weather conditions on the job site. 9. Presence of unskilled labors. 10. Shortage of technical professionals in the contractor's organization.
(Pathirana & Halwatura, 2010)	Sri Lanka	<p>Overall top ten delays are,</p> <ol style="list-style-type: none"> 1. Financial problems (delayed payments, financial difficulties and economic problems). 2. Poor site management. 3. Financial problems. 4. Poor weather conditions. 5. Contract modifications. (Replacement and addition of new work to the project and change in specifications). 6. Incomplete documents. 7. Delayed and slow supervision in making decisions. 8. Slowness in making decisions. 9. Shortage of site labors. 10. Slowness of giving instructions.

Author	Country	Findings of Analysis
(Dolage & Pathmarajah, 2015)	Sri Lanka	<p>Top ten delay causes are,</p> <ol style="list-style-type: none"> 1. Poor project planning & Scheduling. 2. Low profit Margin. 3. Inadequate cash flow management. 4. Handling too many projects at a given time. 5. Incompetence of key staff. 6. Poor decision making by management. 7. Insufficient quality control. 8. Insufficient availability of equipment. 9. Poor supervision of works. 10. Delay in material supply.
(Jeyakanthan & Jayawardana, 2012)	Sri Lanka	<p>Top nine delay causes are,</p> <ol style="list-style-type: none"> 1. Inadequate feasibility studies. 2. Errors and omissions in detail design. 3. Improperly harmonized procurement documents. 4. Shortcomings of contract documents. 5. Stakeholder identification and management issues. 6. Variations and scope changes. 7. Land acquisition & resettlement. 8. Extreme weather. 9. Shortage of bitumen.

Author	Country	Findings of Analysis
(Elawi, Algahtany, & Kashiwagi, 2016)	Saudi Arabia	<p>Top ten delay causes are,</p> <ol style="list-style-type: none"> 1. Land acquisition. 2. Contractor's lack of expertise. 3. Re-designing. 4. Line services (Utilities and underground services) 5. Clashes with other ministers. 6. Design conflict between owners 7. Variation in estimated quantities between designer & General contractor. 8. Differences in opinion from the ministry of traffic. 9. Deliberate delay in construction by General contractor. 10. Change of consultant during project execution.
(Odeh & Battaineh, 2002)	Jordan	<p>Top ten delay causes as per the contractors' point of view are,</p> <ol style="list-style-type: none"> 1. Less labor productivity. 2. Owner interference. 3. Inadequate contractor experience. 4. Delay of finance and payments by client. 5. Poor site management. 6. Poor construction methods. 7. Lack of equipment and equipment failure. 8. Slow decision making by owner. 9. Subcontractor's delay. 10. Improper planning of contractor.

Author	Country	Findings of Analysis
(Odeh & Battaineh, 2002)	Jordan	<p>Top ten delay causes as per the consultants' point of view are,</p> <ol style="list-style-type: none"> 1. Inadequate contractor experience. 2. Delay of finance and payment by client. 3. Subcontractor's delay. 4. Owner's interference. 5. Slow decision making by owner. 6. Unrealistic imposed contract duration. 7. Lack of equipment and equipment failure. 8. Improper planning of contractor. 9. Less labor productivity. 10. Shortage in material.
(Mahamid, Bruland, & Dmaid, 2012)	Palestine	<p>Top ten delay causes are,</p> <ol style="list-style-type: none"> 1. Political situation. 2. Segmentation of the West Bank and limited movement between areas. 3. Award project to lowest bid price. 4. Progress payments delay by owner. 5. Shortage of equipment. 6. Delays in decision making by owner. 7. Low productivity of laborers. 8. Delay in approving sample materials. 9. Poor communication by owner with other construction parties. 10. Conflict between contractor and other parties.

Author	Country	Findings of Analysis
(Aziz R. F., 2013)	Egypt	<p>Top ten delay causes are,</p> <ol style="list-style-type: none"> 1. Delay in progress payments. (Funding problems) 2. Different tactics patterns for bribes. 3. Shortage of equipment. 4. Ineffective planning and scheduling. 5. Poor site management and supervision. 6. Poor financial control on site. 7. Rework due to errors. 8. Selecting inappropriate contractors. 9. Sudden failures actions. 10. Inadequate planning.
(Kesawan, Gobidan, & Dissanayake, 2015)	Sri Lanka	<p>Top ten delay causes are,</p> <ol style="list-style-type: none"> 1. Conflict in Sub contractor schedule during execution of project. 2. Difficulties in financing projects. 3. Frequent change of sub-contractors. 4. Delays in sub-contractor's work. 5. Rework due to error in construction. 6. Poor communication and coordination. 7. Delay in progress payments. 8. Weather effect on construction activities. 9. Shortage of labors. 10. Low productivity level of labors.

2.4. Delay Cause Factors Identification Methods in Past Researches

Majority of the past research authors used the literature survey analysis method to identify the delay causes factors related to their study areas. Few of them went beyond the literature review analysis and explored the additional details with the pilot surveys and interviews with construction field experts to improve the effectiveness of their analysis. Among fourteen numbers of authors mentioned above, only two authors pay their attention regarding the actual project data that helped them to improve the relativeness of the study into the considered sample of analysis.

Table 2- Details of Delay Causes Factors Identification in Previous Research Works.

Author	Delay factors Identification Methods	No of Identified Factors
(Aziz & Abdel-Hakam, 2016)	Literature review	290
	Through the interviews and discussion with experts	3
	From all methods	293
(Dolage & Pathmarajah, 2015)	Literature review and interviews with engineers who are join with project execution	24
(Elawi, Algahtany, & Kashiwagi, 2016)	Real time quantitative Analysis	10
(Hamzah.N, 2011)	Literature review	51
(Jeyakanthan & Jayawardana, 2012)	Comprehensive literature survey and semi structured interviews	36
(Kamanga & Steyn, 2013)	Literature Review	72
(Kikwasi, 2012)	Literature Review	21
(Mahamid, 2013)	Literature Review	45
(Manarvi, Gardezi, & Gardezi, 2014)	From actual project extension data	27
(Niazai & Gidado)	Literature Review	83
(Odeh & Battaineh, 2002)	Literature Review	28
(Pathiranage & Halwatura, 2010)	Relevant international Literature review and conducting pilot with experienced highway practitioners	31
(Ram & Paul, 2015)	Literature Review	101
(Sweis, 2013)	Literature Review	33

2.5. Evaluation Method of Delay Causes Factors in Past Researches

Most of the research authors found in the literature review used the quantitative analysis methods to evaluate the significance level of the delay causes factors rather than qualitative analysis method. Out of fourteen number of selected authors in literature analysis regarding the delay causes factors, only one author namely as (Sweis, 2013) attended on real time quantitative analysis of their sample projects to rank the affecting level of delay causes factors. All other previous authors in the literature review used the delay causes factors found from literature review for their analysis. Only two authors namely as (Elawi, Algahtany, & Kashiwagi, 2016), (Ram & Paul, 2015) used the project case study method to validate the results of questionnaire survey. Usage of actual project data in the research analysis has added advantage called as the relativity of the analysis. Rather than taking the views of the stakeholders in the project, above real time quantitative data provide the exact image of the project work.

Table 3- Delay Factors Evaluation Methods Found from Literature Review.

Author	Delay Factors Evaluation Method
(Aziz & Abdel-Hakam, 2016)	Using the questionnaire survey
(Elawi, Algahtany, & Kashiwagi, 2016)	Case study analysis
(Dolage & Pathmarajah, 2015)	Using the questionnaire survey
(Kamanga & Steyn, 2013)	Using the questionnaire survey
(Kikwasi, 2012)	Using the questionnaire survey
(Mahamid, 2013)	Using the questionnaire survey
(Manarvi, Gardezi, & Gardezi, 2014)	Using the questionnaire survey
(Niazai & Gidado)	Using the questionnaire survey
(Odeh & Battaineh, 2002)	Using the questionnaire survey
(Pathiranage & Halwatura, 2010)	Using the questionnaire survey
(Ram & Paul, 2015)	Using the questionnaire survey & compared with case study
(Sweis, 2013)	Analysis of Actual Project Data and questionnaire survey

2.6. Evaluation Tools of Delay Causes Factors in Past Researches

Evaluation tools named as Relative Significance Index (RSI), Relative Important Index (RII), Spearman's rank correlation coefficient, Average severity value and frequency index were used in the past researches regarding the identification and evaluation of delay causes factors. Above evaluation tools found in the literature review analysis were tabulated in Table 4 shown below.

Table 4- Questionnaire Survey Evaluation Tools Found from the Literature Review.

Author	Tools Used to Rank the Delay Causes Factors from Questionnaire Survey
(Aziz & Abdel-Hakam, 2016)	Relative Importance Index
(Dolage & Pathmarajah, 2015)	Severity index
(Kamanga & Steyn, 2013)	Severity index & Spearman's rank correlation coefficient
(Kikwasi, 2012)	Relative Importance Index
(Mahamid, 2013)	Average severity value
(Manarvi, Gardezi, & Gardezi, 2014)	Relative Importance Index
(Niazai & Gidado)	Relative importance index & Spearman's rank correlation coefficient
(Odeh & Battaineh, 2002)	Relative importance index & Spearman's rank correlation coefficient
(Pathiranage & Halwatura, 2010)	Relative importance index & Relative significance index
(Ram & Paul, 2015)	Relative Importance Index
(Sweis, 2013)	Importance index, Frequency index & Severity Index

2.7. Summary

According to the literature review analysis, researchers all over the world studied about the delay causes factors affected to the delay of construction projects using various types of approaches. Early researchers conducted their delay studies in the section of Road construction sector projects, Building construction sector projects, Water supply or sewerage line laying sector projects separately or as a combination.

Early researchers used few methods to collect the delay causes factors namely as literature review analysis, through the discussion with construction experts, Real time quantitative analysis and analysis of contractors' claim documents as described in Table 2. Various delay causes gathered from the literature review analyses were tabulated with the related author in Table 1. Delay causes factors found in the literature analysis were mainly categorized into few categories as, Critical or non-critical delays, Concurrent or non-concurrent delays, Excusable and non-excusable delays and Compensable and non-compensable delays as per the behavior of them at the delay of project.

According to the responsible party of delay causes factor, authors found in the literature review categorized the delay causes factors in their studies. Most preferable categorization found in our literature study is a five-group categorization named as Client related delays, Contractor related delays, Consultant related delays, Designer related delays and External related delays. Questionnaire survey method was found as the most preferable method of data collection in the past research works. In addition to that delay data collection from actual project documents and project case study were found in the previous research works.

As per the literature review analysis Relative Important Index (RII), Relative Significance index (RSI), Frequency Index and spearman rank coefficient were used for the quantitative ranking of delay causes according to their severity. Considering all above aspects most preferable method of ranking delay causes factors is a quantitative analysis of the delay causes factors according to their significance in the selected projects.

3. METHODOLOGY

3.1. Collection of Critical Delay Causes Factors.

According to the objective of this study, initially critical delay causes factors should be gathered through the various sources to analyze the research problem. Therefore, below three methods were selected to identify the delay causes factors found in the construction projects under Local Bank Funded projects.

- Gathered top critical delay causes factors from the literature review analysis.
- Extracted the project related delay causes factors from the contractors' claim documents.
- Interviewed related project engineers of the sample projects to collect their experience regarding the delay causes factors found in their projects.

3.1.1. Identifying Delay Causes Factors through Literature Review

Sixteen numbers of early researches were studied to identify the top critical delay causes factors found in their studies. At the initial stage, identified top critical delay cause factors according to the literature review were listed in a Table 1 within the literature review part including the categorization as per the authors of those findings. Above top critical delay causes factors were found from the results of conducted research works all over the world. Therefore, some critical delay causes factors found in the literature survey were not directly related to the condition of my research sample area.

3.1.2. Identifying Delay Causes Factors from the Contractors' Claim Documents

Identification of actual delay cause factors affected to the selected sample projects under the Local Bank Project Division is very important to increase the relativity of the study. Therefore, extension of time requests from thirty number of sample road construction projects were analyzed to identify the real delay causes factors affected to the delay of that projects. In this study, individual contribution of the delay causes factors to the delay of each projects can be identified in quantitative manner according to the number of approved extended dates allocated to the individual delay causes factors. Only excusable delay reasons of the contractor were included in to the extension of time requests.

3.1.3. Identifying Delay Causes Factors by the Interview with Project Engineers

Interview method was used to gather information regarding the delay cause factors affected to the selected sample of projects from its related project engineers. For the interview purpose, list of identified critical delay causes factors from the literature survey was sent to the project engineers to take wide view regarding the data collection. Those interviews covered the additional delay cause factors which were not founded in Extension of time requests. From this interview method, delay factors related to the contractor's responsibility were also identified.

3.2. Ranking of the Delay Causes Factors According to Their Affecting Level

One of the main objectives of this research study is to identify delay causes factors in the selected sample projects under the Local bank funded project division and rank them according to the severity level of them. Two methods were used to analyze the severity of delay course factors. They were contractors' claim data analysis using the percentage individual contribution of delay causes factors and questionnaire survey analysis of all identified delay causes factors found from contractors' claim documents and interview with project engineers according to the provided Likert scale.

Sample Size

In this study, thirty number of sample projects were randomly selected for the identification and analysis of delay causes factors under the Local bank funded project division. According to the Central Limit Theorem, sample size approach to the thirty numbers, distribution of sample mean is approximately normal irrespective of the type of population distribution. Therefore, delay causes factors identification analysis of thirty number of projects can be used to forecast the behavior of population.

Confidence Interval for the Mean Percentage Delay of Population

According to Central limit theorem, confidence interval of the mean percentage delay of the population as follows,

$$\mu_{di} = \left(\bar{x} - c \cdot \frac{\sigma}{\sqrt{n}}, \left(\bar{x} + c \cdot \frac{\sigma}{\sqrt{n}} \right) \right)$$

$$\bar{x} = \text{Sample mean} = \frac{\sum_{i=1}^n di}{n}$$

$$\sigma = \text{Standard deviation of the sample} = \sqrt{\frac{\sum_{i=1}^n di^2}{n} - \left(\frac{\sum_{i=1}^n di}{n} \right)^2}$$

For the 95% of confident interval, $c = 1.96$

3.2.1. Affecting Level of Delay Causes Factors as per the Actual Project Data

Thirty number of projects under the Local Bank Funded Projects were selected as the sample of this research analysis. Initially all extensions of time requests raised in above thirty number of projects were analyzed to identify the affected actual delay causes. In addition to that all the quantitative data like amount of delay due to each individual delay causes factor was assessed according to the approved number of extended dates. From above analysis, all the delay causes factors identified were ranked as per their affecting level for all thirty numbers of projects.

3.2.1.1. Percentage Delay

Percentage delay of the project is a good quantitative measure for the evaluation of its magnitude of the delay. (Pathiranage & Halwatura, 2010) introduced percentage delay parameter in his study as follows,

$$\text{Percentage Delay} = (T \text{ Actual} - T \text{ Planned}) / T \text{ Planned}$$

T Actual = Actual Project Duration.

T Planned = Planned Project Duration

3.2.1.2. Weighted Percentage Delay

In this study, I introduced the new parameter “Weighted Percentage Delay” for the analysis of the individual effect of each delay causes. Following Equation derive the value of the Weighted Percentage Delay of the selected delay causes factor.

$$\text{Weighted Percentage Delay (\%)} = \% \text{ Delay of Project} \times \% \text{ individual contribution to the project delay.}$$

3.2.2. Affecting level of delay causes factors as per the Questionnaire survey.

Most of the authors did the researches related to this area using the questionnaire survey method to gather information regarding the affected level of delay causes factors. They prepared the questionnaire survey and sent it to the officers who have involved in the construction project works. According to the project experience received from the involved construction projects, respondent provided the level of significance of each individual delay causes factors to the delay of their construction projects. Most of the early authors used the Likert scale to collect the respondent’s attitude quantitatively regarding the significance level of delay causes factors.

According to the details found by the literature analysis, above Table 04 shows that the most of the early research authors had used the Relative important index to rank the significance of their selected delay causes factors according to the respondents’ level

categorization in Likert scale. (Pathiranage & Halwatura, 2010) introduced new evaluation method namely as the Relative significance index to improve the accuracy of the ranking of delay causes factors. According to the concept of relative significance index, Author included the actual percentage delay of the project to his calculation. Therefore, the actual delay percentage of the individual projects were collaborated with the final ranking of delay causes factors and the accurate effect of the delay causes factor can be evaluated through this method.

Using all the delay causes factors identified from extension of time evaluation reports and interview with the project engineers, Questionnaire survey is prepared for the quantitative evaluation of the delay cause factors using the responds taken from the project engineers involved in the selected thirty number of Local bank funded projects according to their experience. This questionnaire survey includes the Likert scale from zero to five for the answer of each question to take the view of respondent regarding the significant level of each delay cause factor in their project. According to the answers given by the respondents, Rank the selected delay cause factors using the relative significance index according to their impact on delays.

3.2.2.1. Likert Scale

Likert scale is a rating scale widely used in the questionnaire survey to evaluate the respondent's responses into the quantitative measure. Normally Likert scale includes range of two to ten responses options. Five or seven responses are the most common Likert scales use in the questionnaire surveys of research works. In this research work, five-point Likert scale is included to the questioner survey for the quantitative ranking of the delay cause factors according to their significant level of contribution to the delay of the project. Five points included in my questionnaire survey are as follows.

- 1 - Not Significant.
- 2 - Less Significant.
- 3 - Moderately Significant
- 4 - Significant
- 5 - Extremely Significant

3.2.2.2. Relative Importance Index.

$$\text{Relative Importance Index} = \frac{\sum W}{A*N}$$

W= Weighting factors given to the selected factor by respondent. (From one to five)

A= Maximum value given in Likert Scale (Five)

N= Total number of responds.

According to the equation given above, Relative importance index of each delay causes factor is calculated as per the Likert scale value given by the respondents. All the Relative importance Index values ranging from 0 to 1. According to the value of the RII, Delay causes factors are ranked as per their significance on the delay of projects. Higher value of RII is the highest in ranking.

3.2.2.3. Relative Significance Index

(Pathiranage & Halwatura, 2010) introduced the Relative significance index to assess the significance of each delay causes factor including the percentage delay of individual projects. Equation of the Relative Important Index as follows,

$$\text{Relative Significance Index} = \frac{\sum_{i=1}^n (W_i * d_i)}{A * \sum_{i=1}^n d_i}$$

W_i = Weighting factors given to the selected factor in ith project by respondent. (From 1 to 5)

d_i = Percentage Delay of ith Project.

A = Maximum value given in Likert Scale (Five)

According to the equation given above, percentage delays of each project were included to the ranking of delay causes factors by Relative Significance Index, rather than evaluating the significance of delay cause factors only as per the respond of the respondent's in relative important index. This Relative Significance Index method gave weightage to the actual project delay. Therefore, this Relative Significance Index shows the actual delay contribution of each delay causes factor to each project.

4. DATA COLLECTION, ANALYSIS AND DISCUSSION OF RESULTS

4.1. Data Collection

4.1.1. Collected Data from Contractors' Claim Documents

Actual delays and their magnitude in the selected sample projects were gathered through the approved contractors' claim documents. Delay causes factors found from the contractors' claim documents were mapped with the delay causes factors found from the literature review for the simplicity of analysis and tabulated under Table 5.

Table 5- Shortlisted Delay Causes Factors Found from Contractors' Claim Documents with the Mapping of Literature Findings

Project No	Delay Causes Factor Mapped with Literature	Approved Days
1	Extreme Weather	57
	Delaying relocating utilities.	154
	Variations & Scope Changes	126
2	Delay Due to land Acquisition	4
	Extreme Weather	45
	Mistakes in soil investigations	642
	Effect of election	4
	Delay Due to land Acquisition	24
	Conflicts among involved parties	14
3	Delaying relocating utilities.	116
	Variations & Scope Changes	100
4	Delay Due to security reasons	58
	Design Changes	21
	Variations & Scope Changes	31
5	Delaying relocating utilities.	150
6	Variations & Scope Changes	258
	Extreme Weather	49
	Delay Due to land Acquisition	401
	Delaying relocating utilities.	25

Project No	Delay Causes Factor Mapped with Literature	Approved Days
7	Delay Due to land Acquisition	84
	Delays in approving design documents	328
	Extreme weather	48
	Effect of election	6
	Delay Due to land Acquisition	110
8	Extreme weather	28
	Effect of election	2
	Unforeseen site condition	38
	Law and Order situation	91
9	Variations & Scope Changes	145
	Extreme weather	30
	Effect of election	6
	Law and Order situation	91
10	Delay Due to land Acquisition	36
	Extreme weather	76
	Delaying relocating utilities.	25
	Design Changes	18
	Law and Order situation	30
	Effect of election	6
11	Variations & Scope Changes	141
	Law and Order situation	151
12	Variations & Scope Changes	94
	Extreme weather	12
	Effect of election	6
13	Delay Due to land Acquisition	44
	Extreme weather	62
	Effect of election	6
	Variations & Scope Changes	128
14	Delaying relocating utilities.	144
	Extreme weather	31
	Effect of election	3
	Variations & Scope Changes	332

Project No	Delay Causes Factor Mapped with Literature	Approved Days
15	Extreme weather	33
	Effect of election	3
	Delaying relocating utilities.	8
16	Variations & Scope Changes	182
	Extreme weather	43
	Effect of election	3
	Delay Due to land Acquisition	109
17	Variations & Scope Changes	200
	Extreme weather	34
	Design Changes	7
	Unforeseen site condition	101
18	Extreme weather	21
	Effect of election	6
	Delaying relocating utilities.	147
19	Delaying relocating utilities.	162
	Variations & Scope Changes	92
20	Extreme weather	46
	Delay Due to land Acquisition	30
	Variations & Scope Changes	187
21	Extreme weather	21
	Variations & Scope Changes	73
	Effect of election	2
22	Environmental issues	77
	Extreme weather	25
	Design Changes	109
	Delay Due to land Acquisition	59
	Delaying relocating utilities.	32
	Variations & Scope Changes	122
23	Delaying relocating utilities.	96
	Design Changes	59

Project No	Delay Causes Factor Mapped with Literature	Approved Days
24	Delay Due to land Acquisition	41
	Extreme weather	24
	Effect of election	6
	Delaying relocating utilities.	102
25	Extreme weather	132
	Effect of election	6
	Law and Order situation	68
	Delaying relocating utilities.	6
	Delay Due to land Acquisition	44
	Variations & Scope Changes	73
26	Delay of inauguration Ceremony	40
	Variations & Scope Changes	86
27	Delays in approving design documents	42
	Delay Due to land Acquisition	4
	Extreme weather	23
	Delaying relocating utilities.	256
28	Delay Due to land Acquisition	43
	Improper availability of funds with client.	95
	Extreme weather	29
	Delays in approving design documents	76
	Variations & Scope Changes	175
	Design Changes	30
	Law and Order situation	66
29	Variations & Scope Changes	68
	Extreme weather	24
	Delaying relocating utilities.	55
30	Environmental issues	18
	Extreme weather	69
	Effect of election	3
	Ineffective project planning scheduling by contractor	95
	Variations & Scope Changes	134
	Law and Order situation	109

4.1.2. Collected Data from the Interview with Project Engineers of Sample Projects

Only excusable delay causes factors for the contractor were included into the contractors claim documents. Therefore, project engineers related to the selected thirty number of sample projects were interviewed to gather delay causes factors affected to the delay of their projects, in addition to the delay factors found from contractors' claim documents. Delay causes factors identified from interview are as follows,

Table 6- Delay Causes Factors Found from the Interview with Project Engineers.

No	Delay Causes Factor Found from the Interview
1	Unforeseen third-party damage to the built structures.
2	Delay of fuel supply by contractor.
3	Poor site management of contractor.
4	Poor coordination of contractor with other stakeholders.
5	Rework due to poor quality works and error procedures.
6	Plant & equipment failures.
7	Delay of mobilization to the site.
8	Slow decision taking by client.
9	Less labor productivity.
10	Less authority delegation of Engineer to the Engineer representative.
11	Unavailability of required number of staff in contractor organization.
12	Slow decision taking by consultant.
13	Less qualified persons in contractor's key staff.
14	Less material storage facilities in the contractor's yards.
15	Delay of laboratory testing proceed by client's laboratory.
16	Poor traffic management procedures followed by contractor at site.
17	Deficiency of some materials in the country.

4.2. Analysis

4.2.1. Classification of Delay Causes Factors According to the Delay Responsibility.

According to the responsible party of the delay causes factors, all identified delay causes factors were categorized in to the five groups as shown in Table 7 below,

Table 7- Classification of Delay Causes Factors According to the Responsibility.

No	Delay Causes Factor	Delay Responsibility
1	Variation and Scope Changes	Client Related
2	Delaying of relocating utilities	Client Related
3	Delay due to land acquisition	Client Related
4	Ineffective project planning and scheduling by contractor	Contractor Related
5	Deficiency of some materials in the country.	External Related
6	Poor site management of contractor.	Contractor Related
7	Less qualified persons in contractor's key staff.	Contractor Related
8	Design Changes	Designer Related
9	Unavailability of required number of staff in contractor organization.	Contractor Related
10	Improper availability of funds with client	Client Related
11	Poor coordination of contractor with other stakeholders.	Contractor Related
12	Unforeseen site conditions	External Related
13	Less labor productivity.	Contractor Related
14	Extreme weather	External Related
15	Plant & equipment failures.	Contractor Related
16	Mistakes in Soil investigation	Client Related
17	Rework due to poor quality works and error procedures	Contractor Related
18	Less material storage facilities in the contractor's yard.	Contractor Related
19	Conflict among involved parties	Consultant Related
20	Slow decision making by client.	Client Related
21	Delays in approving design	Designer Related

No	Delay Causes Factor	Delay Responsibility
22	Delay of mobilization to the site.	Contractor Related
23	Environmental issues	External Related
24	Law and order situation	External Related
25	Slow decision making by consultant	Consultant Related
26	Less authority delegation to the Engineer's Representative.	Consultant Related
27	Unforeseen third-party damage to the built structures	External Related
28	Poor traffic management procedures followed by contractor at site.	Contractor Related
29	Delay of laboratory testing proceed by client's laboratory.	Client Related
30	Delay of fuel supply by contractor.	Contractor Related
31	Delay due to security reasons	External Related
32	Effect of election	External Related
33	Delay of inauguration ceremony	External Related

Thirty-three number of delay causes factors gathered from the contractor's claim documents and the interview of project engineers were classified in to five groups named as Client Related, Contractor Related, Consultant Related, Designer Related and External Related.

Seven client related delay causes factors, twelve contractor related delay causes factors, three consultant related delay causes factors, two designer related delays causes factors and nine external related delay causes factors were found in the above thirty-three number of delay causes factors. Most of the times above external related delay causes factors are not under control of any stakeholder in the road construction projects. Other delay causes factors should be addressed by responsible party of those delays to mitigate the delays in road construction projects.

4.2.2. Quantitative Analysis of the Delay Causes Factors According to the Contractor's Claim Documents Data.

Contractor's claim documents were analyzed according to the following criteria to evaluate the significant level of delay causes factors.

- Percentage time delay of the individual projects.
- Confident intervals for population mean percentage delay.
- Individual contribution of each delay causes factor on the delay of projects.
- Frequency of individual delay causes factor found in the sample projects.
- Ranking of delay causes factors according to the average individual percentage contribution for the delay of road construction projects

4.2.2.1. Percentage Delay of the Projects in Sample Projects

$$\text{Percentage Delay} = (T \text{ Actual} - T \text{ Planned}) / T \text{ Planned}$$

T Actual = Actual Project Duration.

T Planned = Planned Project Duration.

Percentage delay of a construction project is measured as a proportion of time extension of the construction project in to its planned project duration. Due to various reasons, above construction delay can be happened. According to the magnitude of the delay percentage of the project, severity of delay causes factors found in that project can be evaluated. Actual percentage delay of the sample projects found according to the contractors' claim documents are tabulated in the Table 8.

Table 8- Actual Percentage Delay of the Selected Sample Projects.

Project No	Percentage Delay (%)
Project 01	37%
Project 02	100%
Project 03	20%
Project 04	122%
Project 05	33%
Project 06	204%
Project 07	105%
Project 08	22%
Project 09	38%
Project 10	26%
Project 11	54%
Project 12	25%
Project 13	33%
Project 14	93%
Project 15	10%
Project 16	75%
Project 17	63%
Project 18	32%
Project 19	56%
Project 20	36%
Project 21	13%
Project 22	58%
Project 23	43%
Project 24	32%
Project 25	45%
Project 26	35%
Project 27	36%
Project 28	105%
Project 29	16%
Project 30	47%

4.2.2.2. Confidence Interval for Population Mean of Percentage Delay

$$\mu_{di} = (x - c \cdot \frac{\sigma}{\sqrt{n}}), (x + c \cdot \frac{\sigma}{\sqrt{n}})$$

$$\bar{x} = \text{Sample mean} = \frac{\sum_{i=1}^n di}{n} = 16.14/30 = 0.54$$

$$\begin{aligned} \sigma = \text{Standard deviation of sample} &= \sqrt{\frac{\sum_{i=1}^n di^2}{n} - \left(\frac{\sum_{i=1}^n di}{n}\right)^2} \\ &= \sqrt{13.59/30 - (16.14/30)^2} = 0.4 \end{aligned}$$

For the 95% of confident interval, c = 1.96

$$\mu_{di} = (0.54 - 1.96*0.4 / \sqrt{30}, 0.54 + 1.96*0.4 / \sqrt{30})$$

$$\mu_{di} = (0.40, 0.68)$$

According to the above results, mean percentage delay of the population of Local Bank Funded Road Construction Projects in Sri Lanka varies from 0.40 to 0.68. Above results shows that the average time over run of the project duration due to various reasons in the Local Bank Funded projects goes up to 40% - 68% compared to the original Project duration. Due to the above considerable amount of delay, related delay causes factors should be addressed to find the mitigation measures to reduce the delay of construction projects.

4.2.2.3. Individual Delay Contribution of Delay Cause Factors for Each Project

According to the delay details provided in the contractors' claim documents, delay period related to the individual delay causes factor can be gathered. In addition to that, Percentage delay of each project can be gathered from the above Table 8. Considering the production of above two factors, Individual percentage weighted delay contribution of each delay causes factor can be calculated as follows,

Weighted Percentage Delay (%)	=	% Delay of Project	X	% individual contribution to the project delay.
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Table 9- Individual Percentage Weighted Delay Contribution of Delay Causes Factors.

Project	Mapping with Literature Review	% Contribution Inside the Project	% Delay of Whole Project	% Weighted Delay
Project 01	Extreme Weather	17%	37%	6.3%
	Delaying relocating utilities.	46%		17.0%
	Variations & Scope Changes	37%		13.7%
Project 02	Delay Due to land Acquisition	1%	100%	1.0%
	Extreme Weather	6%		6.0%
	Mistakes in soil investigations	87%		87.0%
	Effect of election	1%		1.0%
	Delay Due to land Acquisition	3%		3.0%
	Conflicts among involved parties	2%		2.0%
Project 03	Delaying relocating utilities.	54%	20%	10.8%
	Variations & Scope Changes	46%		9.2%
Project 04	Delay Due to security reasons	53%	122%	64.7%
	Design Changes	19%		23.2%
	Variations & Scope Changes	28%		34.2%
Project 05	Delaying relocating utilities.	100%	33%	33.0%
Project 06	Variations & Scope Changes	35%	204%	71.4%
	Extreme Weather	7%		14.3%
	Delay Due to land Acquisition	55%		112.2%
	Delaying relocating utilities.	3%		6.1%
Project 07	Delay Due to land Acquisition	15%	105%	15.8%
	Delays in approving design documents	57%		59.9%
	Extreme weather	8%		8.4%
	Effect of election	1%		1.1%
	Delay Due to land Acquisition	19%		20.0%
Project 08	Extreme weather	18%	22%	4.0%
	Effect of election	1%		0.2%
	Unforeseen site condition	24%		5.3%
	Law and Order situation	57%		12.5%
Project 09	Variations & Scope Changes	53%	38%	20.1%
	Extreme weather	11%		4.2%
	Effect of election	2%		0.8%
	Law and Order situation	33%		12.5%

Project	Mapping with Literature Review	% Contribution Inside the Project	% Delay of Whole Project	% Weighted Delay
Project 10	Delay Due to land Acquisition	19%	26%	4.9%
	Extreme weather	40%		10.4%
	Delaying relocating utilities.	13%		3.4%
	Design Changes	9%		2.3%
	Law and Order situation	16%		4.2%
	Effect of election	3%		0.8%
Project 11	Variations & Scope Changes	48%	54%	25.9%
	Law and Order situation	52%		28.1%
Project 12	Variations & Scope Changes	84%	25%	21.0%
	Extreme weather	11%		2.8%
	Effect of election	5%		1.3%
Project 13	Delay Due to land Acquisition	18%	33%	5.9%
	Extreme weather	26%		8.6%
	Effect of election	3%		1.0%
	Variations & Scope Changes	53%		17.5%
Project 14	Delaying relocating utilities.	28%	93%	26.0%
	Extreme weather	6%		5.6%
	Effect of election	1%		0.9%
	Variations & Scope Changes	65%		60.5%
Project 15	Extreme weather	75%	10%	7.5%
	Effect of election	7%		0.7%
	Delaying relocating utilities.	18%		1.8%
Project 16	Variations & Scope Changes	54%	75%	40.5%
	Extreme weather	13%		9.8%
	Effect of election	1%		0.8%
	Delay Due to land Acquisition	32%		24%
Project 17	Variations & Scope Changes	58%	63%	36.5%
	Extreme weather	10%		6.3%
	Design Changes	2%		1.3%
	Unforeseen site condition	30%		18.9%
Project 18	Extreme weather	12%	32%	3.8%
	Effect of election	3%		1.0%
	Delaying relocating utilities.	84%		26.9%
Project 19	Delaying relocating utilities.	64%	56%	35.8%
	Variations & Scope Changes	36%		20.2%
Project 20	Extreme weather	17%	36%	6.1%
	Delay Due to land Acquisition	11%		4.0%
	Variations & Scope Changes	71%		25.6%

Project	Mapping with Literature Review	% Contribution Inside the Project	% Delay of Whole Project	% Weighted Delay
Project 21	Extreme weather	22%	13%	2.9%
	Variations & Scope Changes	76%		9.9%
	Effect of election	2%		0.3%
Project 22	Environmental issues	18%	58%	10.4%
	Extreme weather	6%		3.5%
	Design Changes	26%		15.1%
	Delay Due to land Acquisition	14%		8.1%
	Delaying relocating utilities.	8%		4.6%
	Variations & Scope Changes	29%		16.8%
Project 23	Delaying relocating utilities.	62%	43%	26.7%
	Design Changes	38%		16.3%
Project 24	Delay Due to land Acquisition	24%	32%	7.7%
	Extreme weather	14%		4.5%
	Effect of election	3%		1.0%
	Delaying relocating utilities.	59%		18.9%
Project 25	Extreme weather	40%	45%	18.0%
	Effect of election	2%		0.9%
	Law and Order situation	20%		9.0%
	Delaying relocating utilities.	2%		0.9%
	Delay Due to land Acquisition	13%		5.9%
	Variations & Scope Changes	22%		9.9%
Project 26	Delay of inauguration Ceremony	32%	35%	11.2%
	Variations & Scope Changes	68%		23.8%
Project 27	Delays in approving designs	13%	36%	4.7%
	Delay Due to land Acquisition	1%		0.4%
	Extreme weather	7%		2.5%
	Delaying relocating utilities.	79%		28.4%
Project 28	Delay Due to land Acquisition	8%	105%	8.4%
	Improper availability of funds with client.	18%		6.3%
	Extreme weather	6%		6.3%
	Delays in approving design documents	15%		15.8%
	Variations & Scope Changes	34%		35.7%
	Design Changes	6%		6.3%
	Law and Order situation	13%		13.7%
Project 29	Variations & Scope Changes	46%	16%	7.4%
	Extreme weather	16%		2.6%
	Delaying relocating utilities.	37%		5.9%

Project	Mapping with Literature Review	% Contribution Inside the Project	% Delay of Whole Project	% Weighted Delay
Project 30	Environmental issues	4%	47%	1.9%
	Extreme weather	16%		7.5%
	Effect of election	1%		0.5%
	Ineffective project planning & scheduling by contractor	22%		10.3%
	Variations & Scope Changes	31%		14.6%
	Law and Order situation	25%		11.8%

4.2.2.4. Frequency of Occurrence of Each Delay Causes Factor

According to the details included in the contractors' claim documents, frequency of each delay causes factors found in the thirty number of project sample can be gathered as below.

Table 10- Frequency of Occurrence with in the Sample Projects of Each Delay Causes Factor.

No	Delay Causes Factor	Frequency	Relative Frequency
1	Extreme Weather	23	0.20
2	Variations & Scope Changes	20	0.18
3	Effect of election	15	0.13
4	Delaying relocating utilities.	15	0.13
5	Delay Due to land Acquisition	14	0.12
6	Law and Order situation	7	0.06
7	Design Changes	6	0.05
8	Delays in approving design documents	3	0.03
9	Environmental issues	2	0.02
10	Unforeseen site condition	2	0.02
11	Conflicts among involved parties	1	0.01
12	Improper availability of funds with client.	1	0.01
13	Mistakes in soil investigation	1	0.01
14	Ineffective project planning & scheduling by contractor	1	0.01
15	Delay of inauguration Ceremony	1	0.01

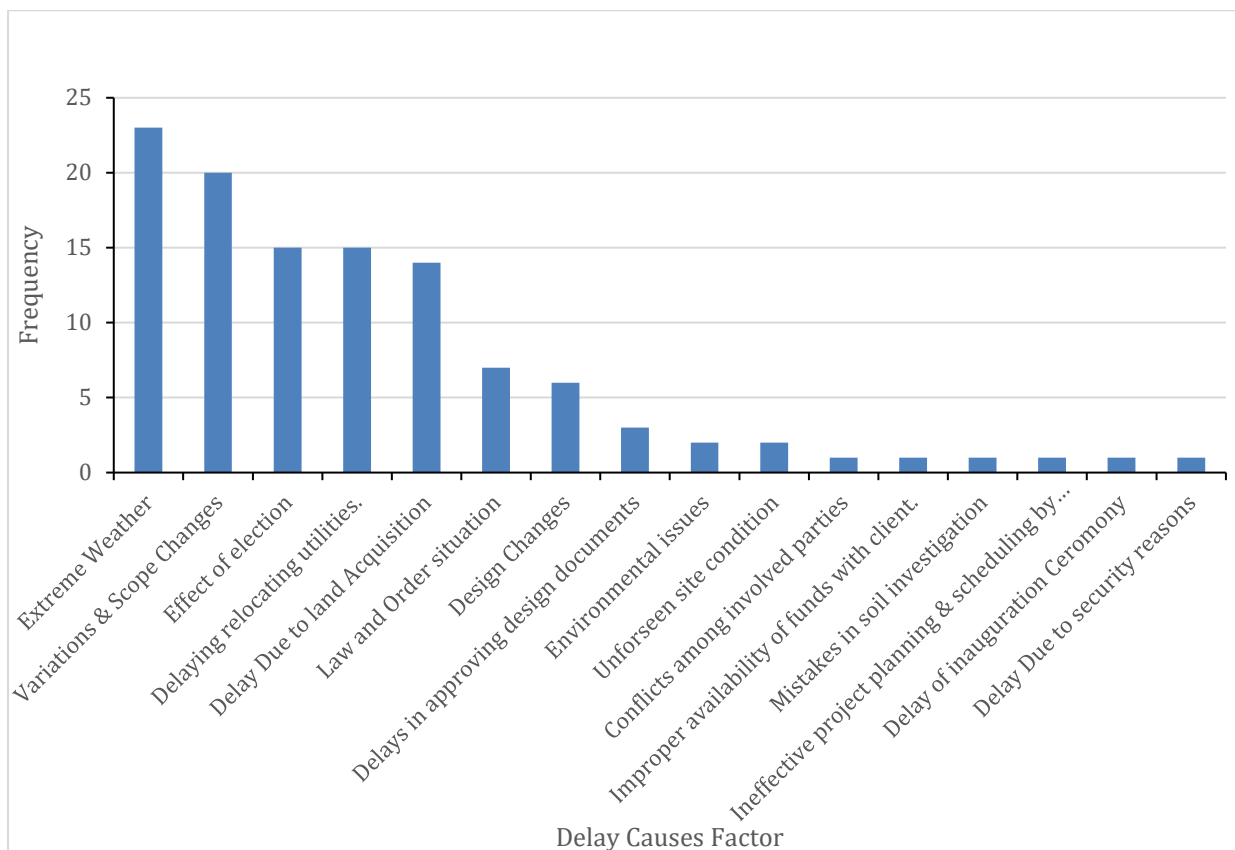


Figure 1- Frequency of Occurrence with in the Sample Projects of Each Delay Causes Factor.

4.2.2.5. Ranking of Delay Factors According to the Contractor's Claim Documents

Total percentage delay contribution of individual delay causes factor within the thirty number of projects in project sample can be calculated by the summation of weighted delay contribution of each delay causes factor in Table 9. Average value of the above total percentage delay contribution can be used to rank the delay causes factors according to their impact on delay as shown in below Table 11.

Table 11- Ranking of Delay Causes Factors According to the Average Percentage Delay.

Rank	Delay cause factor	Average Delay %
1	Variations & Scope Changes	17.15
2	Delaying relocating utilities.	8.21
3	Delay Due to land Acquisition	7.38
4	Extreme Weather	5.06
5	Mistakes in soil investigation	2.90
6	Delays in approving design documents	2.68
7	Law and Order situation	2.60
8	Delay Due to security reasons	2.16
9	Design Changes	2.15
10	Unforeseen site condition	0.81
11	Effect of election	0.41
12	Environmental issues	0.41
13	Delay of inauguration Ceremony	0.37
14	Ineffective project planning & scheduling	0.34
15	Improper availability of funds with client	0.21
16	Conflicts among involved parties	0.07

It is expected that the cash flow problem of the client will come on the top rank among the identified delay causes factors in this study. But contractors weren't highlighted the above factor in contractor's claim documents as major delay causes factor.

Average value of the total percentage delay contribution of individual delay causes are elaborated into the graphical method as shown in Figure 2 below,

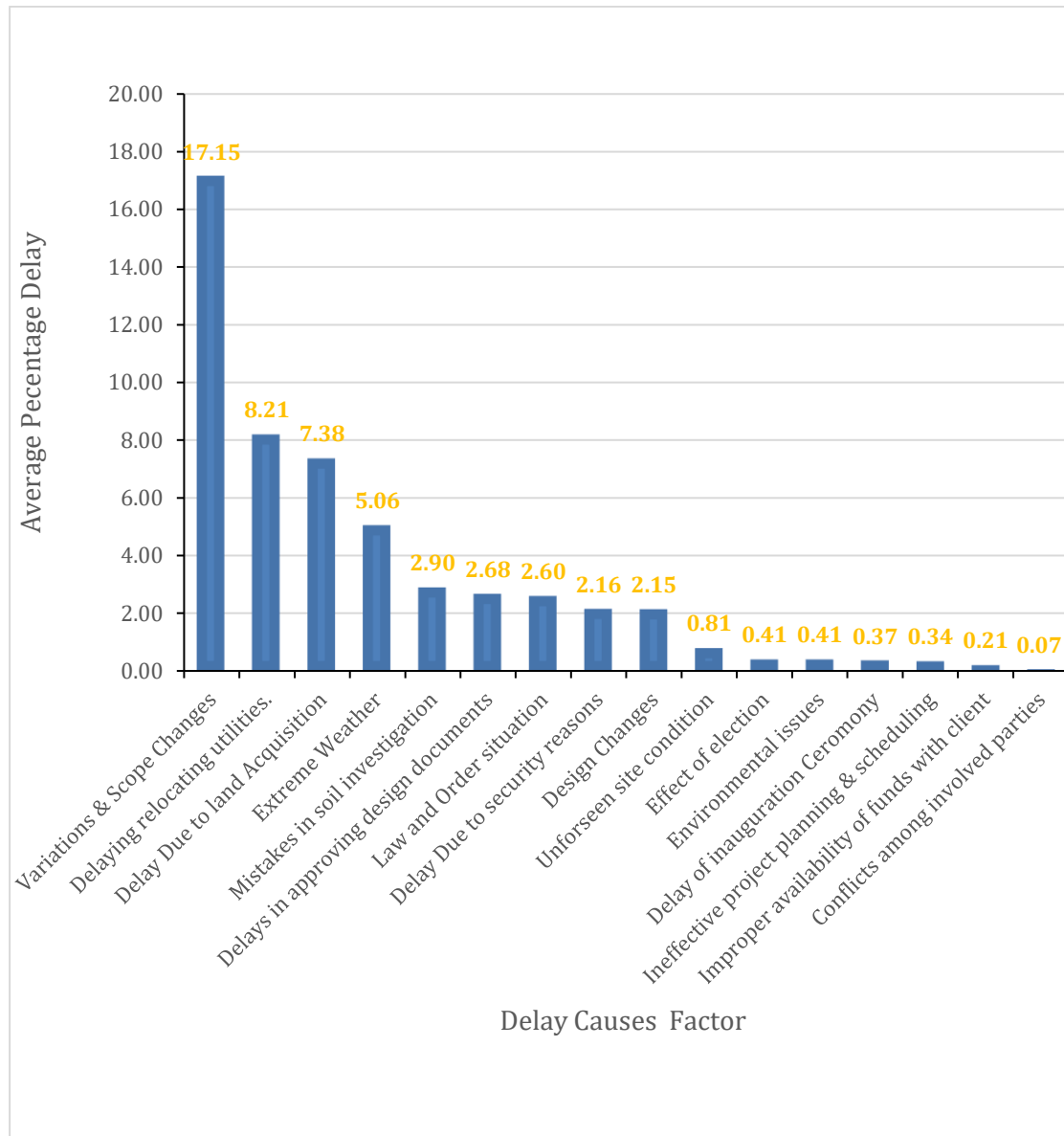


Figure 2- Average Percentage Delay Due to Delay Causes Factors.

4.3. Quantitative Analysis of the Delay Factors According to the Questionnaire Survey

Delay causes factors identified from contractors' claim documents as well as additional delay causes factors identified by the interview with project engineers of the sample projects were formulated in to the questionnaire survey to quantitatively evaluate the significance level of delay causes factors. This questionnaire survey included three sections namely as General information regarding respondent, Delay causes factors identified from contractor's claim documents and Delay causes factors identified by the interview with project engineers.

In section 1 of the questionnaire survey was designed to gather respondents' details regarding their education level and level of construction industry exposure as per their experience in the road construction as well as other construction industries. In Section 2 and section 3 included the identified delay causes factors. Each of the identified delay causes factor had multiple choice options with answers from 1 to 5 as Not significant, Less significant, Moderately significant, Significant and Extremely significant respectively. Respondents should select one of the five options in section 2 and section 3 questions according to their experience regarding the level of significance of each delay causes factors in their projects.

4.3.1. Background Details of the Respondents of Questionnaire Survey

According to the prepared Questionnaire survey, respondent's personal details regarding their education level and number of years of working experience in construction sectors as well as in the road construction sector were collected. As per the collected details of the thirty numbers of respondents, trustworthiness of the given answers can be evaluated qualitatively as their educational knowledge and level of involvement to the construction industry.

Details of the respondents gathered from the questionnaire survey were tabulated in Table 12 below,

Table 12- Background Details of the Respondents.

Project No	Number of Year of Experience in Construction Industry				Number of Year of Experience in Road Construction Industry				Education Level of the Respondent			
	Less than 3	3 to 5	5 to 8	8<	Less than 3	3 to 5	5 to 8	8<	M.Sc.	PG Dip	B.Sc	Dip
Project 01			✓				✓				✓	
Project 02			✓				✓				✓	
Project 03			✓				✓			✓		
Project 04			✓					✓			✓	
Project 05		✓				✓					✓	
Project 06			✓				✓				✓	
Project 07		✓				✓				✓		
Project 08				✓			✓				✓	
Project 09			✓				✓				✓	
Project 10			✓				✓				✓	
Project 11			✓				✓			✓		
Project 12				✓			✓				✓	
Project 13				✓				✓	✓			
Project 14			✓				✓			✓		
Project 15			✓			✓					✓	
Project 16			✓				✓				✓	
Project 17		✓				✓					✓	
Project 18			✓				✓				✓	
Project 19				✓			✓				✓	
Project 20				✓				✓			✓	
Project 21			✓				✓			✓		
Project 22			✓				✓			✓		
Project 23				✓			✓				✓	
Project 24				✓				✓		✓		
Project 25				✓				✓			✓	
Project 26			✓				✓				✓	
Project 27			✓				✓				✓	
Project 28				✓				✓	✓			
Project 29			✓				✓				✓	
Project 30				✓			✓				✓	
Total	0	3	13	14	0	4	20	6	2	7	21	0

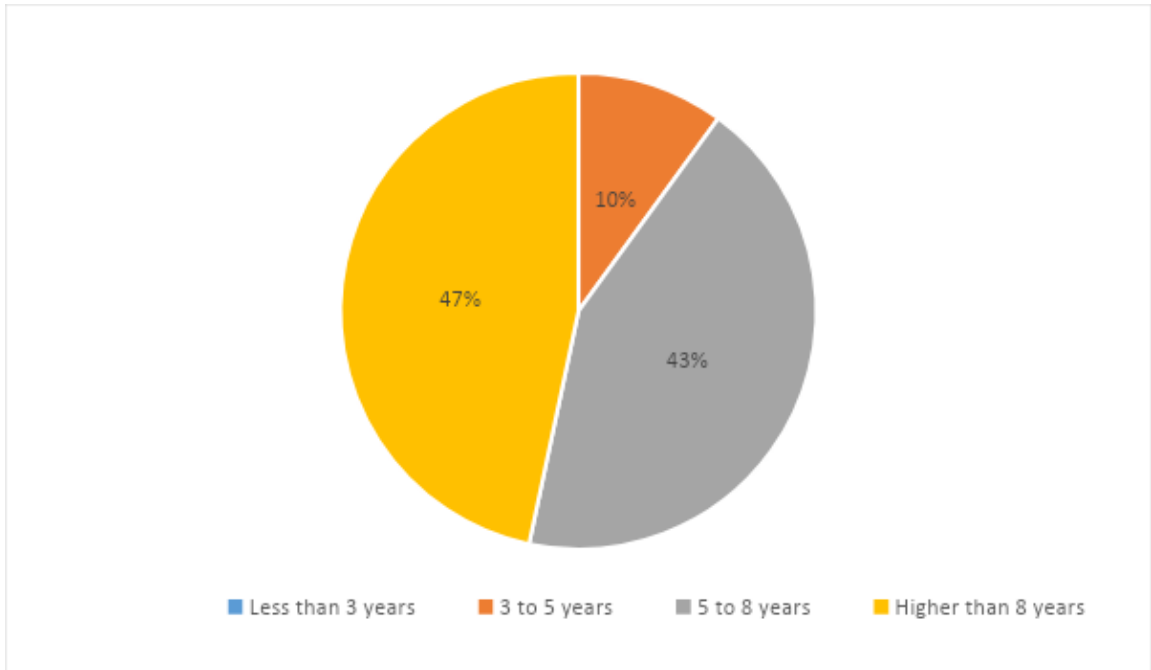


Figure 3- Respondents Experiences in Construction Industry.

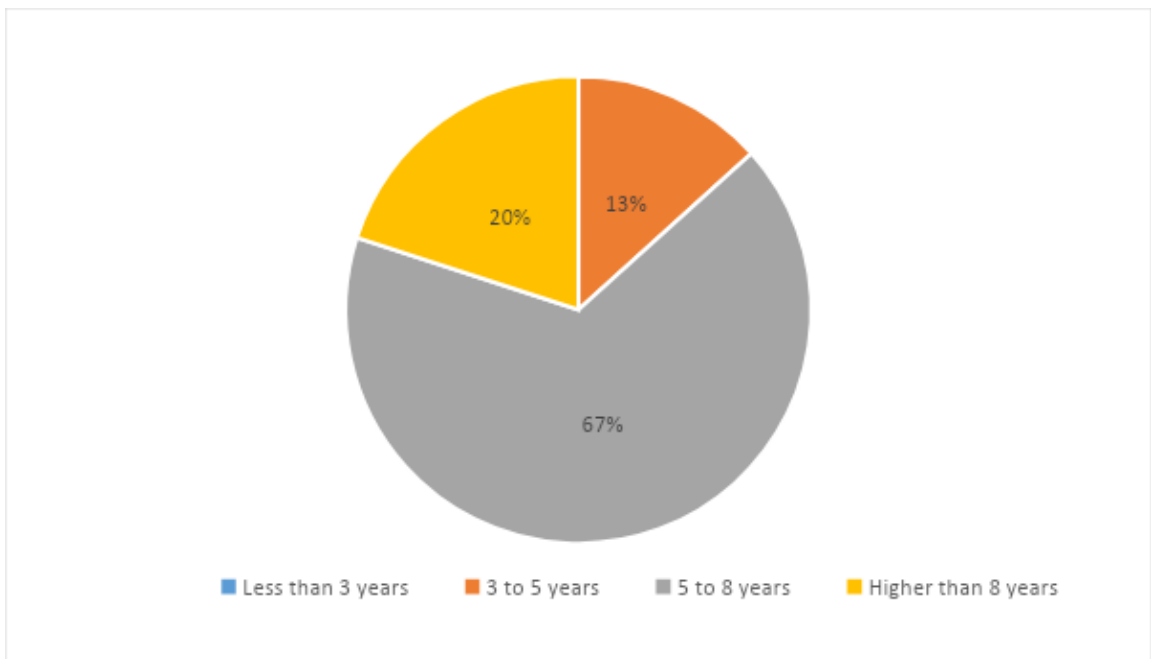


Figure 4- Respondents Experiences in Road Construction Industry.

According to the above Figure 03 and Figure 04, all the respondents of a questionnaire survey have more than three years of experience in the road construction industry. Moreover 87% of respondents have more than 5 years of experience in the road construction industry. Therefore, respondents of our quantitative analysis have wide view and experience regarding the delays of road construction projects and causes of delays. It is very helpful for the gathering of exact reason for the construction delays without any confusion.

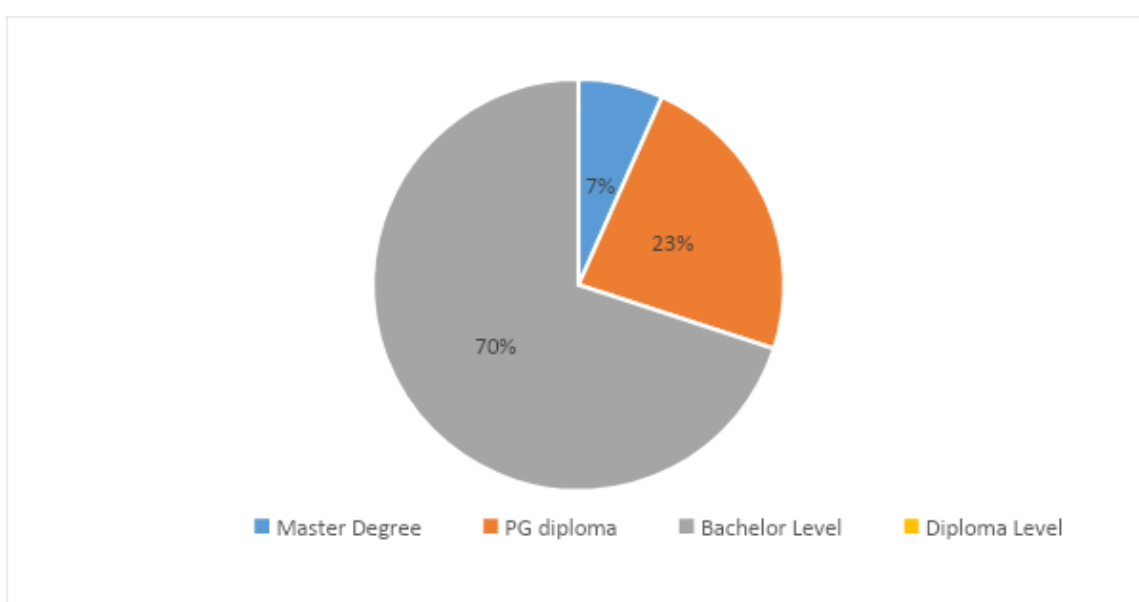


Figure 5- Educational Background of the Respondents.

All respondents have Bachelor Degree qualification. In addition to that 30% of responded has post graduate qualifications also. In this regard, all respondents have good analytical skill to analyze their project delays with the identification of actual delay causes factors of the road construction delays.

Both higher education level and construction experience of the respondents in road construction projects as well as other sectors of construction projects secured the high confidence level for the gathered data regarding the causes of delay.

Table 13 – Analysis for the Relative Significance Index (RSI).

This page including above table is saved as a separate pdf name as “Page 54 of Final Dissertation”.

4.3.2. Ranking of Delay Causes Factors as per Questionnaire Survey

Table 13- Ranking of Delay Causes Factors According to the Questionnaire Survey.

Delay Causes Factor	RSI Value	Overall Rank
Variation and Scope Changes	0.78	1
Delaying of relocating utilities	0.76	2
Delay due to land acquisition	0.74	3
Ineffective project planning and scheduling by contractor	0.67	4
Deficiency of some materials in the country.	0.66	5
Poor site management of contractor.	0.65	6
Less qualified persons in contractor's key staff.	0.65	7
Design Changes	0.65	8
Unavailability of required number of staff in contractor organization.	0.61	9
Improper availability of funds with client	0.61	10
Poor coordination of contractor with other stakeholders.	0.61	11
Unforeseen site conditions	0.59	12
Less labor productivity.	0.59	13
Extreme weather	0.59	14
Plant & equipment failures.	0.57	15
Mistakes in Soil investigation	0.57	16
Rework due to poor quality works and error procedures	0.56	17
Less material storage facilities in the contractor's yard.	0.54	18
Conflict among involved parties	0.54	19
Slow decision making by client.	0.53	20
Delays in approving design	0.53	21
Delay of mobilization to the site.	0.51	22
Environmental issues	0.50	23
Law and order situation	0.49	24
Slow decision making by consultant	0.49	25
Less authority delegation to the Engineer's Representative.	0.48	26
Unforeseen third-party damage to the built structures	0.48	27
Poor traffic management procedures followed by contractor at site.	0.47	28
Delay of laboratory testing proceed by client's laboratory.	0.45	29
Delay of fuel supply by contractor.	0.40	30
Delay due to security reasons	0.38	31
Effect of election	0.35	32
Delay of inauguration ceremony	0.28	33

According to the quantitative analysis of questionnaire survey data, top ten most significant delay causes factors are Variation and scope changes (RSI = 0.78), Delaying of relocating utilities (RSI = 0.76), Delay due to land acquisition (RSI = 0.74), Ineffective project planning and scheduling by contractor (RSI = 0.67), Deficiency of some materials in the country (RSI = 0.66), Poor site management of the contractor (RSI = 0.65), Less qualified persons in contractor's key staff (RSI = 0.65), Design changes (RSI = 0.65), Unavailability of required number of staff in contractor organization (RSI = 0.61) and Improper availability of funds with client (RSI=0.61) respectively.

It is expected that the cash flow problem of the client will come on the top rank among the above identified delay causes factors in the analysis. According to the responds given by the respondents, above cash flow problem of the client comes in to the 10th rank.

Top ten delay causes factors can be classified into the five groups according to the responsible party of the delay as Client related, Contractor related, Consultant related, External related and designer related. Four number of delay cause factors namely as Variation and scope changes, delaying of relocating utilities, delay due to land acquisition and Improper availability of funds with client were selected under the client related delay causes factor category. Four number of contractor related delay causes factors namely as Ineffective project planning and scheduling by contractor, Poor site management of contractor, less qualified persons in the contractor's key staff and Unavailability of required number of staff in contractor organization were selected under the top ten delay causes factors.

Only single delay causes factors selected under the top ten delay causes from the external related and designer related category. They are Deficiency of some materials in the country and Design changes respectively. Considering all above facts, delay mitigation measures should be implemented against the above selected top delay causes factors. All the delay causes factors found in the analysis were elaborated according to the responsible party of the delay causes as shown below in Table 15, Table 16, Table 17, Table 18, Table 19, Figure 05, Figure 06, Figure07, Figure 08 and Figure 09.

Table 14- Ranking of Delay Causes Factors under Client Related Responsibility Group.

No	Delay Causes Factor	Group Rank	Overall Rank
1	Variation and Scope Changes	1	1
2	Delaying relocating utilities	2	2
3	Delay due to land acquisition	3	3
4	Improper availability of funds with client	4	10
5	Mistakes in Soil investigation	5	16
6	Slow decision making by client.	6	20
7	Delay of laboratory testing proceed by client's laboratory.	7	29

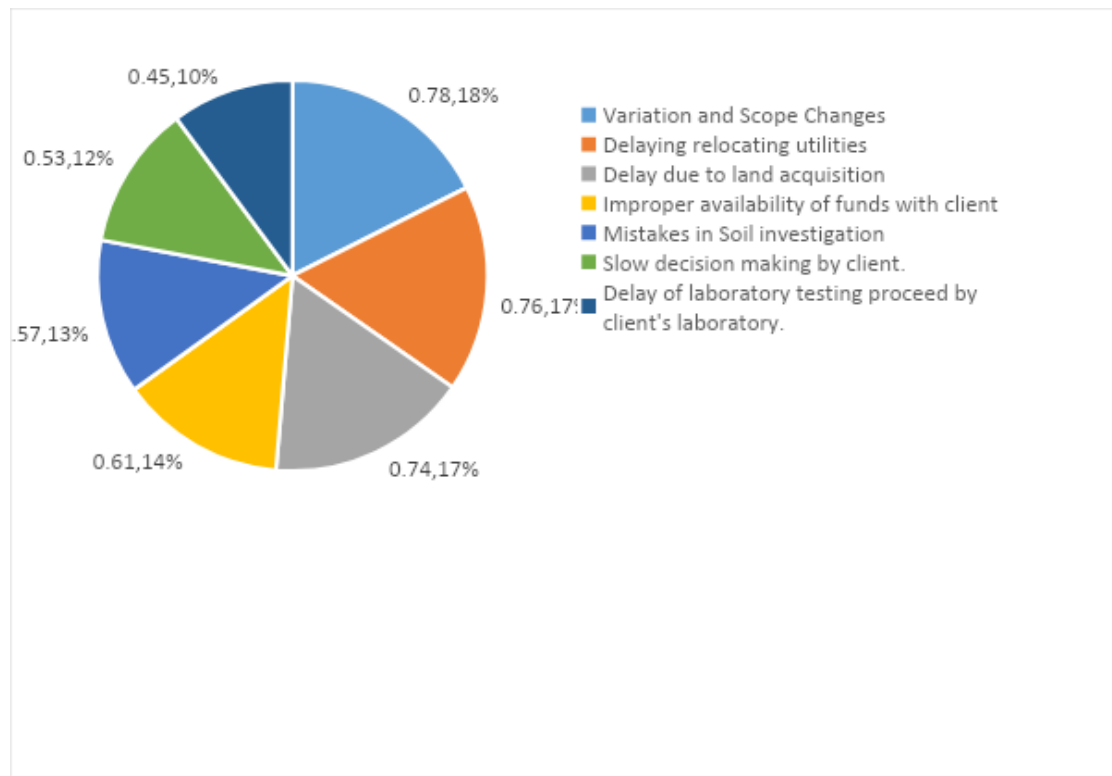


Figure 6- Delay Contribution of Delay Causes Factors under Client Related Group.

Table 15- Ranking of Delay Causes Factors under Consultant Related Responsibility Group.

No	Delay Causes Factor	Group Rank	Overall Rank
1	Conflict among involved parties	1	19
2	Slow decision making by consultant	2	25
3	Less authority delegation to the Engineer's Representative.	3	26

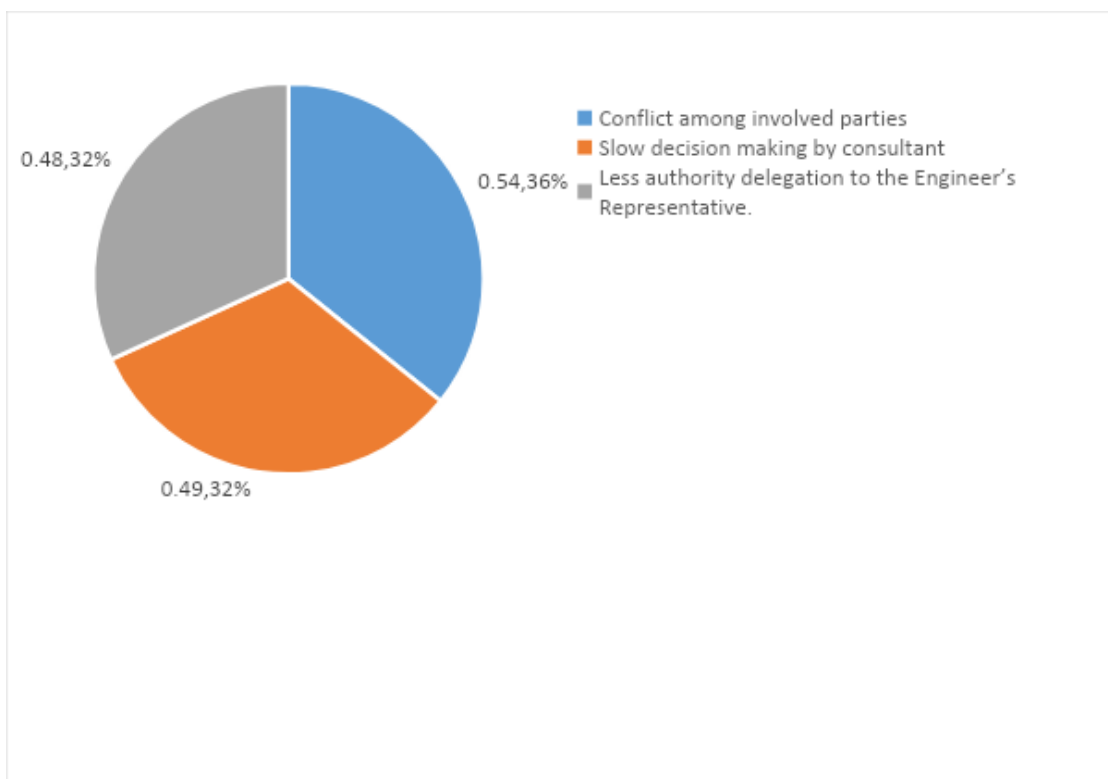


Figure 7- Delay Contribution of Delay Causes Factors under Consultant Related Group.

Table 16- Ranking of Delay Causes Factors under Contractor Related Responsibility Group.

No	Delay Causes Factor	Group Rank	Overall Rank
1	Ineffective project planning and scheduling by contractor	1	4
2	Poor site management of contractor.	2	6
3	Less qualified persons in contractor's key staff.	3	7
4	Unavailability of required number of staff in contractor organization.	4	9
5	Poor coordination of contractor with other stakeholders.	5	11
6	Less labor productivity.	6	13
7	Plant & equipment failures.	7	15
8	Rework due to poor quality works and error procedures	8	17
9	Less material storage facilities in the contractor's yard.	9	18
10	Delay of mobilization to the site.	10	22
11	Poor traffic management procedures followed by contractor at site.	11	28
12	Delay of fuel supply by contractor.	12	30

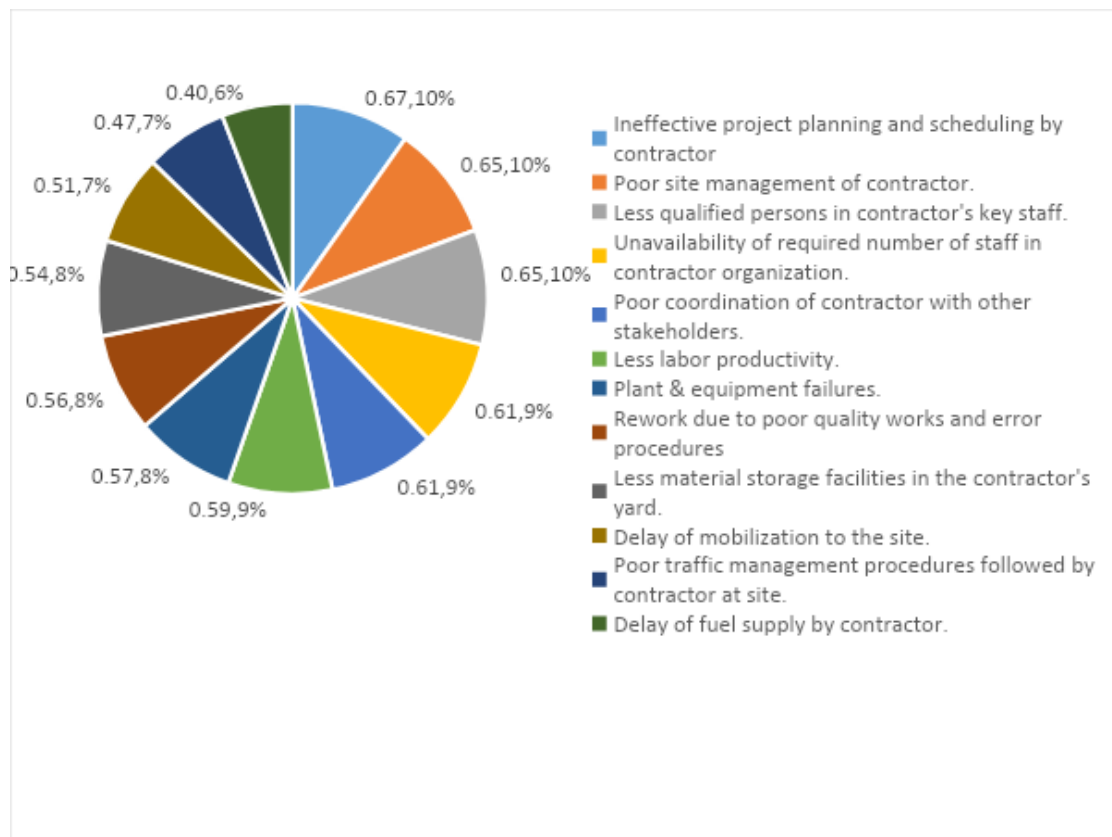


Figure 8- Delay Contribution of Delay Causes Factors under Contractor Related Group.

Table 17- Ranking of Delay Causes Factors under External Related Responsibility Group.

No	Delay Causes Factor	Group Rank	Overall Rank
1	Deficiency of some materials in the country.	1	5
2	Unforeseen site conditions	2	12
3	Extreme weather	3	14
4	Environmental issues	4	23
5	Law and order situation	5	24
6	Unforeseen third-party damage to the built structures	6	27
7	Delay due to security reasons	7	31
8	Effect of election	8	32
9	Delay of inauguration ceremony	9	33

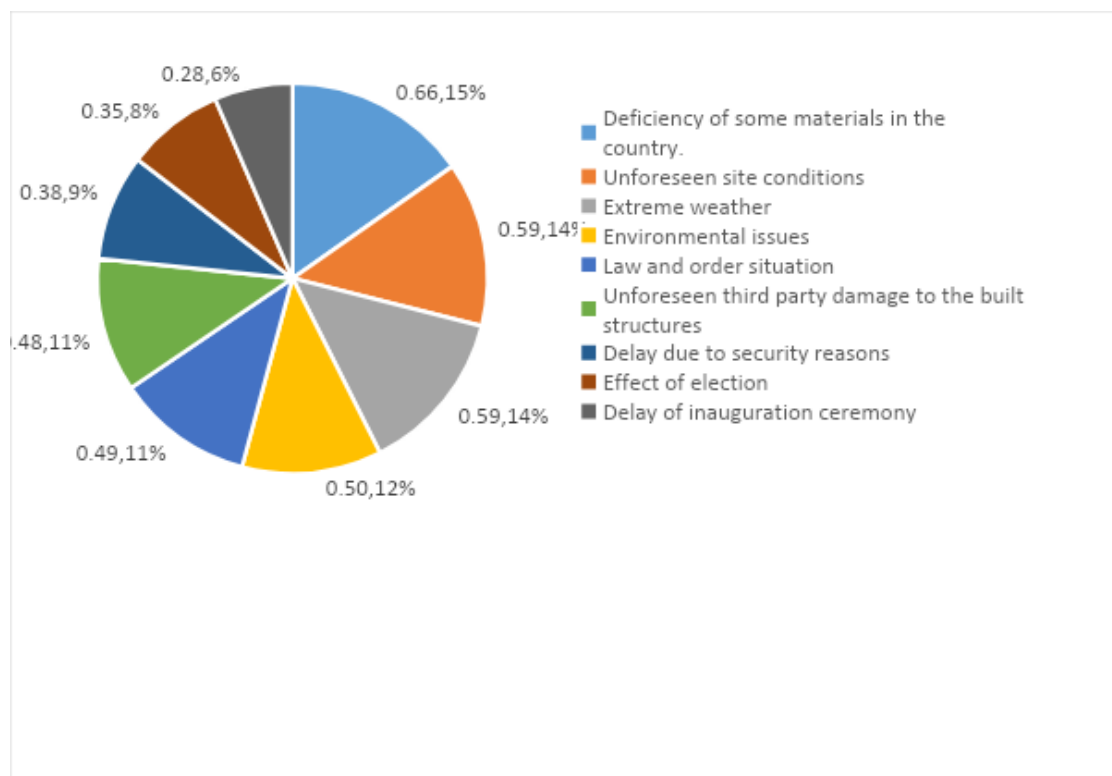


Figure 9- Delay Contribution of Delay Causes Factors under External Related Group.

Table 18- Ranking of Delay Causes Factors under Designer Related Responsibility Group.

No	Delay Causes Factor	Group Rank	Overall Rank
1	Design Changes	1	8
2	Delays in approving design	2	21

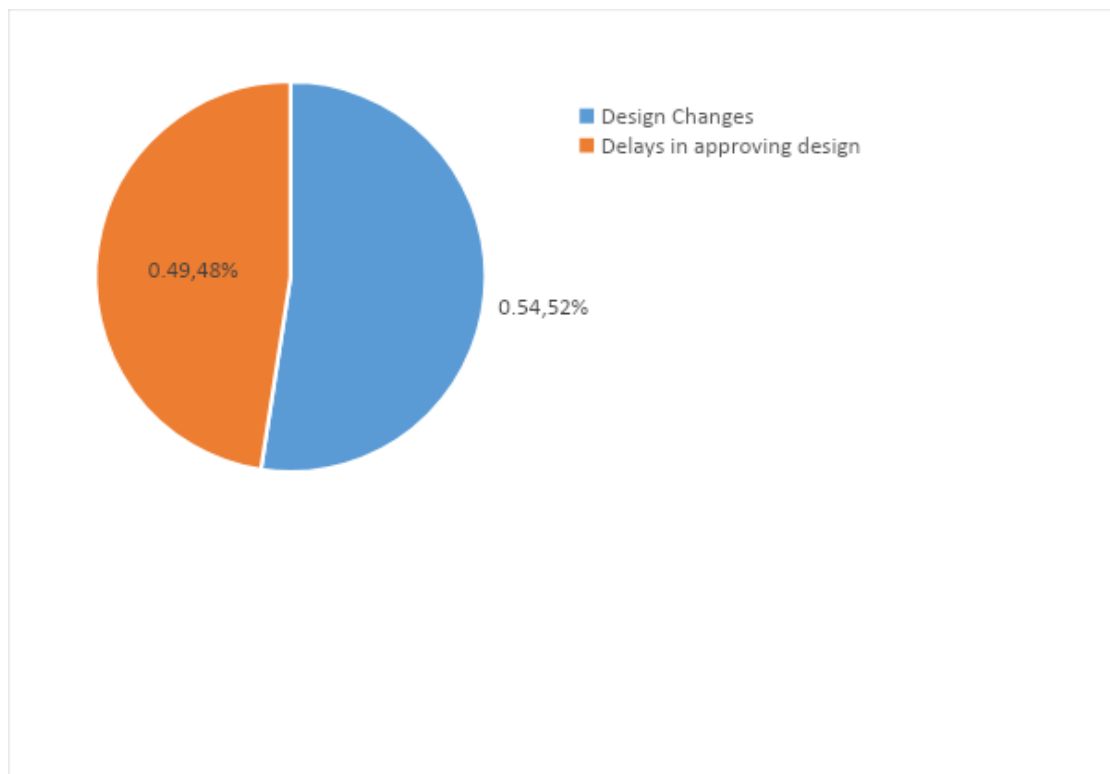


Figure 10- Delay Contribution of Delay Causes Factors under Designer Related Group.

4.4. Validation of Contractor's Claim Analysis Ranking Results Using Questionnaire Survey Ranking Results.

One of the main objectives of this study is to validate the ranking of sixteen number of delay causes factors identified from the contractors claim documents using the Relative Significance Index values of questionnaire survey analysis.

Table 19- Comparison of Contractors' Claim Document Ranking with Questionnaire Survey Ranking Results.

Delay Causes Factors Found from Contractors' Claim Documents	Average Delay %	Rank According to Actual Delay Data	RSI Value	Rank According to RSI Value
Variations & Scope Changes	17.15	1	0.78	1
Delaying of relocating utilities.	8.21	2	0.76	2
Delay Due to land Acquisition	7.38	3	0.74	3
Extreme Weather	5.06	4	0.58	7
Mistakes in soil investigation	2.90	5	0.57	8
Delays in approving design documents	2.68	6	0.53	10
Law and Order situation	2.60	7	0.49	12
Delay Due to security reasons	2.16	8	0.38	14
Design Changes	2.15	9	0.65	5
Unforeseen site condition	0.81	10	0.48	13
Effect of election	0.41	11	0.35	15
Environmental issues	0.41	12	0.50	11
Delay of inauguration Ceremony	0.37	13	0.28	16
Ineffective project planning & scheduling.	0.34	14	0.67	4
Improper availability of funds with client.	0.21	15	0.61	6
Conflicts among involved parties	0.07	16	0.54	9

As per the consideration of sixteen delay causes factors found from the contractors' claim documents, Seven number of Common delay causes factors named as Variation & scope changes, Delaying of relocating utilities, Delay due to land acquisition, Extreme weather, Mistakes in soil investigation, Delays in approving design documents and Design changes were identified within their top ten delay causes factor identification of both actual project data analysis and quantitative analysis using

questionnaire survey. Therefore, using delay data gathered from the contractors' claim document for the evaluation of significance level of delay causes factors is reasonable.

On the other hand, contractor's claim documents cover only the excusable delays for the contractor, therefore it is very important to collect additional delay causes factors from the interview with project engineers and carry out the questionnaire survey to gather the delay details of non-excusable delays for the study. As per this study, Combination of actual project data analysis as well as questionnaire survey analysis is effective and efficient for the identification of the significant level of delay causes factors for the road construction projects.

4.5. Discussion of Results

Above analysis mainly focused on the road construction projects completed under Local Bank Funded project division. Therefore, above findings are specifically significant for the Local Bank Funded projects.

According to individual percentage delay contribution analysis using contractors' claim document data, top ten delay causes factors namely as Variation & scope changes, delaying of relocating utilities, delay due to land acquisition, Extreme weather, Mistakes in soil investigation, Delays in approving design documents, Law and order situation, delay due to security reasons, Design changes and Unforeseen site conditions were identified respectively. Among them delay causes factor due to security reasons is a very specific case happened in road construction project in Northern province of Sri Lanka and it can be removed from the high significant category.

As per the quantitative analysis of questionnaire survey, top ten delay causes were named as Variation and scope changes, Delaying relocating utilities, Delay due to land acquisition, Ineffective project planning and scheduling by contractor, Deficiency of some materials in the country, poor site management of the contractor, less qualified persons in contractor's key staff, Design changes, Unavailability of required number of staff in contractor's organization and Improper availability of fund with client respectively.

From the both method of analysis, Variation and scope changes, delaying of relocating utility and Delay due to land acquisition were identified as top three significant delay causes factors respectively. Above three delay causes factor coming under the client's

responsibility category. Background details of the above top critical delay causes factors as follows,

1. Variation and scope changes.

This is a well-recognized delay cause factor frequently found in the road construction industry in Sri Lanka. Most of the variations occurred due to the less accuracy in the estimation process. Due to the less accuracy of estimates, provided quantities in the bill of quantity is not sufficient at the construction stage to complete the construction work properly. Therefore, variation order should be prepared to complete the construction works and it will affect to the extension of the duration of projects.

2. Delaying of relocating utilities.

Majority of the road construction projects face the problem of relocating utilities. Inter coordination between Road development authority and other utility organization like National Water Supply & Drainage Board, Ceylon Electricity Board, and Sri Lanka Telecom is not sufficient to run the road construction projects smoothly. Therefore, road contractor has to wait until the shifting of utility line to start their construction works. This relocating process may take longer period and client has to extend the project duration according to the delay.

3. Delay due to land acquisition.

According to the improvement requirement of road network, adjacent land of the existing road should be acquired to widen the carriageway. Therefore, land acquisition should be finished before the awarding of road construction contracts. Due to the urgency of the development, construction contracts are awarded to the contractors before the finishing of land acquisition. Therefore, duration of the project should be extended up to the clearance of construction area. This extension of time causes to the conflict among the contract parties. Mainly this acquisition delay arises due to the land ownership problems and the valuation problem of lands.

4. Ineffective project planning and scheduling by contractor.

According to the contract conditions, initially contractor should submit the construction program and follow it up to the end of the project. To implement this process, initial project program should be the realistic one. Most of the contractors don't submit the practical project program and they can't schedule their construction work for the timely completion. This ineffective planning and scheduling end up with the extension of project duration.

5. Deficiency of some material in the country.

Deficiency of materials like river sand, gravel, tar, and aggregate directly affect to the progress of the construction projects. In addition to that price of the materials also increase due to the demand of the material. Therefore, both cost and time overrun arisen in the construction project due to the deficiency of material.

6. Poor site management of contractor.

Poor site management is a common failure in the road construction industry in Sri Lanka. Idling of labor and material occur due to this poor site management and it will cause to the time extension of the project. In addition to that quality of the construction work also decreases due to the poor site management procedures.

7. Less Qualified persons in contractor's key staff.

Success of the construction project directly depends on the contractor's key staff members. Competent level of the key staff member depends on their qualification. In Sri Lankan road construction industry, some contractors appoint less qualified persons to their key staff position. They haven't good competent level to schedule their construction projects to finish them timely. Therefore, project duration should be extended complete the project tasks.

8. Design Changes.

Due to various reasons, design staff of the project changes their initial designs repeatedly. This type of design change may happen due to the change of the scope of the project or the mistakes happened in the initial design or site investigations. Contractor of the project has to stop the construction work until the receiving of revised drawing. Therefore, actual duration of the project is extended and contractual conflict arisen between the contractor and client.

9. Unavailability of required number of staff in contractor's organization.

Always contractors try to minimize their staff for the control of overheads. On the other hand, lack of the suitable persons to appoint the contractor organization is a big issue in the construction industry. According to the above reasons, required number of staff members are not available in contractor staff and this reason causes to the delay completion of construction projects.

10. Improper availability of funds with client.

This is a major issue in the road construction industry Sri Lanka. Delay of the payment of mobilizations as well as interim payment has happened. Due to the lack of funds, contractor tends to stop or slow down his ongoing road construction works. Therefore, contractor has to finish his work with the delay. This may cause to the extension of time process.

11. Extreme weather.

Behavior of the climate varies year by year. Therefore, it is difficult to forecast the pattern of the rain falls. Due to the rapid change of climate, construction work may disturb frequently. This delay is an excusable delay. Due to extreme weather condition, Duration of the project has to be extended. Extension period should be calculated according to the change of rainfall pattern.

12. Mistakes in soil investigation.

Duration and cost of the construction project depend on the initial design of road according to the soil investigation reports provided. If mistake of the soil investigation finds in the construction stage, initial design has to be changed according to the corrected soil investigation report. Therefore, contractor has to wait until the new construction drawings are approved. In addition to that quantities in the bill of quantity may change to address the weakness of soil profile. Therefore, the mistakes in soil investigation directly causes to the delay of construction projects.

13. Delays in approving design documents.

Delay in approving design document mainly happened due to the rush of design works in road design offices. According to the rapid development, staff and other facilities of the design offices are not in the satisfied levels. These delays in approving design document directly affect to the site construction works and end up with road construction delay.

14. Law and order situation.

Frequent government policy changes directly affect to the construction projects. Government policies regarding the mining of earth resources, transport of construction materials, taxation for the importing materials and other taxation related to construction industry directly affect to the cost and duration of the road construction projects. Therefore, the conflict between contractual parties may be happened due to above reasons.

15. Unforeseen site conditions.

This is an excusable delay factor for the contractor due to the uncontrollable condition of the unforeseen site condition. With a more improvement of investigation methods, unpredictable condition may be reduced.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

According to the analysis, Local Bank Funded projects experiences 40% to 68% average percentage time delay with respect to their initial project durations. Initially thirty-three numbers of delay causes factors were identified through the contractor's claim documents and interview of related project engineers. Fifteen number of top significant delay causes factors were shortlisted for the discussion of result using the both actual project data analysis by average percentage delay contribution and Relative Significance Index (RSI) analysis from the questionnaire survey. Variation and scope changes, delaying of relocating utilities and delay due to land acquisition are identified as a most affecting delay causes factors respectively in both method of analysis.

5.2. Recommendations

- It is recommended to allocate additional time duration for the estimation and planning of the construction project rather than starting the project with quick estimating and planning. Higher time allocation for estimating and planning will avoid the variation and scope changes within the construction period.
- It is very essential to launch master plan of the road development by the Road development authority with the coordination of other utility agencies such as NWS&DB, CEB and SLT.
- Government policy regarding the land ownership and valuation should be changed according to the present requirement for the acceleration of land acquisition process.
- It is recommended to evaluate the realistic behavior of each initial project schedule submitted by the contractor according to their resource allocation and it should monitor throughout the project duration.
- Government policies should be changed to avoid the deficiency of construction materials. In addition to that, research works regarding the alternative material should be implemented for the presently deficient materials.

- Qualification requirement for the contractor's key staff should be mentioned in the each of the contract documents according to the project requirements and follow it strictly for the selection of contractor.
- It is very essential to reduce design changes in the construction projects. In addition to that quick redesign procedure should be implemented in every construction project to address the unavoidable design changes without any delay.
- Client of the project should prepare the cash flow plan according to the estimate finalized for the project and secured the funding method before awarding the contract. This cash flow problem of the client was not highlighted in above results of the study as per the expected level. It is better to do the further study regarding this factor in future research works.
- Newly introduced technological methods of site investigation should be used in the site investigation process of the road construction projects. Above technological methods are very important for the construction areas located in the critical soil profiles.
- Government should implement long term policies related to the construction industry to avoid the unnecessary project delay due to the frequent change of policies.

6. REFERENCES

1. Aibinu, A. A., & Jagboro, G. O. (2002). The effects of construction delays on project delivery in Nigerian construction industry. *International Journal of Project Management*, 593-599.
2. Alinaitwe, H., Apolot, R., & Tindiwensi, D. (2013). Investigation in to the Causes of Delays and Cost Overruns in Uganda's Public Sector Construction Projects. *Journal of Construction in Developing Countries.*, 33-47.
3. Aziz, R. F. (2013). Ranking of delay factors in construction projects after Egyptian revolution. *Alexandria Engineering Journal*, 387-406.
4. Aziz, R. F., & Abdel-Hakam, A. A. (2016). Exploring delay causes of road construction projects in Egypt. *Alexandria Engineering Journal*, 1-24.
5. Dolage, D. R., & Pathmarajah, T. (2015). Mitigation of Delays Attributable to the Contractors in the Construction Industry of Sri Lanka - Consultants' Perspective. *Engineer (The Institution of Engineers, Sri Lanka)*, 21-30.
6. Elawi, G. A., Algahtany, M., & Kashiwagi, D. (2016). Owners' perspective of factors contributing to project delay: case studies of road and bridge projects in Saudi Arabia. *International Conference on Sustainable Design, Engineering and Construction* (pp. 1402-1409). Procedia Engineering.
7. Hamzah, N, K. A. (2011). Cause of Construction Delay -Theoretical Framework. *The 2nd International Building Control Conference* (pp. 490-495). Bangi, Malaysia: Procedia Engineering.
8. Jeyakanthan, J., & Jayawardana, A. (2012). Mitigating Delays in Donor Funded Road Projects in Sri Lanka. *The Institution of Engineers, Sri Lanka, ENGINEER - Vol. XXXXV, No.01*, 65-75.
9. Jhonsen, W. J. (2014, July). Organizational Research Methods. *History and Use of Relative Importance Indices in Organizational Research*, pp. 238-257.
10. Kamanga, M. J., & Steyn, W. v. (2013). Causes of delay in road construction projects in Malawi. *JOURNAL OF THE SOUTH AFRICAN INSTITUTION OF CIVIL ENGINEERING*, 79-85.
11. Keane, P., & Caletka, A. (2015). *Delay Analysis in Construction Contracts, Second Edition*. The Atrium, Southern gate Chichester , West sussex, United Kingdom: Blackwell Publishing Limited.
12. Kesawan, M., Gobidan, N. N., & Dissanayake, P. (2015). Analysis of Factors Contributing Civil Engineering Project Delays in Sri Lanka. *6th International Conference on Structural Engineering and Construction Management 2015*, (pp. 40-46). Kandy, Sri Lanka.
13. Kikwasi, G. J. (2012). Causes and Effects of Delays and Disruptions in Construction Projects in Tanzania. *Australasian Journal of Construction Economics and Building*, (pp. 52-59). Tanzania: Ardhi university.

14. Mahamid, I. (2013). Common risks affecting time overrun in road construction projects in Palestine Contractor's perspective. *Australasian Journal of Construction Economics and Building*, 45-53.
15. Mahamid, I., Bruland, A., & Dmaid, N. (2012). Causes of Delay in Road Construction Projects. *Journal of Management in Engineering*, 300-310.
16. Manarvi, I. A., Gardezi, S. S., & Gardezi, J. S. (2014). Time Extension Factors in Construction Industry of Pakistan. *Procedia Engineering*, 196-204.
17. Niazai, G. A., & Gidado, K. (n.d.). *Causes of Project Delay in the Construction Industry in Afghanistan*.
18. Odeh, A. M., & Battaineh, H. T. (2002). Causes of construction delay: Traditional contracts. *International Journal of Project Management*, 67-73.
19. Pathirana, Y. L., & Halwatura, R. U. (2010). *Factors Influencing the Duration of Road Construction Projects in Sri Lanka*. Colombo: Institute of Engineers, Sri Lanka.
20. Ralph, D., & Ellis, Jr. (2003). The Root Causes of Delays in Highway Construction. *82nd Annual Meeting of the Transportation Research Board*, (p. 1). Washington.
21. Ram, A., & Paul, D. (2015). Study on Construction Sequence Delay for Road Infrastructure Projects. *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*, 15-21.
22. Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research Methods for Business Students*. Edinbrugh Gate: Pearson Education Limited.
23. Sumaiyya, N. R., & Pranay, K. R. (2014). Causes of Delays in any Construction Project. *International Journal of Science and Research (IJSR)*, 59-61.
24. Sweis, G. J. (2013). Factors Affecting Time Overruns in Public Construction Projects: The Case of Jordan. *International Journal of Business and Management*.
25. Trauner, T. (2009). *Construction Delays. Understanding Them Clearly. Analysing Them Correctly*. Elsevier.Inc.
26. Walliman, N. (2011). *Research Methods, The Basics*. Newyork: Routledge.