

**SIGNIFICANCE OF CONTRACTOR'S INTERNAL TEAM
COLLABORATIVE PRACTICES TO MANAGE
CONSTRUCTION PROJECT DELAYS DURING
IMPLIMENTATION STAGE**

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TABLE OF CONTENTS

	Page
Front page	i
Table of Contents.....	ii
List of Tables.....	vi
List of Figures.....	viii
List of Appendices.....	ix
Acknowledgment.....	x
Declaration.....	xi
Abbreviations.....	xii
Abstract.....	xiii

CHAPTER 1

INTRODUCTION

1.1 General.....	1
1.2 Background and problem identification.....	2
1.3 Research gap.....	3
1.4 Aim and objectives.....	3
1.5 Research methodology.....	4
1.6 Research deliverables.....	5
1.7 Limitations of the study.....	5
1.8 Structure of theses.....	6

CHAPTER 2

LITERATURE REVIEW

2.1 General overview.....	7
2.2 Different interpretations to construction delay and current situation of the construction industry.....	7
2.3 Causes & effects of delays and recommendations	8
2.3.1 Researchers conducted in Sri Lanka.....	8

2.3.2 Researchers conducted in other countries.....	11
2.4 Discussion on preliminary research findings.....	15
2.5 Expertise views on current issues of delay management.....	16
2.6 Application of collaborative team approach for delay management.....	16
2.7 Different approaches & best practices on delay management.....	18
2.7.1 Planning & scheduling related.....	18
2.7.2 Construction management related.....	20
2.7.3 Contract administration/delay claim management related.....	23
2.7.4 Document management related.....	26
2.8 Team collaboration and barriers.....	28
2.9 Team collaboration enhancing methods and techniques.....	32
2.10 Chapter summary.....	34

CHAPTER 3

METHODOLOGY OF STUDY

3.1 Introduction.....	35
3.2 Research frame work design.....	35
3.3 Research method and processes.....	36
3.3.1 Collection of expertise ideas/views.....	37
3.3.2 Carrying out literature survey.....	37
3.3.3 Utilizing researchers experience in the construction industry.....	37
3.3.4 Grouping of data received under these three techniques.....	38
3.3.5 Questionnaire form design.....	38
3.3.6 Identifying attributes to design the questionnaire form	39
3.4 Questionnaire survey.....	44
3.4.1 Sample size and data collection techniques.....	44
3.4.2 Ethical consideration.....	46
3.5 Data analysis technique.....	47
3.5.1 Severity Index (SE.I).....	48
3.5.2 Frequency Index (F.I).....	48
3.5.3 Importance Index (IMPI).....	48
3.6 Chapter Summary.....	48

CHAPTER 4

ANALYSIS & DISCUSSION OF RESULTS

4.1 Introduction.....	49
4.2 Data analysis.....	49
4.2.1 Demographic analysis.....	49
4.2.2 Analysis of best internal collaboration practices.....	52
4.2.2.1 Analysis on client /consultant perspective.....	53
4.2.2.2 Analysis on contractor's perspective.....	54
4.2.2.3 Analysis on overall perspective.....	55
4.2.2.4 Comparison & discussion of result obtained from the analysis....	56
4.2.3 Analysis of evaluating the current barriers to internal collaborative approaches.....	64
4.2.3.1 Analysis on client /consultant perspective.....	64
4.2.3.2 Analysis on contractor's perspective.....	65
4.2.3.3 Analysis on overall perspective.....	66
4.2.3.4 Comparison and discussion of result obtained from analysis.....	66
4.2.4 Analysis of identification of significant methods and techniques to enhance the internal collaboration.....	70
4.2.4.1 Analysis on client /consultant perspective.....	70
4.2.4.2 Analysis on contractor's perspective.....	71
4.2.4.3 Analysis on overall perspective.....	72
4.2.4.4 Comparison and discussion of result obtained from analysis.....	72
4.2.5 Analysis of identifying the focal point for internal collaboration in the project.....	76
4.3 Further discussions of results in comparison to Literature.....	77
4.4 Chapter Summary.....	84

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions	86
5.2 Recommendations.....	87
5.3 Future research areas.....	90

REFERENCES.....	91
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APENDICES	100
Appendix-1: Tables.....	101
Appendix-2: Questionnaire survey form.....	116
Appendix-3: Researcher’s construction experience.....	127
Appendix-4: Collection of expertise ideas/views on construction delay Management.....	132

LIST OF TABLES

Reference No	Description	Page no.
Table 3.1	Key differences between qualitative and quantitative research	36
Table 3.2	Method of data collection	38
Table 3.3	Identifying different internal team best practices for delay management	40
Table 3.4	Identifying different barriers to internal team collaboration	42
Table 3.5	Identifying different methods and techniques to enhance internal team collaboration	43
Table 4.1	Response rates of target groups	50
Table 4.2	Summary of designation levels	51
Table 4.3	Summary of respondents education level, designation and the experience	52
Table 4.4	Analysis of internal team collaboration practices from Client/consultant perspective	102
Table 4.5	Top ten Significance practices of internal collaboration from Client/consultants' Perspective	53
Table 4.6	Analysis of internal team collaboration practices from contractors' perspective	105
Table 4.7	Top ten Significance practices of internal collaboration from Contractors' Perspective	55
Table 4.8	Analysis of collaboration practices from Overall perspective	108
Table 4.9	Top ten Significance practices of internal collaboration from Overall perspective	56
Table 4.10	Summary of top ten significance practices of internal collaboration from three perspectives	57
Table 4.11	Summary of number of practices for three perspectives under four dimensions considered	57
Table 4.12	Analysis of current barriers to internal collaboration from Client/consultants' perspective	110
Table 4.13	Top ten significant barriers from Client/Consultants' Perspective	65
Table 4.14	Analysis of current barriers to internal collaboration from contractors' perspective	111
Table 4.15	Top ten significant barriers from Contractor Perspective	65

Table 4.16	Analysis of current barriers to internal collaboration from overall perspective	112
Table 4.17	Top ten significant barriers from overall Perspective	66
Table 4.18	Summary of top six significance barriers from three perspectives	67
Table 4.19	Analysis of method and techniques to enhance internal collaboration -Client/consultants' perspective	113
Table 4.20	Top ten significant techniques to enhance collaboration from Client/Consultants' Perspective	70
Table 4.21	Analysis of method and techniques to enhance collaboration-Contractors' perspective	114
Table 4.22	Top ten significant techniques to enhance collaboration from contractors' Perspective	71
Table 4.23	Analysis of method and techniques to enhance collaboration-Overall perspective	115
Table 4.24	Top ten significant techniques to enhance collaboration from overall Perspective	72
Table 4.25	Summary of top six significant techniques to enhance collaboration from three perspectives	73
Table 4.26	Results of Focal point for internal collaboration	76

LIST OF FIGURES

Reference no.	Description	Page no.
Fig. 1.1	Flow diagram of the research methodology	4
Fig. 4.1	Educational background of overall participants	50
Fig. 4.2	Participants experience in the construction industry	51
Fig. 4.3	Graphical representation of significance of four dimensions considered in the research area for internal team collaboration process based on results of three perspectives	57
Fig. 4.4	Venn diagram for top ten significant practices from three perspectives	58
Fig. 4.5	Venn diagram for top six significant barriers from three perspectives	67
Fig. 4.6	Venn diagram for top six significant methods and techniques from three perspectives	73
Fig. 4.7	Summary of focal point for internal collaboration	77

LIST OF APPENDICES

Reference no.	Description	Page no.
Appendix-1	Tables	101
Appendix-2	Questionnaire survey form	116
Appendix-3	Researcher's construction experience	127
Appendix-4	Details of expertise, their views & ideas	132

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DECLARATION

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university to the best of my knowledge and believe it does not contain any material previously published, written or orally communicated by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for inter library loans, and for the title and summary to be available to outside organizations.

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22/08/2022
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Date

The above particulars are correct to the best of my knowledge.

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Signature of Supervisor

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Date

ABBREVIATIONS

PMBOK: Project Management Body of Knowledge

ICT: Information Communication Technology

ERP: Enterprise Resource Planning

EDMS: Electronic Data Management system

QHSE: Quality Health Safety and Environmental

ITC: Internal Team Collaboration

ABSTRACT

Completion of projects on time is one of the major challenge faced by the construction industry. There are many studies conducted on construction project delays focusing on causes and effects of delays and mitigation measures, etc. Initial literature survey has been highlighted that Internal Team Collaboration (ITC) under planning & scheduling, construction management, contract administration and document management is an essential requirement for contractual management of project delays. Therefore, the current study is planned to capture the best practices that can be incorporated with ITCs to manage the project delays contractually and to identify barriers for ITC implementation.

In order to achieve the objectives a pre-survey was done by reviewing literatures, gathering industry expertise ideas and incorporating researcher's experience in the industry for conducting pilot questionnaire design. Subsequently, final questionnaire survey was conducted with industry experts comprised of engineers, managers and executives who directly involve in large scale construction projects representing client/consultant and contractor organizations. Questionnaire forms were emailed and hand delivered to eighty (80) individuals of the target group. There were sixty five successful response, representing 31 from contractors and 34 of client/consultant organizations.

The results of the analysis from overall perspective revealed that these four major categories related to ITC practices; planning & scheduling, construction management, contract administration and document management are equally contributed to contractual management of construction project delays but high attention should be paid on document management practices. And also project manager has a major role to act as a focal point for making ITC process successful during implementation. Moreover, the researcher has identified the barriers to internal team collaborative approach and the methods and techniques that can be implemented to enhance the ITC process at project implementation stage in order to reduce and manage project delays.

Keywords: Construction project delays; Project team collaboration; Delay claim management

CHAPTER 1

INTRODUCTION

1.1 General

Construction industry contributes immensely to the economic growth of any country in the world through infrastructure development related to transport, health, education and other sectors. However, construction projects are operated in more dynamic and complex nature of environment in which there are many stakeholders getting involved for the success or failure (Hamid et al., 2015). Generally, these projects are considered to be very challenging to achieve the objectives during implementation due to major limitations such as time, cost, scope, quality, risk, resources and customer satisfaction (Mulcahy, 2018).

Therefore, Success of construction projects is mainly dependent on completion within agreed time, work on allocated budget, achieve the end user requirement, maintain right level of quality, achieve sustainability targets, ease of maintenance, low life-cycle management cost, reduction in defects and gain the value for money etc. (Weaver, 2010). Out of top seven construction industry challenges in 2020, completing projects on time is the top most significant issue faced by all the countries in the world (Dorosh, 2019). The time is the most sensitive factor than the others which cannot be regained once it is passed. Therefore, everyone is more concerned on this critical constraint during implementation to minimize risks for achieving the expected outcomes.

According to the current trends and forecasts of global construction industry, it is expected to reach US\$ 11.4 Trillion by year 2025 from US\$ 8.9 Trillion which was estimated in year 2019. This will be a 4.2% of rise in the global construction industry in comparison to the other industries despite the recent market challenges like Covid-19 impacts, lack of skilled workers, increasing cost of capital & financial funding and uncontrolled time consuming on government regulatory approvals & environmental clearances (Lucintel, 2020). The trend of construction project delays is still being increased notwithstanding many solutions proposed by expertise through different studies. Therefore, this study area should be further explored in order to reach to a permanent solution.

Moreover, the impacts of construction project delays comprise of time overrun, cost overrun, disputes, litigation, arbitration and total abandonment of project (Islam & Trigunarsyah, 2017; Samarah & Bekr, 2016; Alade et al., 2016). Most of the impacts are cascading in nature to the time overrun. Further, It gives rise to other consequences like bad reputation to the company, loss of business relationships between parties, possible rescheduling of business plans of the owner and the contractor, cancellation of future funding arrangements to the owners from donor agencies and economic loss to the country (Aydin & Mihlaynlar, 2018; Ekanayake & Perera, 2016; Halwatura & Perera, 2012). Further, construction delays should be managed in a strategic way to minimize the possible consequential impacts to the project. This will help to maintain the sustainability of the construction industry in the long run. Therefore, more exploration of the study area will be required in order to find more reliable and effective solutions to address this long lasting crucial issue.

1.2 Background and problem identification

Most of the construction projects are getting delayed and experienced many contractual issues subsequently in construction industry across the world. This positive trend of failure of projects due to time factor has severely affected to the growth of construction industry. Even though, there have been many studies conducted on the subject area, it is questionable about the practicality and the reliability of these findings of the studies. Time overrun would lead to cost overrun, disputes, litigations, arbitration and total abandonment while reducing the quality of work and diminishing the business relationships between parties to the Contract and many more consequential direct or indirect impacts to the projects. The reason for project delays may differ from project to project due to its unique nature.

It has become a common phenomenon in construction industry that project delays are to be anticipated willingly or unwillingly in the current situation. Therefore, industry practitioners need to focus on managing the construction delays in the best possible way without being isolated only to delay avoidance and mitigation. The project parties need giving more attention on contractual management of projects to address most of the issues pertaining to construction project delays. Further, contractors are most of the time failed to win the full entitlement of the claims submitted to the client/consultant in relation to the project delays. This disagreements between the parties has also become a

common issue in the construction industry due to poor attention to the particular issues from start till the end of the project.

1.3 Research gap

Literature review was done for the study area of construction project delays in order to identify the major concerns of the researchers under their previous studies. Then, The previous studies conducted in Sri Lankan context as well as other foreign countries were reviewed in order to get a better understanding on the subject area.

Based on the outcome achieved from previous literature studies, It could be identified that researchers had mainly focused more on finding the Causes of delays, Effects of delays and giving recommendations in order to AVOID or MITIGATE the construction project delays. Despite many previous studies, it is understood that the project delay is a global issue to the construction industry in the past, now and may be even in the future. This has led to many contractual issues between parties across the world. Therefore, it is questionable about the practicality and reliability of the findings of previous studies.

This positive trend of failure of projects due to the time factors has severely affected to the growth of construction industry and also large scale construction projects are more impacted compared to the small scale projects. However, construction projects need to be implemented for the economic growth of any country regardless of many barriers coming across. Therefore, In the current context, It is advisable the industry practitioners to anticipate or expect the Project delays willingly or unwillingly. Then, more strategic approaches need to be implemented during managing the project delays in order to minimize the possible damages or the impacts.

1.4 Aim and objectives

Following are the main objectives of the research:

- To identify the best internal collaborative practices for the performance of construction delay management.
- To identify current barriers to internal collaborative approaches.
- To find out how to enhance the internal team collaboration.
- To identify the focal point in the project for implementing internal team collaboration

1.5 Research methodology

The flow diagram of the research methodology is presented in Fig. 1.1 as shown below:

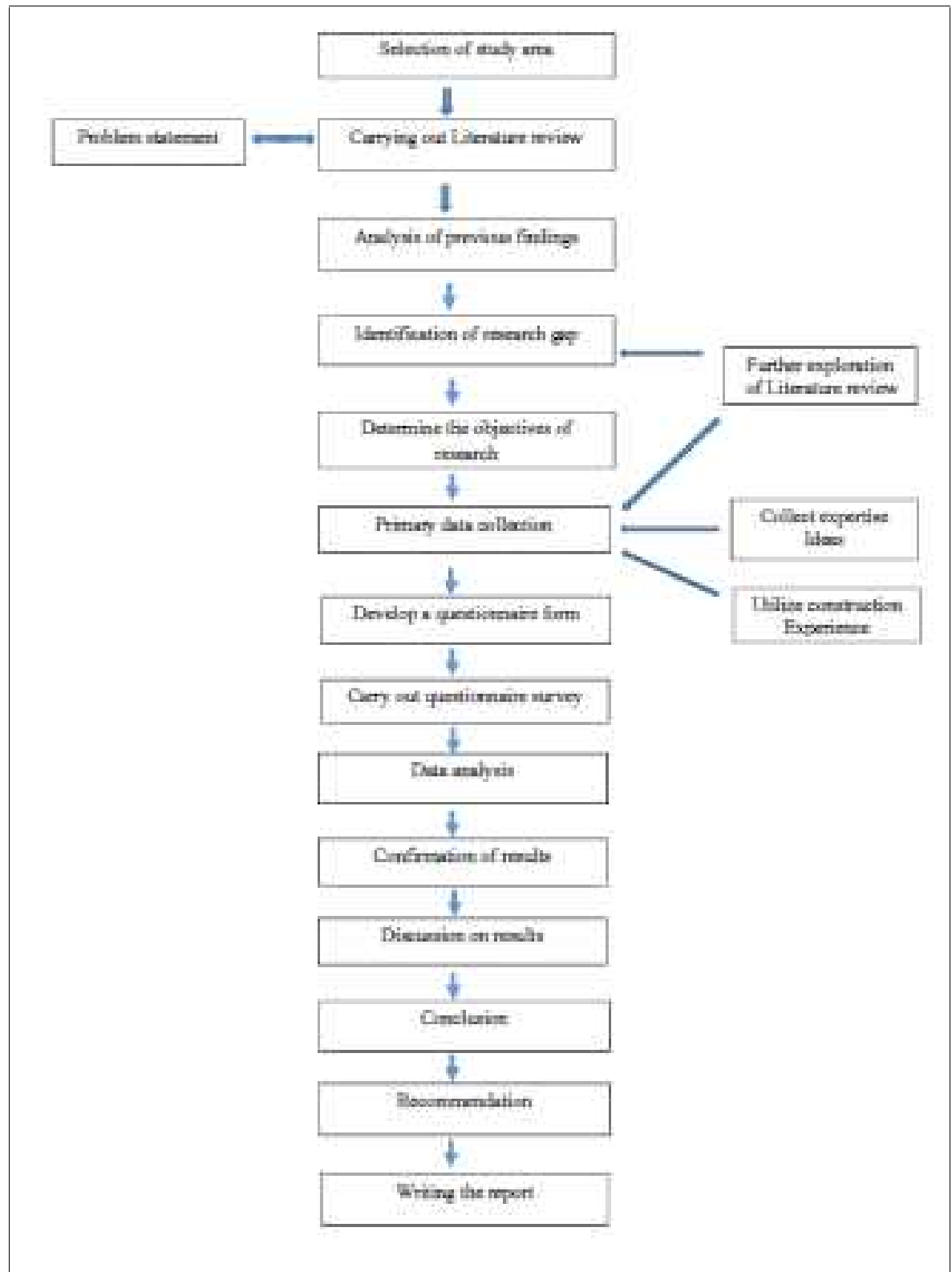


Fig.1.1: Flow diagram of research methodology

1.6 Research Deliverables

The findings and recommendations of the study would be expected to assist the contractors to manage the construction delays efficiently based on the application of proposed practices and the techniques under planning & scheduling, construction project management, delay claim management and document management. And also this will be helpful to the industry practitioners to shift from traditional delay management techniques to a better and efficient delay management system.

In addition, these findings for enhancing the internal team collaborative practices will lead to a positive trend to go forward in line with emerging technologies available in the information technology market. Even though, there are many barriers to overcome under this concept, it would give many positive results comparatively in the long run.

Also the findings and recommendations of the study will be helpful especially to the contractors to manage the construction delays contractually based on the application of proposed practices and the techniques. And also this will be helpful to the industry practitioners to pay more attention on the deficiencies of the current system and make necessary adjustments to incorporate with proposed concepts. Similarly, the emerging technologies available in the Information Communication Technology (ICT) market would also facilitate to enhance the proposed internal team collaborative practices despite many barriers which may encounter during implementation.

1.7 Limitations of the study

In addition to key areas; planning & scheduling, construction project management, delay claim management and document management that have been considered for efficient management of construction project delays, there may be other project management key areas like procurement management, purchasing & logistic management etc., which might influence on construction project delays. The level of significant of these areas can be evaluated for more exploration of the study area. A limited number of expertise views and ideas were considered for primary data collection in this study. But this can be done in more structured manner with increased number of participants by using a Delphi technique or similar in order to achieve more reliable converging factors. Most of the participants of the sample

belong to citizens of Sri Lanka. This can be further expanded by selecting the target groups which include international participants. Similarly, majority of the research data collection was done through emails due to restrictions of the Covid-19 pandemic situation. However, more attention should be paid on other data collection techniques like face to face meetings, direct observations, focus groups etc. that will be more effective to get more reliable data in normal situation.

1.8 Structure of theses

The structure of this report is comprised of mainly five chapters. These are organized in the following order:

Chapter One: Chapter one covers the introduction, background & problem identification, aim & objectives, research methodology & deliverables, scope & limitations and structure of the research.

Chapter Two: Chapter two of the report comprises review of the relevant literature of the study area. It has covered existing knowledge on the set objectives of the research. Similarly, the literature review covers the background for identification of the research gap and identification of the research question.

Chapter Three: This Chapter has elaborated the research methodology and analysis techniques used in the study in order to reach research objectives.

Chapter Four Chapter four has covered the analysis of data obtained through the questionnaire survey. And also the discussion of results gained based on the data analysis.

Chapter Five Chapter five of the report presents the conclusions and recommendations of the research based on the results obtained in Chapter Four.

CHAPTER 2

LITERATURE REVIEW

2.1 General Overview

Literature survey has been conducted under the following key areas in the research during the period of study in order to attain the objectives:

- a. Preliminary study to understand the research area and to identify research gap
 - Different interpretations to construction delays and current situation of the construction industry
 - Causes & effects of delays and recommendations
 - Review of previous studies to identify the research gap
- b. Exploratory study specific to the research problem
 - Identify current approaches, best practices, tools and techniques available in the industry
 - Introduction of new concept for research problem

2.2 Different interpretations to construction delay and current situation of the construction industry

Construction project delay can be described in general as risk events which may come across during any phase of the project life cycle (Kesavan et al., 2015). Both contractor and client or other individuals might contribute to deviate from originally agreed schedule due to many reasons leading to project delays (Perera & Halwatura, 2012). Contractual claims and increase in project cost are some of the major consequences due to construction project delays (Jeyakanthan & Jayawardane, 2012). Road construction projects undergo 56%-80% average time overrun from the original schedule (Pathiranage & Halwatura, 2010). It has become a global issue which requires reliable solutions to the progress of the industry in any country (Soliman, 2017; Alade et al, 2016). However, project delays may limit the developing countries to achieve the expected project objectives (Isalm & Trigunarsyah, 2017). Despite the fact that latest technology and advanced management systems, construction delays still have been a common issue to all the countries in the world (Sweis et al, 2007). Therefore, it is

worthwhile to study the causes of delays and effects and also the recommendations that have been proposed by different researchers.

2.3 Causes & effects of delays and recommendations

2.3.1 Researches conducted in Sri Lanka

The study conducted by Ekanayake & Perera (2016) explained the issues that can be led to impact on economy due to delay of completing the building construction projects funded by Sri Lankan government. The delay of completing projects can be impacted on both client and the contractor at different condition in long and short term basis. These impacts could be mainly in one or many of the following forms; increasing of overall project cost, resources underutilize & wastage, postponing clients future plans and activities, reduced quality of work, decreasing the profit margin of the contractor, disagreements of project parties, clients additional cost involvement, project abandonment, arbitration and litigation. Further, researchers had identified following ten causes in order as the most significant to the project delays based on findings : Skill labour shortage, timely not receiving the required drawings, materials delivery delays, financial issues faced by client, contractor's team attitudes, contractor's funding issues, scope changes, decision making delays, allocation of inexperience & unqualified technical staff and government authority approval delays. And also recommendations and suggestions have been given for each causes of delay to minimize the effects of delay causes. However, the authors have recommended that parties to the project; client, contractor and consultant should work together to achieve the expected outcomes.

According to the study of Dolage and Pathmarajah (2015), it is important to follow correct contract administration procedures and apply systematic project management tools and techniques to minimize project delays. In addition, the construction project delays can be minimized by identifying causes of delays and taking corrective actions. Project delays lead to time and cost overrun directly, while breaking of relationship between parties to the project, mistrust, litigation, issues in cash flows, arbitration and project abandonment or termination. Researchers had considered twenty four significant causes of delays in the study, and following are most influential ten factors in order based on their ranking the factors: planning & scheduling deficiencies, insufficient profit margins, contractor's poor cash flow, contractor's work overload,

inefficient key staff allocation, management poor decisions, quality control deficiencies, non-availability of required equipment, reduced work supervision at site and materials supply delays. The authors have highlighted the facts of preparing realistic work programme, accuracy of bid value, contractor's efficient utilization of project funds, contractor's capacity assessment, recruiting right people, confirming to the specifications for materials services & equipment, ensuring availability of appropriate machinery & equipment etc. in the recommendations given for mitigating the causes of delays related to the contractors.

Further, the study conducted by Kesavan et al. (2015) highlighted that effective management of construction project is very essential requirement at all stages due to its risky nature. The project delays have been a major issue faced by the industry and the significance might differ from project to project. The causes of delays can be related to client, consultant, materials, labour, equipment and external. The study had found the labour related issues as the most significant case followed by contractor and the client. The researchers had identified following ten causes of delays as the most significant ones out of fifty two causes of delays: Sub-contractor's schedule conflicts, progress payment delays, unfavorable weather condition, contractor's financial issues, labour shortage, regular alteration of subcontractors, inadequate labour productivity, subcontractor's work delays, reworks due to defects and variations of subsurface & ground conditions. The authors had recommended to carryout continues monitoring and controlling procedures on work, finance, resources & planning activities, clients understanding to minimize changes, client's on time progress payments, producing design drawings on time, implement programs to improve technical staff knowledge & skills, contractor's efficient cash flow management plan. Authors proposed to focus on research areas to develop guidelines and activities pertaining to planning.

The study conducted by Dolage and Rathnamali (2013) based on a case study of state sector building projects to explore the delay causes, had identified ten significant factors in the following ranking order; client's progress payment delays, contractor's deficiencies of planning & scheduling activities, heavy rain, not providing experienced technical staff, contractor's work overload, contractor's poor liquidity, labour shortages, approval delays of variations & extra works, contractor's site management and supervision issues and contractor's deficiencies in time management. Authors had given recommendations in general as well as specifically to client, consultant and

contractor to mitigate the factors caused by delays. Also the main objective of the research was to get the maximum benefit from the funds allocated to the government building projects.

However, the study conducted by Perera and Halwatura (2012) specific to water supply projects had identified thirty nine (39) causes of delays related to construction projects. Following factors had been found as the major influential causes of delay from the analysis of study: extreme weather, financial difficulties faced by the contractor, labour shortage, governing rules & regulations of road authorities for trenching works, subcontractor delays, delays in material import, contractor's deficiencies in planning & scheduling, large number of change orders, site handover delays to the contractor and issues pertain to obtain permits and services. Based on the findings of research, it is revealed that client/consultant and contractor are in different opinion regarding the delay factors of the construction projects which may need to pay serious attention. Also this research had highlighted the importance of project management teams' proper understanding of delay situation and its consequences in advance to take precautionary actions for better managing the delay situations. Further this study has pointed out nine effects due to causes of delay in the following order: Time overrun, cost overrun, funding problems, disagreements, arbitration, litigation, abandonment, commissioning delays of related projects and conflicts with other organizations. Even though the research has covered many foreseen areas of the delays in medium scale water supply projects in Sri Lanka, it is questionable to understand how far these factors will be applicable for large scale water supply projects which would be carried out by local and foreign contractors.

Most of the foreign funded buildings, roads and other civil engineering projects have been delayed in Sri Lanka resulting cost increase and contractual claims (Jeyakanthan and Jayawardane, 2012). The success of construction project and efficiency of project team can be evaluated considering the delay as an indicator. Researchers had focused mostly on road projects which are financed by donor agencies like Japan International Cooperation Agency (JICA), Asian Development Bank (ADB) and World Bank (WB), since donor agencies are more concerned on completing the projects on time. Significant causes of delays at initiation and feasibility, design and tendering, implementation, monitoring & controlling and closing stages had been identified by the

researchers and developed a road map for the donor funded road projects outlining the major activities to be involved.

According to Pathirana and Halwatura (2010), contractor has become the most answerable party for road construction delays in Sri Lanka in comparison to the other parties involved with. However, the research had highlighted the fact that client's influence is more than the consultant. Compared to the factors related to contractor, consultant, owner, external factors have been contributed in less significant level to the causes of delays. The researchers had identified following major causes of delay that would require more attention to mitigate road project delays; contractor's cash flow issues, contractor's weak site management, extreme weather conditions, excessive changes, slow decision making and inadequate documents, labour and material shortages, poor skills and experience of subcontractors, reworks due to errors/defective works and unforeseen ground conditions. Moreover, recommendations have been suggested by the researchers to address the significant causes of delay identified through the research. When we compare above mentioned studies conducted from Sri Lankan context, most of the causes of delay are similar irrespective of infrastructure sector considered.

2.3.2 Researches conducted in other countries

The study conducted by Aydin and Mihlayanlar (2018) has highlighted the significance of paying attention on causes of delays at early stage of the project so that parties can take necessary precautionary actions to control the events. Based on the case study, a total of fifty eight (58) delay causes had been identified under different categories related to client, contractor, design, external, finance-labour, material-equipment and project management. The researchers had identified the following ten causes of delays as the most significant ones from the study: Municipality permit delays, government legislation changes, contractor's financial difficulties, design document approval delays, labour shortages, client's decision making slowness, contractor's less experience, non-availability of skilled labourers, non-availability of experienced design office, unclear, inadequately detailed drawings. The case study had been conducted based on Edirne city centre in Turkey. Similarly, they had come up factors such as bad reputation, time overrun, cost overrun, total abandonment, dispute, low quality work, litigation and arbitration as the most influential effects due to causes of delays.

Further, Soliman (2017) had conducted the study based on construction industry in Kuwait. He had identified many delay causes in construction industry from the previous studies and had analyzed those using a different scale to separate top ranked delay causes relevant to Kuwait construction industry. These causes categorized into five main groups related problems encountered due to local construction industry, financial, procedures in planning & control and skills, special project management and procedures pertain to contract and government legislations. However, it had been found that most of the suggestions have been directed to influencers of the government. The author had given the recommendations to address the problems created from the causes of delays which comprises of appointing corporative focal agencies for new project approvals and finalizing the required time frame, documents cycle acceleration required for new projects, project parties' planning and skill development, amending the functions and speed-up procedures pertain to change orders, generate skills & training programs to qualify local workers to the industry, amendment to the selection criteria of the project consultant, contract selection criteria to be specific to contractor's financial capacity and project management capability and making amendments to contract clauses pertaining to planning & scheduling.

Further, Islam and Trigunarsyah (2017) had mainly focused on reviewing forty one (41) research papers in the same study area in different developing countries in the world such as Afghanistan, Bangladesh, China, India and other Middle East countries. The researchers had identified fifty three (53) major causes of delays in developing countries and classified them in to eight major groups during the study. It had been identified through the study that the financial issues are the most frequent causes of delay in construction projects such as contractor's inadequate cash flow in hand, client's delayed progress payments and also owner's funding issues in line with planning & scheduling issues and contractor's lack of site management. There had been issues related to owners like change orders that would acknowledge as most frequent causes in many countries of the world. In addition, procurement issues are like late delivery of materials and equipment and shortage is most frequently happening delay causes in developing countries simultaneously with lack of communication and coordination. Moreover, researchers had highlighted other factors such as owner's insufficient funds availability, lack of skilled and unskilled work force and poor experience of the contractor are major causes of delays that should pay high attention. The consequences

or the effects of delays are found to be disputes, additional claims, litigation, arbitration and project abandonment in addition to time and cost overrun.

According to the study of Samarah and Bekr (2016), who conducted the study based on Jordan construction industry had categorized fifty five (55) delay causes under four main categories related to client, contractor, consultant and external effects. However the researchers had identified twenty two (22) most significant factors from the study and most top ranked factors were; contractor's poor site management and supervision, design changes done by the client, contractor's poor planning & control, low performance due to selection of contractors on lowest bid concept, project changes, design and contract document errors, clients delayed progress payments, reworks, original design changes and low construction productivity. The field study had revealed time overrun, cost overrun, disputes, arbitration, total abandonment and litigations are the most significant effects of delay on construction projects to successful delivery.

Similarly, Alade et al. (2016) identified the following ten significant causes of delays based on the study conducted in Nigeria: the lack of contractor's skill on site management and supervision, contractor's poor construction experience, financial difficulties faced by client, sub-contractors issues, time estimate errors, lack of equipment, payments delays to suppliers and subcontractors, construction materials shortages, cost estimation inaccuracies, inadequate equipment, payments delays to subcontractors and suppliers, construction materials shortages, cost estimation inaccuracies and regular equipment breakdown. Similarly, time overrun, cost overrun and disputes had been identified as the most significant three out of six effects of delays. The authors had proposed recommendations to adopt by clients, consultants and contractors to get involve with in order to minimize the effects of delays.

More comprehensive study conducted by Aziz (2013) to identify new factors related to delay causes in Egypt construction project, had categorized the delay causes into nine major groups related to consultant, contractor, design, equipment, external, labor, material, owner and project. The researcher had identified ninety nine causes of delays under these main categories which is found to be a major list that had been identified compared with the other studies conducted in the same research area. Based on the interview conducted with two thousand five hundred (2500) different highly

experienced construction professionals of key parties to the construction projects such as owners, consultants, managers, engineers and contractors. However the research had found following top ten causes of delays out of ninety nine factors taken into consideration to find Overall Relative Importance Index (ORII) for the analysis: progress payment delays, bribes handling patterns and strategies, equipment shortages, project planning & scheduling deficiencies, improper site management and supervision, financial control deficiencies on site, rework due to errors, inappropriate contractor selection criteria, failure actions taken suddenly and planning weakness. In addition, the author had conducted a case study to verify the results obtained from the questionnaire survey and the analysis and had proposed recommendations to minimize and control the delays based on the findings.

According to the study of Sweis et al. (2007), the case study conducted in Jordan had identified forty (40) delay causes under three main categories based on the results extracted from previous researches conducted mainly focusing building sector projects in Gulf region countries such as Saudi Arabia, Lebanon, Jordan, Kuwait and United Arab Emirates. The results of the study had revealed that contractor's financial difficulties, change orders raised by owners, lack of planning & scheduling and poor project management techniques have been the significant causes of delays in construction projects.

Further, Assaf and Al-Hejji (2005) studied the time performance of different types of construction projects in Saudi Arabia, they had identified seventy three (73) causes of delay in construction projects of Saudi Arabia for the study under nine (9) group categories related to project, owner, contractor, consultant, design, materials, equipment, labour and external. The researchers had identified most severe causes of delays separately from the perspective of three parties; owners, contractors and consultants. According to the summary and conclusion of this study, owners had specified that most of the delay causes are happen in relation to the contractors and labourers. The researchers had highlighted the importance of paying the progress payments on time to contractor, client's change order minimization, reviewing and approving design documents in line with anticipated schedules, identifying availability of resources and capacities in selecting the contractors based on lowest bidder .

2.4 Discussion on preliminary research findings

When we compare all the studies conducted in Sri Lanka and other countries, those findings had been focused to identify causes of delays, effects of such delays and to give recommendations to avoid or mitigate construction project delays. However, the findings of these researches were common to the industry irrespective of country concerned.

Despite many studies conducted recent past on construction project delays, it has still become a global issue in the construction industry (Indhu & Ajai, 2011). Also this issue has been experienced both developed and developing countries in the world and found 72% of projects are delayed with 38% increase in original contract duration on average (Rivera et al., 2016). In Sri Lanka, more than 90% of projects implemented are delayed (Ramachandra et al., 2014). However this situation is getting worse over the time in construction industry and large scale construction projects are severely affected in comparison to the small scale construction projects. This has led to possible impacts like time overrun, cost overrun, disputes, litigation, arbitration and total abandonment. In addition, other possible impacts are bad reputation to the company, breaking of business relationship, impacts to parties' future schedules, cancellation of donor agencies funds and economic losses etc. (Ekanayake & Perera, 2016; Perera & Halwatura, 2012).

However, construction delay causes a risk on time and cost throughout its life cycle to all key stakeholders (Ramanathan et al., 2012). A risk always has a probability and when it occurred it becomes an issue. Therefore it requires to avoid, mitigate, transfer or accept the event for efficient management of the risk (PMBOK, 2017).

Similarly, A construction project is a temporary endeavor in nature which would give a unique product (PMBOK, 2017), and therefore, these causes & effects and recommendations found in previous studies have been mostly project specific because of the type of stakeholder engagement, complexity, differences in geography and stratified nature etc. In today's context, Delays in construction projects have become a common phenomenon throughout the industry (Khatib et al., 2018). Therefore, it is very important to consider the contractual management of construction delays without being isolated to avoidance or mitigation of construction delays which is not discussed specifically in previous studies. Further exploration of the research area was initiated in this study in order to identify the strategies on contractual management of construction project delays.

In addition, most of the researchers tend to follow one approach in order to gather required data and information for the study. Therefore, researcher has considered three different approaches to collect preliminary data to formulate the research background and subsequent data required for the research analysis. These three approaches were: collection of views and ideas of industry expertise regarding current issues, reviewing the published documents and utilizing the researcher's construction experience in the industry for wider exploration of the study area.

2.5 Expertise views on current issues of delay management

According to the ideas of industry expertise, the lack of proper integration under the key processes of construction namely; planning and scheduling, construction management, contract administration and document management within the internal team has been one of the major issue in the current context leading to project delays during implementation stage. Similarly, this current individual or isolated performance behavior of internal team members has been weaken to identify their responsibility, accountability, consultancy and inform nature (RACI) for each and every activities under the project. In order to achieve the objectives of integrations of these processes, there should be a collaboration within the internal team members of the respective disciplines of the project. Similarly, application of best practices would lead to enhance the processes efficiently at more practicable manner.

2.6 Application of collaborative team approach for delay management

There are many innovative concepts that have been introduced to the construction industry in order to overcome the issues pertaining to the construction project delays. Out of many new concepts, team collaboration is considered to be one best approach that can be utilized to enhance the performance of the construction industry. Most of the researchers have currently focused to incorporate team collaboration under Integrated Project Delivery (IPD) concept among the key stakeholders to the construction project. They have identified that this concept would help to reach the end results with fewer delays, lower costs, greener project, and higher quality level (Ostanik, 2010). However, there are many complications to integrate this concept with normal contracts during implementation due to the incompatibility of contractual terms and conditions of the existing procurement documents, managerial and environmental issues (Kahvandi, 2019). The key stakeholders who have certain power to take decisions such as client,

design team, civil contractor, MEP contractors etc., would involve with this concept and take decisions collectively to achieve the project objectives. But, traditional procurement procedures and guidelines and contractual terms and conditions may not fit with this concept for successful implementation. Therefore, it is still worthwhile to consider by enhancing work collaboration within internal team members of the parties to the project, since internal team collaboration is much more achievable and feasible solution with the current procurement policies and procedures during implementation stage of the construction projects. Since team members have been grouped mainly in to several key divisions based on job responsibilities in the project. According to the views and ideas of construction industry experts, team members working under planning & scheduling, construction management, contract administration and document management are playing a major role and responsible for the successful performance. Therefore, internal team collaboration under the above mentioned key areas would be focused in the research to integrate with efficient management of construction project delays. In addition, most of the industry practitioners believe that construction organizations need to think of adopting best practices with good results aiming for development of construction industry for better management, reduce potential risks and conflicts and improve the safety (Samari & Shafiei, 2012).

Therefore, the research area under construction project delay shall be explored further under the internal team collaboration concept in order to identify the suitability for efficient management of construction project delays and cater the current issues in the construction industry.

There are many different categories like Owner/Consultant related, Contractor related, Consultant related, External/Other Delays, Material related, Equipment related, Management related, Finance related, Construction related etc., under causes of construction project delays in different studies (Perera & Ekanayake, 2016; Pathmaraja & Dolage, 2015; Kesavan et al., 2015; Rathnamali & Dolage, 2013; Perera & Halwatura, 2012). However, Mehany & Grigg (2016) commented on best practices under planning & scheduling, project record keeping and documentation for delay claim management in road construction projects. Poor contract administration is one of the key factor in construction project delay management. Similarly, the study of Jergeas, & Hartman (1994) had highlighted the key categories under record keeping, knowledge of contract, planning & scheduling, contractor's right and proactive action which goes with

construction management for contractor's claim avoidance. There is a big impact on duration of construction projects due to poor planning & scheduling and construction management activities of the project (Khalid, 2019). Further, there should be a proper control of day-to-day operations of the construction activities using clearly defined targets of performance to avoid the delays and manage the construction activities in order to fulfil the obligations of contract for managing the delays contractually (Atout, 2008). Therefore, it is clear that these planning & scheduling, construction management, contract administration and document management are key influential categories for managing the construction delays contractually. The best practices and techniques under these four dimensions are identified in the research in order to meet the objectives of the research.

2.7 Different approaches & best practices on delay management

2.7.1 Planning & scheduling related

A project planning is a team work that would create a project development strategy. The management team, design team and cost control team would involve with project planner to create the planning documents. Whereas, project scheduling is a concept which involves interpretation of the outcomes obtained from the project planning process. Therefore, appropriate software tools and techniques should be used to establish activity start & finish dates and sequencing. During the planning process, the planner takes the leadership to make decisions on approach for breaking down the work process for easy control, and how control is to be managed, ways and means of adopting for design, procurement and construction works, decisions on subcontracting & procurement, management of risk and opportunities etc., with the relevant team members in order to execute the works at maximum efficiency. After that, the scheduler is required to work together with responsible persons for executing the work. Then it will determine activity duration, the parties involve with and the resource allocation, sequencing of activities, formats related to reporting and communication, timing etc. Therefore, good project plans and schedules provide all the guidance required to be followed by the project team in completing the project successfully (Weaver, 2007).

Therefore, it has been identified by the project management professionals that following the guide lines given under project time management process group will assist for making a successful schedule to the team members which comprise of plan schedule management, defining the activities, sequencing the activities, estimating activity

resources, estimating activity durations, developing the schedule and controlling schedule in the sequencing order (PMBOK, 2017).

According to Kesavan et al. (2015), Construction planning is considered to be a tedious task due to its dynamic nature progressively during execution of the work. Therefore, the planner should ensure the reliability of different options available for construction and technical feasibility of the planning documents together with associated cost implications. All the risks and constraints identified during the initiation stage should be incorporated with the planning and scheduling documents in producing realistic project documents. Therefore, planning is considered to be most important element in construction project management that would ensure the successful completion of the project. It had been identified through the study that proper planning methods such as regular monitoring, cash flow monitoring & controlling, material & equipment controlling, schedule revising, managing labour etc., would lead to avoid construction project delays.

Project delays happen mostly due to project risks and constraints. The key stakeholders should have strategies to take actions on avoidance, mitigation, transfer or accept these risks. Therefore, it is very essential requirement under project scope management to identify the associated risks and constraints for documenting with planning & scheduling, technical and contractual documents. This anticipation of risks and constraints will facilitate the contractor to be more vigilant on taking necessary precautions to avoid or minimize the impacts as well as getting necessary relief from the client/consultant at the event of occurrence (PMBOK, 2017).

Similarly, selecting a more familiar planning and scheduling software applications will facilitate internal teams for using independently. Otherwise, team members may require to put additional efforts to get familiar with the applications during its usage for perfect information. In addition, this will facilitate to produce faster, accurate and contractual requirements. It was highlighted that only one agreed schedule should be used in the project with necessary controls to produce contractual reports as well as to fulfil the monitoring & controlling requirements of the project. (Mosaic, 2007; Alotaibi et al., 2016).

Project resources should be planned, managed and controlled in a systematic manner in order to get the maximum benefit of the resources. Also acquiring the right quantity

of required resources on time would drive the project to achieve schedule objectives. Also the contractor should ensure that resources defined in the procurement documents are correctly provided or prior approvals are obtained for any deviation. Also Gathering information of previous projects and knowledge of expertise would help to identify the best possible way to handle the situation at faster. Further, it will facilitate to reuse some available data and information for activities which require tests and investigations to proceed. Therefore, it requires to follow the documents on contractual requirements when identifying the resources to the project (PMBOK, 2017; Mulcahy, 2018).

The study conducted by Jacob (2018) had highlighted that 50% of daily activities in construction projects are executed in unplanned nature and wastage of time on non-value adding situations. Therefore, it is worthwhile to focus on collaborative approach specifically for planning process. Therefore, this approach is considered as a consolidation of simple best practices enables from lean construction and project management concepts. It has provided a practical framework to plan and monitor and control the construction projects. Failure to have common understand of the scope, lack of proper action plan to execute project within constraints, non-identification of risk and uncertainties etc., would create improper planning and project uncertainties. Assuming the project as a commitment network, planning approach should be able to identify its weak points during monitoring & controlling phase in order to provide necessary supports at right time. The procurement schedule plays very important role to meet the targets of deliverables under time schedule. This should be in line with the time schedule by identifying realistic time periods for procurement processes, manufacturing and delivery to the site (Tanubrata & Gunawan, 2018).

2.7.2 Construction management related

Considering the fact that project delay is common situation in construction industry irrespective of simple or complex project which leads to incur additional cost to the project. Therefore, Implementation of delay rectification methods would relieve the contractor to avoid or mitigate the delays and to reduce subsequent cost and contractual implications. The study of Hamid et al. (2015) had found the following remedial actions to rectify the delayed completion of construction projects; allowing to work beyond normal work period, arranging several working shifts, extending number of working days, application for EOT, subcontracting the delayed works or activities, meeting arrangement with all site functional teams, providing more executive power to project

manager, adopting a different construction methodology, moving to new technology, adopting multiple or alternative methodologies in construction, allocation of high capacity or extra equipment to the work, increasing workforce, attention on quick & easy installed material options irrespective of cost, dependency double checking, revisiting the original scope, pay high attention on critical activities, scope change prevention and design change avoidance etc.

Another study conducted by Divakar and Ashitha (2016) had proposed to apply agile project management to reduce the construction project delays. The concept agile was initially implemented for projects in software industry due to its ever changing nature. It could reduce about 60% to 80% project delays in the software industry. The authors believe that it would help to reduce the construction project delays by applying the framework developed by the researchers. The agile is used for change driven processes due to its flexibility and reliability. The reliability of project delivery is to be achieved by decomposing the project into smaller manageable component. These components will be completed in greater value of delivery. Also the study had identified the following causes of delays: planning deficiencies, poor communication, lack of integration, inadequate management and inexperienced staff.

Usage of relational Database for construction delay provides a data structure in the form of entity-relationship model for logical background of the study. Past project data may be used to learn from previous projects and to take preventive actions in order to minimize delays. This can be developed by using Microsoft Access or similar application and which would be a user friendly, inexpensive, easily accessible database for establishing delay knowledge and timely handing of the delays occurred in a project (Bilgin et al., 2015).

However, ERP System can control significant delay causing factors. In today's context, most of the construction companies are moving to use Enterprise Resource Planning (ERP) applications in order to manage their resources more efficient and effective way. Implementation of a six dimensional ERP system (includes: Length, breadth, height, cost, time, information exchange) is suggested as the best possible remedy to control delay. The advantages of using this type of 6D ERP system are: output integration from fast track software, creation of workflow structure by connecting a time factor, data creation to manage the site works, works and inventory integration, materials and

labour stock management, human resource management, resource crashing and smoothening through integration with other scheduling software. The data from the site is directly entered into the system by the site engineer and therefore, time lag can be controlled and quality can be improved (Thembalath & Mathew, 2016).

Another study conducted by Alenazi and Adamu (2017) developed a framework under Building Information Modeling (BIM) to address the issues pertain to the construction project delays. BIM is a 3D modeling design application which has the additional functionalities such as design coordination for helping to resolve various communication and collaboration challenges faced in construction. The authors had considered five critical delay factors related to the clients namely; planning & scheduling deficiencies, change requests made by client, progress payment delays, client's slow decision making, communication weakness between client and other stakeholders. The authors had expected to take mitigation measures through BIMs benefits by developing a framework. Further, the developed framework could assist to decrease the cost impacts due to delay causes in construction projects.

Moreover, Adopting lean construction to the construction industry would facilitate to improve productivity, waste minimization and promoting the team building (AlSehaimi & Koskela, 2011). As a positive consequences of these factors, causes of construction delay also can be minimized by executing the lean construction concept in the project.

Additionally, implementation of regular meetings at construction project would lead to minimize the causes of construction delays. When the team members meet regularly in a virtual or physical manner, they get the opportunity to share the available internal resources in an effective manner. Also these regular meetings help to update the time targets of key milestones of deliverables and find solutions collectively for pending unresolved issues during construction works (Ludwig, 2018). Further, contractor's team should ensure that they have followed approved QHSE plan in the project. This would assist the teams to avoid or mitigate the possible reworks of the project leading to suspension of works by the client/consultant. And also QHSE policies and procedures should be aligned with contractual requirements as well as organizational needs (Salvi & Kerkar, 2020; Loushine et al., 2006). These factors would automatically give rise to construction project delays. Also by developing the project team through knowledge enhancement and skills development may help to mitigate construction delays under

training and Continuous Professional Development (CPD) programmes (Frimpong et al., 2003).

2.7.3 Contract administration/delay claim management related

There have been many reason for contractor's delay claim failure which include provision of insufficient data, information and other documents for substantiation, non-submission of claim details on time, wrong link establishment in cause and claim effect, failure to take mitigation actions on delay effects (Ramachandra et al., 2014). Therefore, it is suggested to introduce innovative approaches to safeguard the contractors being undergone such situation, unless or otherwise the impacts may lead to project delays ultimately. One solution for this is to address this situation is provision of amount for delay claims under contingency or included with markup during bidding stage. Introducing a buffer or margin to the first time delay claim submission to reach the actual during negotiation, maintaining site records up to date are some other strategies that can be applied in order to overcome disputes in delay claims. Most importantly, all relevant team members should be arranged training and knowledge improvement sessions on contractual procedures to be followed suited to the Sri Lankan context(Ramachandra et al., 2014).

According to governing rules under FIDIC, contractor should have given prior notice to the client as specified for any claim related to time, money or both. Also the contractor should submit the claim application within the period specified along with all supportive documents pertain to substantiation. Extension of Time (EOT) is the additional relief period allowed the contractor to complete balance works together with cost or not considering the reasonableness of causes of delays. There can be many reasons to consider for Extension of Time (EOT) which may be changes, resource limitations due to pandemic or actions of government, client's or his party's delay causes and extraordinary climates etc. In addition, any condition referred to the contract clauses: Clause 1.9 –late information, Clause 2.1- denied or late access or possession, Clause 4.7-errors in setting out information, Clause 4.12 –adverse physical conditions, Clause 4.24-Fossils, Clause 7.4-testing, Clause 8.5-Delay caused by authorities, Clause 8.9-Engineer's instruction to suspend work, would lead to EOT applications. Therefore, the contractor's understanding on governing contract procedures is an essential parameter to deal with delay claims successfully. Also the contractor should have

included all the supportive documents to substantiate the validity and correctness of his claim (Frics & FCI Arb, 2004).

It has been identified that there are many disputes arise during the substantiation of EOT applications with the traditional claim management system. The emerging digital technology can be incorporated with delay claim management in the construction industry. Building Information Modeling (BIM) based claims management system (BIM-CMS) is one of such model developed in order to avoid the disputes among the key stakeholders of the project. It addresses the problematic issues in claim management such as non-availability of sufficient contemporary records, contractor's nonstandard documents submissions, communication lapses, poor impact presentation, poor contract knowledge etc. This type of claim management system would enable the team to track and monitor all the claim from beginning until its closure (Ali et al., 2018).

Tan and Anumba (2010) had introduced a conceptual frame work for the development of a web-based construction claims management system in order to address the common issues arisen under; submission of claims with evidences for substantiation, timely submissions of notices and claims, procedures to be followed as specified in the contract. These causes are arisen mainly due to documentation inadequacy, non-availability of competent staff and leaving of key staff members from the project etc. This newly developed framework would help to identify the correct workflow that needs to be followed as per the governing contract, producing the claim timely while keeping the copy of the submission of the collective efforts of the participants and retrieving data for future work.

Similarly, the study conducted by Braimah (2013) found that the delay claims are resolved at the end of the project and taken considerable time duration for resolution. Though it is more popular to follow very simplistic approaches based on previous cases, those approaches may not be valid in some extent to take correct decisions to the present case. In addition, there are many more sophisticated and robust approaches that are available, those are not popular in current practice. Therefore, more focus should be given in selecting the appropriate construction delay analysis techniques for the particular delay claim, out of the available techniques such as As-planned Vs As-Built, Impacted As-planned, As-planned but for, Collapsed as-built, window analysis and Time impact analysis (Braimah, 2013).

Mehany & Grigg (2016) identified best practices and effective guidelines to control delay caused claims. The authors had mainly focused on the road construction projects for the study. Authors had mentioned the requirement of standardized process of delay claim management system for the owners and contractors with guidelines, limitations and obligations in order to detect and document the delays as soon as they happen. They had developed a system by identifying the main component related to the delay claim management. This system allows to encourage contractors to pay more attention to detailed project studies and acting as encouraging tool for better communication because schedule communication and project status under this system have to be periodically reviewed and discussed frequently and on time.

However, claim notices should be produced on time and submit the comprehensive delay claims by following the correct contractual procedures in order to win the contractual entitlement of the claim. Otherwise, the client/consultant may refuse to accept the contractor's entitlement of claims due to failure to notify the intention to claim in due time and non-submission of relevant supportive documents for substantiation the claim on time as per the conditions of Contract (Ramachandra et al., 2014). Similarly, both the employer and contractor should have maintained a complete, contemporaneous, chronological and provable records of what had happened on site together with the problems and its impact upon the progress, schedule and cost. These records should be produced, recorded and maintained in such a way that it would help to use substantiating the claim (Tan & Anumba, 2010; Ramachandra et al., 2014). Also the contractors should identify and inform the varied item of work to the client before the activity starts to reduce disputes arisen due to changes. Because the client will have sufficient time to check the varied item in different perspectives to give work order at minimum variations. Therefore, there should be a focal point in the project who is having adequate knowledge of the contract so that changes to the contract is identified and controlled in a proper sequence manner without implementing an arbitrary approach (Yadeta, 2017). However, it is the obligation of the contractor to take necessary precautionary actions to mitigate or avoid the impacts of the delay events as per the contract (Ramachnadra et al., 2014). Similarly, it is highlighted the significance of adherence to the contract in order to ensure the success of any contractual claims and smooth management of a project (Yusuwan and Adnan, 2013).

2.7.4 Document management related

Most of the construction companies do not have a proper process of handling and managing its project documents. This may negatively impact on poor work performance and may undergo project delays (Yatin et al., 2015). A massive amounts of project documents are being handled in construction projects for various communications during project operation. Project documents are collection of files in digital or hardcopy base related to any one of the form of technical, contractual, administrative, procurement, or general administration matters of the project. Many standard documents are being used during internal & external communication that need to be managed carefully (Perumal & Bakar, 2011). If these project documents were not managed in a systematic manner from the beginning of the project, the project team may lose control of managing it after getting accumulated dozens of documents related to various subject matters. Therefore, it should be ensured that all the documents are managed, organized in systematic manner so that the access is open to all authorized personnel throughout the project period and to be used as a knowledge repository. Proper document management system is the controlling and handling the inflows and outflows of project documents which are in paper based or electronic based in secure and efficient manner by the authorized team members. Deputing a focal point for controlling the document may enhance the efficiency of the document management process (Yatin et al., 2015).

There are many implications due to poor documents management system in construction projects. When team members do not get the right version of the documents, there exists many reworks in the deliverables during implementation. Team members may have to spend lot of time to find some important documents required for claim substantiation etc. Also there may be communication delays in projects with subcontractors etc., during provision of urgent data information for work execution. More importantly, when there are many change requests, the response for them may become slow. In addition, there may be leakages in security of confidential documents (Ginsberg, 2019). However, most of them agree that managing the construction documents can be a most tedious and time consuming tasks due to its complexity. But, proper and effective document control is crucial for the success of the project. Otherwise, the project may become more challenging to complete on time, within the allocated budget and defending against the contractual claims. It is evident that having all the documents and data readily available will make easy for day-to-day operations and will reduce the wastage of time spending

on searching the required documents when it is necessary. However, centralize document storage maintenance, accessibility enhancement, coding system introduction, etc., to be the best practices for managing construction documentation in the industry.

Ramachandra et al. (2014) had identified reasons for failures to contractors' delay claims that included in documentation inadequacy to substantiate delay claims and contractor's delayed submission of claim details due to non-availability of contemporary records to include with claim application. Similarly, the research conducted by Braimah (2013) had found lack of clear, accurate/reliable and adequate contemporaneous records have become a major issue for the delay claims.

Nowadays, there are web based document management software available under Electronic Data Management system (EDMS) for utilizing to handle vast amount of data and information in very efficient and reliable manner. These digital document management platform provides document sharing facility to the different groups of the project in addition to basic functions such as document creation, storage and retrieval, management, version control, workflow and multiple delivery formats. Similarly, these EDMS can be integrated with current Enterprise Resource Planning (ERP) system for efficient and effective utilization of company resources. Further, it has been identified that knowledge has becoming the most important asset for the success of organization and document management system facilitates a major role to achieve this objectives. In addition, these company knowledge repository and the lessons learnt in previous projects can be used as references to initiate and plan current ongoing and future projects of the company (Matheu & Casanova, 2005). However, there are many barriers in introducing a change to construction companies due to investment cost, time and effort for getting used to the new system. On the other hand, some employees may reluctant to change from the traditional system used due to fear of losing important data (Yatin et al., 2015).

Rajagopal (2018) had basically described the documents that need to be maintained to substantiate construction claims include bid documents, schedule data, project diaries, change orders, drawings and specifications, project correspondence (letters, emails, log notes etc.), costing related reports, employee pay roll related records and financial statements. Further, efficient and organized construction document management is critical to avoid costly mistakes, manage notes for review, avoid missing communications, and manage large volumes of digital images and providing the document visibility for clients. Also it has been highlighted that however much project

management software and web-based platforms are available to improve the controlling to store files, monitor the revisions and streamlining the reviewing process, human element is still involved with implementing document management best practices in the construction industry. Therefore, it has been suggested the following key points for effectively manage the construction projects: availability of written document management policy, making documents accessible to authorized users, creating an organized file structure, enabling tracking revisions, creating emails and notification alerts etc. Carrying out continuous monitoring and evaluation is required to ensure successful implementation of the document management system.

In general, project may include a lot of documents pertain to technical, contractual, administration, procurement etc. and find very difficult to manage them when it gets accumulated. Therefore, there should be a proper system in the project from the very beginning for managing these vast amount of documents efficiently. Currently, Electronic Document Management System (EDMS) provides the facility to manage the vast amount of project information for construction projects as well. The system will provide the facility to share the information and utilize in the form of knowledge base with various groups which comprises its function, document creation, storage and retrieval, management, version control, workflow and multiple delivery formats (Sathiadas & Wikramanayake, 2003). Further, a new model for document management in E-Governance etc., provides high security control to the EDMS. It will consider mapping of document security for the confidentiality, integrity, authenticity and traceability of the documents. When there is no access control of the document, it may lead to leak useful information to the outside parties who may use for harmful purposes (Kunis et al., 2007).

2.8 Team collaboration and barriers

Collaboration in construction project can be simply defined as the teams are working together towards one project goal. Then everybody has the understanding on main plans, goals of project at any time and what and how they should perform in order to achieve the project objectives. The project teams can be either internal or external team members in construction projects. Team collaboration among team members like client, architect, consultant, general contractor and other key stake holders is considered to be external which contribute to successful delivery of construction projects. Also this concept is becoming more popular in the industry today as the concept called

Integrating Project Delivery (IPD) for addressing the lasting issues such as impending delays, astonishing cost implications and environmental impacts from end result of current industry practice. In addition, there are many software applications for Integrated Project Collaboration among owner team, design team and construction team to reach the end results with minimum delays, lower costs and higher quality level (Ostanik, 2010). One of the major issue faced during implementation of integrated project delivery concept is that it does not directly support the usual type of contract administration procedures and guide lines. Based on the outputs of previous studies, there is a positive relationship between the project performance and the work collaboration in construction projects (Lofgren and Eriksson, 2007). Out of many objectives under collaborative working agreements, main focus is given to create an environment to the key stakeholders to work together to achieve one common goal. It should be understood by the team members to share the equitable benefits as well as to share the pain of the project. Similarly, team members should be trustworthy and open minded to make the objectives to be successful. Therefore, the team should always be encouraged to pay attention to best solution to the project (Weaver, 2010).

However, most of them believe that collaboration is also similar to the communication. But, there is a clear difference between the communication and the collaboration. Communication always considers to share the knowledge, while collaboration focuses to utilize and create something out of it. It is expected that construction manager should act as a focal point to get maximum benefit from the work collaboration and the team members should be guided to maintain the trust and respect for all stakeholders for their expertise and experience (Stonemarkcm, 2019).

According to Lewis (2019), there are many components in effective team collaboration. Having strong communication system among the team members, setting up transparent dialogue among the team, keeping the team members interested and engaged with collaboration, preparation to compromise during team disagreements, implementing strategies for managing conflicts, holding the accountability of goals, availability of diverse team. Then, the discussions with industry expertise who have similar project experience would lead to share the knowledge and experience to support with current project. However, company culture should be adjusted to get these assistance to the project requirements. Also there may be restraints from seniors of the organization for implementing these methods and techniques.

Angeline (2010) highlighted the importance of managing the generational diversity at workplaces by identifying their expectations and different perceptions to avoid being a barrier to effective team collaboration.

There are considerable stakeholder engagement and high interdependency, construction projects are more complex compared with other agencies. Most of construction projects may undergo delays, when problems and issues were not identified early stage by communicating with right people and take decisions collectively. Collaborative planning approach is structured by combining the concepts of lean construction and best practices in project management for efficient planning the processes in construction. Therefore, Involvement of collaborative planning approach would increase the efficiency of the current system and reduce the stresses of people who engaged with the process. Also this approach will facilitate people to focus on proactively on project management activities required to complete the work (Jacob, 2018).

Information and communication technologies have become today one of key factor that enhanced the effective team collaboration. Appointing a focal point for collaboration, building up distributed vision assigning the teams' roles and responsibilities and acceptance to procedures and standards were taken into consideration in developing a decision making frame work under effective work collaboration. Also it is an essential parameter to identify right people who fit with other members to make the process more successful (Shelbourn et al., 2007). According to Assbeihat (2016), the team collaboration increases the performance of the team. When the team do not work together, the expected outcome cannot be achieved. Out of many factors on barriers to the team collaboration, the equality between each team members have become one of the significant characteristic under the social perspective. When there are distinctions of power and status based on qualifications and experience would discourage and unsupportive to the mutual working arrangement in the internal system. The team performance may reduce due to work stress, overload and the fatigue (Ellis, 2017). The construction team members work in very tight schedule environment to meet the project objectives. Therefore, development of stress and fatigue among the team members could be cumbersome to the internal collaboration process. Implementing team building activities and developing the required facilities would need a strong commitment and support of the company by identifying the significance and importance of the

sustainability of internal team collaboration process. This may happen due to limitation of the budget in projects during implementation as well (Fapohunda, 2013). Also collaborative based human resource management practices have been identified more effective and suitable for organizations rather than continuing only the traditional human resource management policies and procedures implemented at the initiation stage. Therefore, Moving to strategic human resource management from traditional system would give better outcome to the development of the industry (Hong et al., 2019). The study conducted by Holtzman & Anderberg (2011) have identified the issue of senior manager's reluctance to change from traditional system to a new system with technological advancement. This would greatly impact to the sustainability of the organization and improving the productivity. In addition, communication technology barriers and break downs would also impact on internal collaboration within the team members (Wikforss & Löfgren, 2007).

Team collaboration leads on high work performance of construction projects. Then, quality, cost and time are the three main dependent variables while work collaboration automatically acts as independent variable (Lofgren & Eriksson, 2010). The contractual relationship between the parties to the project can be enhanced by sharing the knowledge and information within the team members. Out of many factors that lead to preparedness on collaboration, team work inspiration, assigning the team members of same race, information sharing, completed project within schedule and quality criteria, enhancing the service quality are significant for the success of team collaboration in construction industry (Rahman et al., 2014). However, it should be ensured that all collaborative relationships among the key stakeholders are committed to achieve the end goals. Therefore, Clear understanding on the requirements and assigning the roles and responsibilities are significant in this regard. And also converging many ideas to come to a focus point may be difficult task in some situation with the team members (Akintoye & Main, 2006). When team members actively participate for the work collaboration at the implementation stage, it would provide the advantages of faster delivery and lesser money spent for site overheads. Additionally, team members learn from each other, resolve issues faster and efficient way. Team co-location generally enhance the team collaboration, since team members have facility to directly communicate each other engaged in executing the work. But the team co-locating is costly operation in comparison to the projects implemented in virtual means (Zenun et

al., 2007). Even though the cost of implementation for co-locating the staff is high for construction industry, the work performance would not be achievable as per the expectation. However, the cultural and geographical differences should be understood by the team members when remote operating with the team members for projects in virtual means (Morrison-Smith & Ruiz, 2020).

The project manager is generally responsible for integration of processes or rather putting all the pieces of the project together in order to get the project done faster, cheaper, and with fewer resources while meeting the project objectives. There are two distinct types of knowledge in the Manage project knowledge processes. Explicit knowledge which can be easily communicated through words and symbols and the tacit knowledge which includes emotion, experience and ability. This tacit knowledge sharing is very difficult since it is more difficult to communicate clearly. However the project manager is responsible for planning and developing an environment within a project that will support the sharing of tacit knowledge. This shall include the ways people do their work, their experiences and implementation of best practices and how they resolve problems encountered during execution. Therefore, team collaboration and sharing knowledge are key to successful projects. In this process, the project manager is responsible for managing both knowledge and information (Mulkahy, 2018). In project environments teams usually desire to work collaboratively with other team members of the project, but they tend to operate as individually expert work teams due to organizational procedures. Implementation of events such as social gathering after achieving the milestones would enhance and make strong the team collaboration process (Baiden et al., 2005).

2.9 Team collaboration enhancing methods and techniques

Sharing the file within the team members is a major requirement in performing the work tasks related to the job. This can be hard copy base or electronic soft copy base. With the evolution of the computer, electronic base documents were more popular and easy to handle. But, there were only few methods available earlier to share the files and it was done by means of external devices like floppy disks, compacted devices etc. However, the computer networking enabled the users to share the information within the group easily despite many security related issues. Setting up the home group base network system was very difficult and tedious task. However, internet facility based

file sharing have become more popular now and been widely used. Among many techniques, nearby sharing with latest operating systems, transferring files by email and via cloud, using File Transfer Protocol (FTP) client/server software and transferring between windows 10 computers are some of the latest techniques (Dube, 2019). Similarly, applications like SharePoint, Google Drive, Dropbox and High Tail would offer a convenient way to access the files up to date from anywhere. However, team collaboration software tools can be used to increase efficiency of team collaboration. Software applications are currently available for video conferencing, chatting platforms, scheduling systems etc. Microsoft, Slack, Trello, Zendesk, Dropbox and Skype are some of the popular team collaboration software available in the current market (Ravenscraft, 2019).

Most of them prefer to use social media applications today irrespective of gender and age groups with current technology development in mobile smart phones. Therefore, most popular applications like whatsapp, viber, facebook, twitter etc., can be used to share the details and information in faster manner within the team (Eid & Al-Jabri, 2016). Cloud or web based document management systems can be used for proper document handling and management in the industry (Yates & Paquette, 2010). Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc., is very useful to carry on the team collaboration to any industry in remote operation as well as pandemic or epidemic situation (Hu et al, 2020)

Many organizations have moved to Enterprise Resource Planning (ERP) in order to integrate organizational-wide information systems. This can link entire organization's operations such as accounting, finance, human resources, manufacturing and distribution. Therefore, it facilitates to enhance the team collaboration after introducing to the organization's information technology system successfully (Ahmed, 2003). In addition to applying tools and techniques, incentives program can be implemented within the project or the organization to motivate the teams based on their target achievement. This will enhance the motivation and increase the performance (Milne, 2007). When selecting the team members, it must be ensured that they possess positive attitudes towards the project or organizational objectives (Kozlowski & Ilgen, 2006). Continuous implementation of training and development events or activities is required to maintain the work performance as well as the team collaboration (Karim et al., 2019). Executing social gathering and team building activities would lead towards effective

team building in the workplace (Fapohunda, 2013). According to Manca et al. (2018), the physical environment must be aligned to a supportive organizational job culture in order to enable new supporting ways or working in the organization as a team. Therefore, the physical environment, technologies and work practices mainly get involved with this to form collaborative work places. The team leader should possess the interpersonal skills in communication, trust building, creative problem solving, leadership, decision making and conflict management for successful collaborative team efforts (Thousand and Villa, 1992). Developing the team members through continuous performance evaluation, promoting and appraising members is required for continuous engagement of team performance. However, performance appraisal, feedback is accepted as a comprehensive management process. Salary and the promotion is another dimension determined through team performance. Therefore, Team based performance appraisal systems scale development process is preferred to carryout to get desired output from the team members (Karabat et al., 2013).

2.10 Chapter summary

This chapter has provided comprehensive details of the literature survey from basics to the specific area that would be considered for the study. Studying the previous basic studies in the research area was useful to identify the research gap for the study, then the research area was explored further in order to collect the detailed data and information. Also different approaches, practices and new concepts available in the construction industry to overcome the issues pertain to the research problem has been discussed in this chapter. In addition, literature survey has elaborated the barriers to the researcher's proposed concept and also the tools and techniques available in the current market to make this process succeeded. Basically, the chapter covers all the literature survey conducted by the researcher to reach to the final deliverables of the research.

CHAPTER 3

METHODOLOGY OF STUDY

3.1 Introduction

This chapter covers the full description of research methodology that has been followed by the researcher for implementing the study. This comprises of framework of the research strategy, research method and processes, research approach, data collection method, selection of sample, type of data analysis, ethical considerations and the research limitations of the study.

The research methodology generally streamlines the route map of the researcher that needs to be followed in conducting the research from identification of research problem up to the point of presenting the results achieved during the study period (Sileyew, 2019). There are many significant points in between these two that researcher will pass through based on guidance of methodology of study. Therefore, the researcher needs to formulate a specific strategy for the research methodology in order to reach the research objectives based on the problem identification. However, this research has referred the methodologies followed by different researchers in the previous studies as a knowledge repository. These knowledge areas can be utilized to incorporate in finding the most appropriate solution to the methodology of study that needs to be followed.

3.2 Research frame work design

The researcher should design an appropriate framework so that he can determine the way of obtaining relevant information for the study area (Sileyew, 2019). A flowchart was developed to guide the research methods and processes that needs to be followed at various stages for successful implementation as shown in Fig.1.1. It has shown many interrelated decisions that should be chosen at prior and post stage to the relevant process. A conceptual framework designed at the initial stage can be further developed exploring the study area when and where required by the researcher when it is in progress. Similarly, flowchart can give overall image of the process at glance to the observer for quick understanding, and also enhance the communicating the logic of the proposed process. It may require to redraw the whole diagram when alteration to the process is needed.

3.3 Research method and processes

Research is identified as investigations done in a systematic way to identify or address for a particular problem. Generally, qualitative research deals with words & meanings and discover views and experience in depth whereas quantitative research plays with numbers & statistics and test a hypothesis by collecting and analyzing the data systematically (McLeod, 2017). The comparison of qualitative and quantitative research is shown in Table 3.1. Also Qualitative research looks into local knowledge and understanding based on peoples' experience and interactions. Accordingly, Qualitative research technique is to be followed for this study to investigate the facts of ideas and experiences collected from the initial investigation. Qualitative data can be comprised of either peoples' written or spoken words which are collected through individual interviews, questionnaires, focus group discussions etc. (Celano, 2016).

Table 3.1: Key differences between qualitative and quantitative research

Source : Save the Children (Monitoring, Evaluation, Accountability and Learning (MEAL) 6 Methods of data collection and analysis

	Qualitative research	Quantitative research
Type of knowledge	Subjective	Objective
Aim	Exploratory and observational Flexible	Generalisable and testing Fixed and controlled
Characteristics	Contextual portrayal Dynamic, continuous view of change	Independent and dependent variables Pre- and post-measurement of change
Sampling	Purposeful	Random
Data collection	Semi-structured or unstructured	Structured
Nature of data	Narratives, quotations, descriptions Value uniqueness, particularity	Numbers, statistics Replication
Analysis	Thematic	Statistical

Primary data collection for designing the questionnaire survey was done under three approaches; literature review, expertise ideas and researcher's construction experience. The data collected from these three techniques were utilized to formulate the research questions in the questionnaire form depending on the research objectives. Questionnaire survey would be conducted to check the validity of the findings obtained from the preliminary survey.

3.3.1 Collection of expertise ideas/views

Industry expertise views and ideas were gathered by means of telephone conversations and face to face meetings during this period. Though holding face to face meeting were difficult due to the Covid-19 pandemic situation, telephone conversations were very successful and could share many ideas and thoughts to the research area. There were eight industry expertise who shared useful information specializing in different construction sectors. All of the selected expertise have been actively getting involved with major construction projects in Sri Lanka and overseas at managerial or director level representing client and contractor organizations. The details of collection of expertise ideas/views on construction delay management is given in Apendix-4 for reference. These preliminary data and information were helpful to identify and validate the research problem. In addition, some of the attributes required to formulate the questionnaire survey was incorporated based on the views, ideas and suggestions of the expertise.

3.3.2 Carrying out Literature survey

Literature survey was further conducted to explore the study area to identify the best practices under four dimensions concerned in the research area, emerging tools & techniques and the concepts in order to incorporate with the research objectives. Most of the data gathered through previous research papers, text books and internet published documents.

3.3.3 Utilizing researcher's experience in the construction industry

In addition to above two techniques, the researcher has utilized and incorporated the experience in the construction industry to the research. More than twenty years of construction experience in different sectors under many local and international organizations were helpful to contribute in giving inputs to the research. This can be considered as a knowledge sharing with the construction industry practitioners through the study area. The details of researcher's construction experience is presented in Appendix-3 for reference.

3.3.4 Grouping of data received under these three techniques

The data and information collected through these three techniques were considered as following Table 3.2 to represent method of collecting or receiving the inputs to the study area.

Table 3.2: Method of data collection	
Expertise interview	Data type 1
Literature survey	Data type 2
Researcher's construction experience	Data type 3

3.3.5 Questionnaire form design

By using these three techniques or mixed approach, the researcher was able to identify the current trends, pending issues, suggestions and recommendations related to project delays in the current construction industry. These were incorporated in designing and formatting the Questionnaire form under the research.

The questionnaire form was developed to look into the validation of data collected from above methods. The structure of the Questionnaire form was comprised of four sections A,B,C and D for respondent's background, identification of best internal collaborative practices and its significance, evaluating current barriers to internal collaborative approaches based on different perceptions and identification of significant methods and techniques to enhance the internal collaboration (See Appendix-1). The brief summary of Questionnaire form is as follows:

Section A: Respondent Background; This section comprises background information of the respondent such as type of organization, capacity of the organization, sector, current project value, designation level, education level, experience in the industry and the highly specialized area.

Section B: Identification of best internal collaborative practices and its significance; this section is designed mainly for identifying the first objectives of the research. The respondent has given the freedom to tick the selection based on his response by using the following two Likert scales for Acceptance and the Frequency.

Acceptance criteria: 1- Strongly disagree, 2- Disagree, 3- Neutral, 4- Agree and 5- Strongly agree. And also the frequency criteria: 1- Never, 2- Rarely, 3- Sometimes, 4- Often and 5- Always.

There are twenty six internal team best practices proposed under Planning & scheduling, construction management, contract administration and document management based on the three approaches on data collection which were assed for acceptance and frequency of application during the Questionnaire survey.

Section C: Evaluating the current barriers to collaborative approaches; this section has been utilized to assess fifteen current barriers for internal collaboration that were found from the initial data collection. This section has used five scale Likert scale in order to make the selection to the respondent in terms of 1- Strongly agree, 2- Mildly agree, 3- Neither agree or disagree, 4- Mildly disagree and 5- Strongly disagree.

Section-D: Identification of methods and techniques to enhance the internal collaboration; this section has been separated to identify the third objective of the study. There are twelve proposed methods and techniques that were assessed during the questionnaire survey. However, the respondent was able to choose the selection based on five scale Likert scale based on the criteria variation; 1- Strongly disagree, 2- Disagree, 3- Neutral, 4- Agree and 5- Strongly agree. In addition, Section-D has been separated to identify the focal point for internal collaboration in the project out of key team members like Project Coordinator, Project manager, Construction manager, Planning manager, Contract manager.

3.3.6 Identifying the attributes to design the questionnaire form

The attributes which are contributing to the different sections of the questionnaire form were identified through three techniques described previously. These three techniques were categorized as data type 1, 2 and 3 separately. The contribution of three different data set to the questionnaire form is presented in Table 3.3 for Identifying different internal team best practices for delay management, Table 3.4 for Identifying different barriers to internal team collaboration and Table 3.5 for Identifying different methods and techniques to enhance internal team collaboration. These data would be validated through the questionnaire survey by identifying the significance of the attributes under four sections of the questionnaire form.

Table 3.3: Identifying different internal team best practices for delay management			
#	Proposed Internal team best practices for delay management	Type	Reference
A1.0	Under planning & scheduling		
A1.1	Identify the risks and constraints of the project to include with planning & scheduling, technical and contractual documents.	2	(PMBOK, 2017; Kesavan et al., 2015)
A1.2	Finalize the most suitable method of construction and required resources in compliance to technical and contractual requirement.	1	Based on expertise interview/ideas
A1.3	Select a familiar planning & scheduling software to all team members which can produce faster, accurate and contractual report requirement.	2	(Mosaic, 2007; Alotaibi et al., 2016)
A1.4	Select and assign the suitable resources (staff, workers, plant, machinery & equipment), with sufficient quantity and at right time to match with contractual and approved project documents.	2	(PMBOK, 2017; Mulcahy, 2018)
A1.5	Organize discussions with industry expertise who have similar project experience and review the lessons learnt documents of previous similar projects of the company.	2	(Matheu & Casanova, 2005; Lewis, 2019)
A1.6	Prepare the detailed internal procurement schedule to ensure meeting of time targets and comply with contractual requirements.	2	(Tanubrata & Gunawan, 2018)
A1.7	Finalize project Quality Health Safety & Environmental (QHSE) policies and procedures aligned with organizational needs and comply with contractual requirements.	2	(Loushine et al., 2006; Salvi & Kerkar, 2020)
A1.8	Select most suitable modes and means of project communication system which is convenient and non-disruptive.	2	(PMBOK, 2017)
A2.0	Under construction management		
A2.1	Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hands.	3	Based on researcher's construction experience
A2.2	Conduct regular meetings and discussions for sharing resources within the team, aware them about time targets, and discuss solutions for pending issues.	2	(Ludwig, 2018)

A2.3	Ensure to follow the approved QHSE policies and procedures to avoid rework and prevent site accidents.	2	(Loushine et al., 2006; Salvi & Kerkar, 2020)
A2.4	Coordinate with supportive services (purchasing and logistic etc.) to ensure timely receiving of goods and services as per internal procurement schedule.	3	Based on researcher's construction experience
A2.5	Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers.	2	(Frimpong et al., 2003)
A2.6	Organize events to share the challenges, experience and knowledge gained by the team members after completion of milestones.	2	(Baiden et al., 2005)
A3.0	Under contract administration/delay claim management		
A3.1	Produce claim notices on time and submit comprehensive delay claims by following the correct contractual procedure.	2	(Ramachandra et al., 2014)
A3.2	Educate the team members to enhance the correct record keeping and reporting requirement in order to substantiate the claims.	2	(Tan, 2010; Ramachandra et al., 2014)
A3.3	Develop a delay claim tracking system for easy monitoring purpose until closing the matter.	2	(Ali et al., 2018)
A3.4	Maintain the full control of handling Change orders through contract administration team.	2	(Yadeta, 2017)
A3.5	Get expertise ideas and/or refer lessons learnt from previous projects to incorporate with addressing delay claim issues.	1	Based on expertise interview/ideas
A3.6	Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties.	2	(Ramachandra et al., 2014; FIDIC-1999)
A4.0	Under document management		
A4.1	Implement a convenient method of handling and managing the project documents (hard copies /digital copies) to ensure the well organize, fast access and security control.	2	(Sathidas & Wikramanayake, 2003)
A4.2	Conduct awareness and training programs on proper document handling procedures for storing, sharing, and retrieval and securing data.	1&3	Based on expertise interview/ideas and researcher's construction experience

A4.3	Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system.	2	(Rajagopal, 2018)
A4.4	Depute a focal point for full control of the document and the documents management system of the project.	2	(Yatin et al., 2015)
A4.5	Provide access control mechanism based on authority levels to avoid transparency of important documents.	2	(Kunis et al., 2007)
A4.6	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	2	(Sathiadas & Wikramanayake, 2003)

The following Table 3.4 shows different barriers to internal team collaboration identified for the study:

Table 3.4: Identifying different barriers to internal team collaboration			
#	Current barriers to internal team collaboration	Type	Reference
B1	Culture and politics of the organization	2	(Lewis , 2019)
B2	Generational diversity	2	(Angeline, 2010)
B3	Differences of individuals' professional qualifications and experience	2	(Assbeihat, 2016)
B4	Stress and fatigue due to tight schedules and work overload	2	(Ellis, 2017)
B5	Company's reluctance to spend on team building activities and related facility development	2	(Fapohunda, 2013)
B6	Companies' traditional human resources management policies and procedures	2	(Hong et al., 2019)
B7	Restraints from the field officers due to challenges in working environment	3	Based on expertise interview/ideas
B8	Senior officers' reluctance to diversify from the traditional working system	2	(Holtzman & Anderberg, 2011)
B9	Project budget limitations on IT tools and techniques required for collaboration	2	(Fapohunda, 2013)
B10	Difficulties in converging many ideas to reach conclusions	2	(Akintoye & Main, 2006)
B11	Cost implications for co-locating of teams	2	(Zenun et al., 2007)

B12	Communication technology barriers and breakdowns.	2	(Wikforss & Löfgren, 2007)
B13	Restrictions imposed during pandemic or epidemic situation etc., by the government and health services.	2	(WHO /CIDA Guide lines, 2020)
B14	Cultural and geographical differences during remote team operation	2	(Morrison-Smith & Ruiz, 2020)
B15	Individuals' personnel conflicts	2	(PMBOK, 2017)

Similarly, following table shows the different methods and techniques to enhance internal team collaboration for the study:

Table 3.5: Identifying different methods and techniques to enhance internal team collaboration

#	Methods and techniques to enhance internal team collaboration	Type	Reference
C1	Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail.	2	(Dube, 2019; Ravenscraft, 2019)
C2	Promote forming different internal team groups through social media such as whatsapp, viber, facebook, twitter etc. for sharing details and information at faster.	2	(Eid & Al-Jabri, 2016)
C3	Usage of web or cloud based document management system for proper document handling and knowledge sharing.	2	(Yates & Paquette, 2010)
C4	Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.	2	(Hu et al, 2020)
C5	Implementation of Enterprise Resource Planning (ERP) system by integrating all the key functions related to the construction process.	2	(Ahmed, 2003)
C6	Introduce incentives program to motivate the teams based on target achievement	2	(Milne, 2007)
C7	Select team members who possess positive attitudes	2	(Kozlowski & Ilgen, 2006)
C8	Continuous implementation of training and development events or activities.	2	(Karim et al., 2019)
C9	Changing the workplace and/or job site culture	2	Manca et al. (2018)

C10	Appointing a focal point having strong interpersonal skills	2	Thousand,J. and Villa,R. (1992)
C11	Execute social gathering and team building activities	2	(Fapohunda, 2013)
C12	Develop the team members through continuous performance evaluation, promoting and appraising members.	2	(Karabat et al., 2013).

3.4 Questionnaire survey

However, carrying out the questionnaire survey is one of the most popular data collection technique due to the fact that data collection can be administered through post, hand delivery, emails, telephone or online. Out of many advantages available in the questionnaire survey, following are some of the major advantages; researcher has the opportunity to carefully structure and formulate the data collection plan, respondents are free to answer at convenient time and think about the answers at their own pace and the questionnaire can be circulated every corner of the globe. But the major disadvantages of questionnaire survey are as follows; it might include dishonest answers, respondents may have skipped some questions, interpretation issues, accessibility issues and survey fatigue etc. In addition, there are many limitations and constraints that need to be considered when using different media for questionnaire surveys which could discourage the respondents or impacts on reliability of the responses. It is always advisable to carry out a pilot survey of the questionnaire before performing the actual survey with target groups, since questionnaire survey offers only one chance to collect data from the respondents and no any other additional information can be recalled afterwards. Therefore, the questionnaire should be designed in order to meet with the research objectives considering the type of data to be collected and how the data to be analyzed during this process.

3.4.1 Sample size and data collection technique

The study population comprises of all the industry practitioners who involve in large scale construction projects representing client/consultant and contractor organizations under planning and scheduling, construction management, contract administration and document management. However, when we identify the participants, the researcher should ensure that they have experienced in the particular issue, and have particular knowledge or expertise regarding the study area (Celano, 2016). Specially, the target group was selected from industry practitioners; engineers, managers and directors

representing both contractor and client/consultant parties of construction industry who are currently engaged mainly with planning & scheduling, construction management, contract administration and document management process. Also special attention was given to those who have been working with large scale construction projects. The random sample was selected in such a way that it represented 50% of contractors and balance 50% from client/ consultants.

Similarly, Questionnaire forms were distributed through e-mails and hand delivered among the target group. However, some responded very fast and others were reminded several times over telephone calls and e-mails to expedite for receiving the responses. Though the questionnaire forms were distributed among eighty (80) individuals of target group, there were only sixty five successful responses that could be utilized for the analysis. Out of sixty five successful responses, 31 of contractor responses and 34 of client/consultant responses were available to the study. The researcher had given top priority to collect the data through emails due to issues pertaining to Covid-19 pandemic situation.

The researcher had developed a simple word format questionnaire sheet in Microsoft word format which included simple check boxes for selecting the respondent's choices (See Appendix-1). The respondents could make it converted into PDF format after filling it and send back to the researcher. Even though this method facilitates the respondent to easily answer to the research questions in the form, few participants had not answered to all questions or skip some questions. However, Electronic online surveys generally do not allow the participants to skip questions or move to the subsequent section without responding all the questions in the relevant section (Hammer, 2017). But, participants are sometimes discouraged overspending time for repeating the sections and then give up responding to the questionnaire form.

Pilot survey was conducted with ten participants to ensure the validity of the questionnaire and response time before circulating among the target group. Many revisions of the questionnaire form was done before circulating among the target group in order to make an attractive shape for obtaining reliable and accurate data within limited time, expected to the research. All the data collected from the successful respondents were tabulated and summarized in an Excel sheet to refer during the data analysis. Though Face to face meetings give better results for collecting the data and

information required for designing the Questionnaire form, it was difficult to achieve the target due to the Covid-19 Pandemic restrictions and risks of the country for social interactions. In general, the telephone conversation and video conferencing through internet are fastest and easy way of handling the expertise who are in faraway places, difficulties such as getting a time slot from expertise with their busy schedules and keeping them on track for the telephone conversation considerable period to get their ideas/opinions were identified as some of the tedious tasks during the study. All the key points gathered from the interview were recorded to incorporate with the questionnaire form.

3.4.2 Ethical consideration

Since the research has been conducted based on questionnaire survey through internet data collection and paper based hand delivery, the ethical consideration was a paramount important factor during the study. When the questionnaire is forwarded to the participant, it shall include the covering letter explaining the purpose of study and the researcher's general details and also the institution or the organization referred to. It is very important to consider the fact that expectations, awareness and views about privacy of the respondents. Also it should be ensured that respondents consent is received, knowledgeable and no unauthorized person is able to access the data (Gupta, 2017). The researcher should get the consent of the participant for discussions and get a prior appointment to meet and discuss the matters pertain to research area. Also it is worthwhile to inform him the time required for the discussion so that he is able to plan and schedule his other activities. Also the researcher needs to stick to the time frame allocated for the discussion. The researcher needs to thank the participant for giving him the opportunity to collect the data required or answering to the questionnaire form etc. However, it is required to obtain the ethical clearance in order to collect required information from government organizations and other private organizations depending on the type of data collected in the study. Also the researcher has maintained the ethics on plagiarism during the extraction of data from previous research publications.

3.5 Data Analysis technique

Qualitative data analysis produces to interpret a meaningful and communicative outcomes by following a systematic process. This can be carried out at any stage during collection of data, after collecting data or while collecting the data simultaneously.

Therefore, it can be seen that there is a dynamic and evolving nature for qualitative data analysis (Harding & Whitehead, 2013). There are industry specific approaches for data analysis like grounded theory and framework analysis. There are many approaches for qualitative data analysis. Grounded theory and framework analysis are some of the techniques being increasingly used in health related researches. Data shall be transcript, organized, familiarized and coded before conducting the data analysis process. There are many data analysis software available in the market which can be used to analyze the qualitative data (Lacey & Luff, 2001).

Further, there are many data analysis techniques available with previous researchers that can be adopted in order to utilize for analyzing the qualitative data gathered from the survey. The study conducted by Assaf & Al-Hejji (2005) had analyzed the data by using statistical techniques and indices. Frequency index (F.I) was used to rank the causes of delay based on frequency of occurrence as identified by respondents. Similarly, Severity index (S.I) was used in order to find rank causes of delay based on severity and the Importance index (IMP.I) as a function of both frequency and severity indices. In addition, the researcher had used Spearman's rank correlation in order to measure and compare the association between the rankings of the two parties for a single cause of delay. Similarly, another study conducted by Sweis et al. (2007), the respective average score of the reported data for all respondents were ranked in descending order in order to identify the significant causes of delays. Relative Importance Index (RII) and Overall Importance Index (ORII) were used for giving the ranks for delay factors during the analysis (Aziz, 2013). The study conducted by Kometa et al. (1994) also adopted the same technique in order to analyze the data by using Relative Importance Index (RII). Further, Spearman's rank correlation was used to measure the relationship among different parties or factors and strength and direction of relationship. Similarly, Samrah & Bekr (2016) had followed to calculate Importance index (I.I) by means of frequency index (F.I) and the Severity index (S.I). Similarly, the study done by Aydin (2018) conducted face to face meetings for the collection of data with thirty four participants. Relative importance index was used in order to evaluate the results obtained from the survey. Moreover, the studies conducted by Dolage & Rathnamali (2013), Pathiranage & Halwatura (2010) and Perera & Halwathura (2012) had also followed the same method of analysis during those particular studies.

3.5.1 Severity Index (SE.I)

The following formula could be used for computing the severity index for each responses.

$$\text{Severity index (SE.I)} = \sum a_n / (A \times N) \times 100$$

Where a is the constant expressing weighting given to each response, n is the frequency of responses, A represents highest weight and N is the sample size considered.

Similarly, Relative Importance Index (RII) also could be considered to compute the importance of each factors by using following equation similar to severity index (Perera et al, 2016).

$$\text{Relative importance index RII} = \sum a_n / (A \times N)$$

3.5.2 Frequency Index (F.I)

$$\text{Frequency Index (F.I)} = \sum a_n / (A \times N) \times 100$$

Where a is the constant expressing weighting given to each response, n is the frequency of responses, A represents highest weight and N is the sample size considered.

3.5.3 Importance index (IMPI)

The importance index for each cause could be calculated by using the following formula.

$$(\text{IMPI}) = (\text{SE.I}) \times (\text{F.I})$$

In analyzing the data, the responses of Client and consultant were grouped into one category considering their key responsibilities are similar with respect to administering the Contracts and Contractor responses were considered as separate category. The Overall responses were based on the total of these two categories.

3.6 Chapter summary

This chapter comprises of the extensive details of methods and techniques followed by the researcher based on the conceptual framework designed in terms of a flow diagram. Further, researcher's pathway to carry out the study which includes different approaches, selection of sample, data collection techniques, design of questionnaire form and the ethical considerations. Moreover, the chapter has given the basis for selection and the data analysis technique followed during the study.

CHAPTER 4

ANALYSIS & DISCUSSION OF RESULTS

4.1 Introduction

There are four main objectives of this research as given below:

- To identify the best internal collaborative practices for the performance of construction delay management.
- To identify current barriers to internal collaborative approaches.
- To find out how to enhance the internal team collaboration.
- To identify the focal point in the project for implementing internal team collaboration

The Questionnaire survey was carried out with the participation of sixty five successful respondents. It represented thirty four from client/consultant organizations and thirty one from contractor organizations. The target group was selected from industry practitioners who possess thorough knowledge and experience in the subject areas of planning & scheduling, construction management, delay claim management and document management in order to gather required data for the analysis. Simple data analysis technique was performed for the Section-A of the Questionnaire while comprehensive analysis was done for Sections B, C and D based on analysis technique discussed under Chapter 3 in order to meet the objectives of the research.

4.2 Data Analysis

4.2.1 Demographic analysis

The questionnaire was distributed among the total of eighty industry practitioners representing the groups of planning & scheduling, construction management, contract administration and document management of the two parties concerned for the study in order to receive the considerable responses for the analysis. The survey was carried out over the period from 20th of October 2020 to 31st May 2021. Following Table 4.1 shows the response rate of the participants based on method of distributing the questionnaire form.

Out of eighty total distribution among the Client/consultant and contractor groups, there were total of seventy responses received through email and hand delivery. However, it could be seen that there were sixty five successful responses out of eighty total

distribution which is about 81.25% response rate. The successful responses were comprised of thirty four responses representing from client/consultant groups and thirty one representing contractor groups. These details are tabulated in following Table 4.1 for reference.

Table 4.1: Response rate of target groups									
	Client/consultant			Contractor			Total		
	Email	Hand delivery	Total	Email	Hand delivery	Total	Email	Hand delivery	Total
Total distribution	30	10	40	31	9	40	61	19	80
No. of Respondents	28	8	36	28	6	34	56	14	70
Successful responses	27	7	34 (85%)	26	5	31 (77.5%)	53	12	65 (81.25%)

When the education level of the respondents were analyzed, it could be identified that most of the respondents are having postgraduate, degree or diploma qualifications to both participants who represented client/consultant and contractor organizations. There are 46% of participants who have degree qualifications while 42% possess postgraduate and 12% possess diploma qualifications. The summary of qualification details is shown in Fig. 4.1.

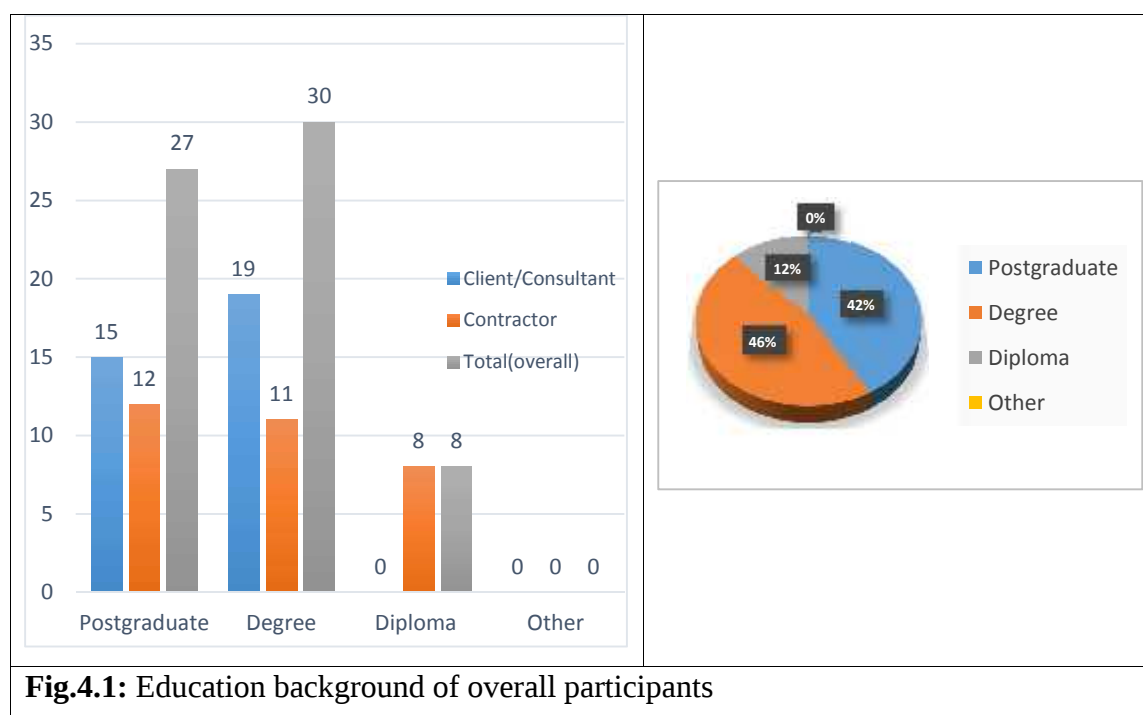


Fig.4.1: Education background of overall participants

However, majority of the participants were having the experience in construction industry experience between 11-20 years. 52% of the participants were having experience between 5-10 years and 21-30 years. Only 9% participants were having more than 30 years of experience in the construction industry. The details of participants' experience in construction industry is shown below (Fig. 4.2).

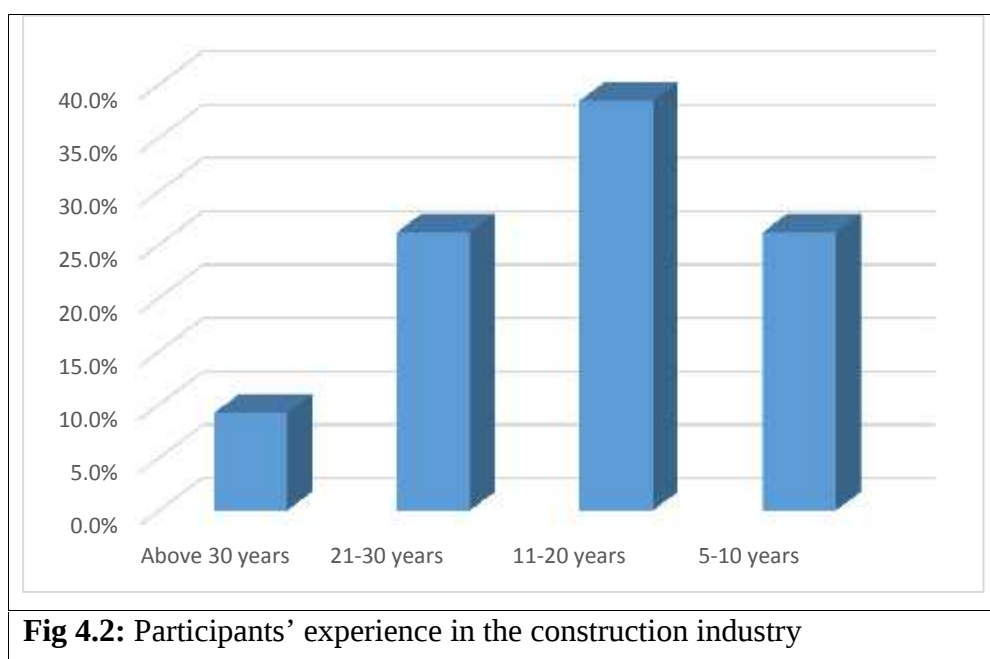


Fig 4.2: Participants' experience in the construction industry

Further, most of these participants are in the capacity of engineer, managerial or director level of the organization. The respondents' designations in the organization is shown in Table 4.2.

Designation	Client/Consultant		Contractor		Overall	
	Total	%	Total	%	Total	%
Director and above	1	2.9%	3	9.7%	4	6.15%
Managerial	15	44.1%	7	22.6%	22	33.8%
Engineer	17	50.0%	13	41.9%	30	46.10%
Other	1	2.9%	8	25.8%	9	13.8%

In terms of project value that participants are currently engaged with, all most all participants are being contributed to the major construction projects currently being implemented in Sri Lanka. Also it shall be noted that these participants have variety of specialization in the construction industry such as buildings, roads, irrigation, water supply and sewerage etc. These are summarized under Table 4.3.

Table 4.3: Summary of respondents' education level, designation and the experience						
Value of currently engaged project	Client/Consultant		Contractor		Overall	
	Total	%	Total	%	Total	%
Less than Rs. 1 Billion	2	5.9%	3	9.7%	5	7.7%
Between Rs. 1-5 Billion	12	35.3%	7	22.6%	19	29.2%
Between Rs. 5-10Billion	13	38.2%	13	41.9%	26	40.0%
Above Rs. 10 Billion	7	20.6%	8	25.8%	15	23.1%

Therefore, considering the fact that participants' educational level and the experience in the construction industry, it is clearly visible that these participants possess not only the procedural knowledge comes from the educational background but also the tacit knowledge which would gain from experience in the industry.

4.2.2 Analysis of best internal collaboration practices

Section-B of the questionnaire form is entirely separated for identifying the best internal collaboration practices and its significance during the analysis under four main dimensions namely; planning & scheduling, construction management, contract administration and document management of construction projects. Responses were obtained for both acceptance criteria and frequency of applicability. Based on the data collected from the questionnaire survey, Severity Index (SE.I) and Frequency Index (F.I) were calculated for both input criteria. All the best practices were ranked based on the values of Significance Index (SI.I) which was calculated by using equation as a function of Severity Index (SE.I) and Frequency Index (F.I) in the above section. This process was done separately to the three perspectives; client/ consultant, contractor and the overall based on the data obtained through the questionnaire survey.

4.2.2.1 Analysis on client /consultant perspective

The data obtained from questionnaire survey was analyzed from the perspective of client/consultant and these results are tabulated as shown in Table 4.4 of Appendix-1 based on the weightage given for acceptance criteria and the frequency of applicability criteria, Severity index (SE.I) and the Frequency index (F.I) were calculated in order to derive the Significance index (SI.I). All the proposed best internal collaborative practices were ranked in descending order based on the values obtained from calculations for Significance index.

Accordingly the following order of top ten significance of the internal collaboration practices from Client/consultants' perspective were identified as tabulated in Table 4.5.

Table 4.5: Top ten significance practices of internal team collaboration from client/consultants' perspective

SIIndex	Rank	Description of approach	#	Category
42.657	1	Get expertise ideas and/or refer lessons learnt from previous projects to incorporate with addressing delay claim issues.	A3.5	Contract administration
42.519	2	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management	A4.6	Document management
40.869	3	Ensure to follow the approved QHSE policies and procedures to avoid rework and prevent site accidents.	A2.3	Construction management
39.135	4	Identify the risks and constraints of the project to include with planning & scheduling, technical and contractual documents.	A1.1	Planning & scheduling
38.730	5	Conduct awareness and training programs on proper document handling procedures for storing, sharing, and retrieval and	A4.2	Document management
38.706	6	Develop a delay claim tracking system for easy monitoring purpose until closing the matter.	A3.3	Contract administration
38.671	7	Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system.	A4.3	Document management
38.671	7	Maintain the full control of handling Change orders through contract administration team.	A3.4	Contract administration
38.616	9	Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers.	A2.5	Construction management
38.304	10	Finalize the most suitable method of construction and required resources in compliance to technical and contractual requirement	A1.2	Planning & scheduling

Following six attributes have been identified as most significant contributing factors in descending order based on the results collected through the analysis: (1) Get expertise ideas and/or refer lessons learnt from previous projects to incorporate with addressing delay claim issues under contract administration, (2) Facilitate to share the knowledge

and information of previous projects and knowledge banks through document management system under document management, (3) Ensure to follow the approved QHSE policies and procedures to avoid rework and prevent site accidents under construction management, (4) Identify the risks and constraints of the project to include with planning & scheduling, technical and contractual documents under planning & scheduling, (5) Conduct awareness and training programs on proper document handling procedures for storing, sharing, and retrieval and securing data under document management, and (6) Develop a delay claim tracking system for easy monitoring purpose until closing the matter under contract administration. Therefore, implementation of these best internal team collaborative practices under four main categories will give highest results to enhance the construction delay management contractually during execution of projects from the perspective of client/consultant. Also these four main categories are found to be equally important in order to achieve the expected outcomes.

4.2.2.2 Analysis on contractor's perspective

Similar procedure was followed to get the results for analysis from the perspective of the contractor. The results obtained from the analysis were tabulated in Table 4.6 of Appendix-1. The top ten significance practices have been summarized in descending order in Table 4.7 for reference as given below.

Accordingly the following five attributes have been identified as the most significant best internal team collaborative practices that would contribute to enhance the construction delay management contractually: (1) Issue the latest approved documents and regular revisions of drawings etc., immediately to the field officers and get back the old version of documents from their hands which is under construction management, (2) Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties under contract administration, (3) Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system under document management, (4) Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers under construction management, (5) Select a familiar planning & scheduling software to all team members and (6) Carry out continuous monitoring and evaluation to ensure successful implementation of the

document management system under document management which can produce faster, accurate and contractual report requirement under planning & scheduling.

Table 4.7: Top ten significance practices of internal team collaboration from contractors' perspective

Sl. Index	Rank	Description of approach	#	Category
42.626	1	Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hands.	A2.1	Construction Management
42.622	2	Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties.	A3.6	Contract Administration
42.456	3	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	A4.6	Document Management
42.144	4	Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers.	A2.5	Construction Management
41.232	5	Select a familiar planning & scheduling software to all team members which can produce faster, accurate and contractual report requirement.	A1.3	Planning & Scheduling
40.774	6	Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system.	A4.3	Document Management
40.703	7	Implement a convenient method of handling and managing the project documents (hard copies / digital copies) to ensure the well organize, fast access and security control.	A4.1	Document Management
40.258	8	Designate a focal point for full control of the document and the documents management system of the project.	A4.4	Document Management
39.734	9	Coordinate with supportive services (purchasing and logistic etc.) to ensure timely receiving of goods and services as per internal procurement schedule.	A2.4	Construction Management
39.542	10	Organize events to share the challenges, experience and knowledge gained by the team members after completion of milestones.	A2.6	Construction Management

We can see both client/consultant and the contractor are in the opinion that facilitating the sharing of knowledge and information of previous projects and knowledge through document management system would play a significant role during execution stage for efficient management of construction project delays. Also the four main categories under planning & scheduling, construction management, document management and contract administration have been equally important and contributed for efficient management of construction project delays.

4.2.2.3 Analysis on overall perspective

The analysis conducted on overall perspective to rank the best internal collaborative practices are represented in Table 4.8 of Appendix-1 for reference. However, overall analysis shows that following are the most significant best internal team collaborative practices in the descending order: (1) Facilitate to share the knowledge and information

of previous projects and knowledge banks through document management system under document management, (2) Get expertise ideas and/or refer lessons learnt from previous projects to incorporate with addressing delay claim issues under contract administration, (3) Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers under construction management, (4) Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties under contract administration, (5) Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system under document management and (6) Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hand under construction management. These results are presented in Table 4.9 below for reference.

Table 4.9: Top ten significance practices of internal collaboration from overall perspective

Sl.Index	Rank	Description of approach	#	Category
42.498	1	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	A4.6	Document Management
40.704	2	Get expertise ideas and/or refer lessons learnt from previous projects to incorporate with addressing delay claim issues.	A3.5	Contract Administration
40.311	3	Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers.	A2.5	Construction Management
39.741	4	Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties.	A3.6	Contract Administration
39.551	5	Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system.	A4.3	Document Management
39.570	6	Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hands.	A2.1	Construction Management
39.771	7	Select a familiar planning & scheduling software to all team members which can produce faster, accurate and contractual report requirement.	A1.3	Planning & Scheduling
38.550	8	Conduct awareness and training programs on proper document handling procedures for storage, sharing, and retrieval and securing data.	A4.2	Document Management
38.593	9	Designate a focal point for full control of the document and the documents management system of the project.	A4.4	Document Management
38.550	10	Identify the risks and constraints of the project to include with planning & scheduling, technical and contractual documents.	A1.1	Planning & Scheduling

4.2.2.4 Comparison & Discussion of results obtained from the Analysis

When we compare the outcome of the analysis from the perspectives of Clients/consultant, contractor and overall separately, it could be identified that most of the significant practices are common under three perspectives. The summary of top ten significant practices for internal team collaboration have been tabulated in Table 4.10 below.

Table 4.10: Summary of top ten significance practices of internal collaboration from three perspectives

Client/consultants' perspective	{A1.1,A1.2,A2.3,A2.5,A3.3,A3.4,A3.5,A4.2,A4.3,A4.6}
Contractors' perspective	{A1.3,A2.1,A2.4,A2.5,A2.6,A3.5,A3.6,A4.1,A4.3,A4.4}
Overall perspective	{A1.1,A1.3,A2.1,A2.5,A3.5,A3.6,A4.2,A4.3,A4.4,A4.6}

Similarly, the contribution of the practices under Planning & scheduling, Construction management, Contract administration and the Document management from three perspectives are tabulated in Table 4.11.

Table 4.11: Summary of number of practices for three perspectives under four dimensions considered

	No. of Significant Practices				
	Client/ Consultant	Contractor	Overall	Total	%
Planning & scheduling related	2	1	2	5	16.7
Construction management related	2	4	2	8	26.7
Contract administration related	3	1	2	6	20.0
Document management related	3	4	4	11	36.6

This result is graphically represented in Fig4.3. Below

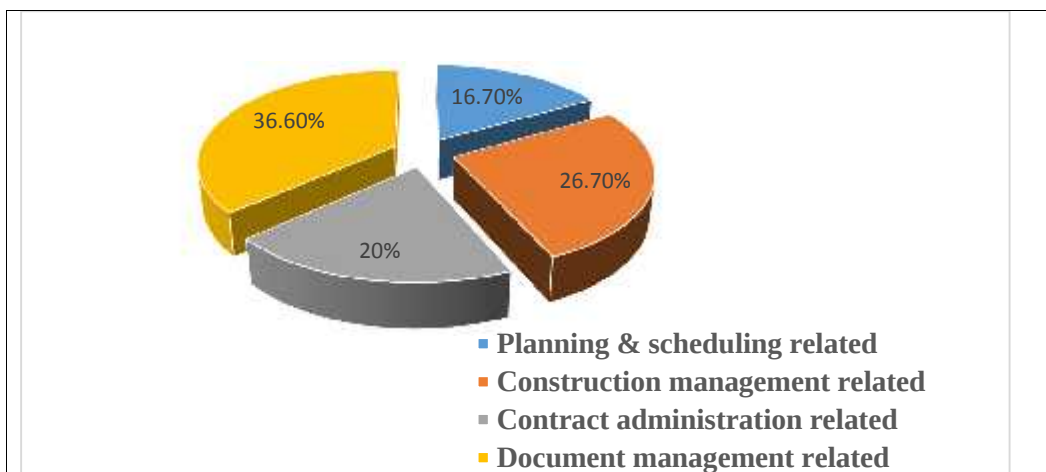
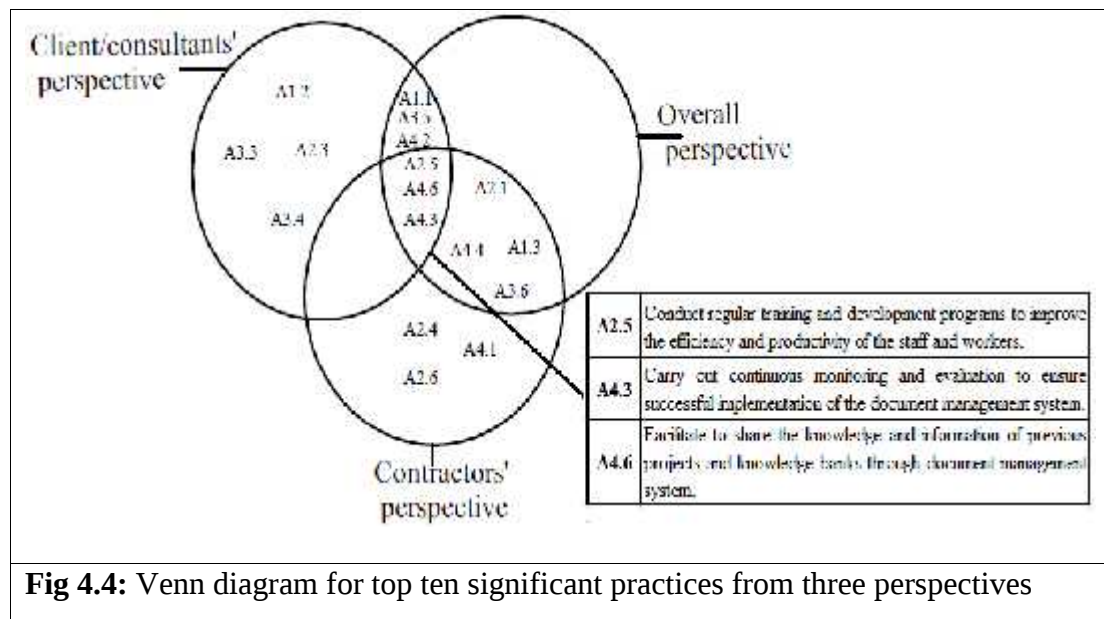


Fig.4.3: Graphical representation of significance of four dimensions considered in the research area for internal team collaboration process based on results of three perspectives

Accordingly, it is visible that best practices under four dimensions related to; Planning & scheduling, Construction management, Contract administration and Document management are equally important and contributed for Internal Team Collaboration process. However, high weightage could be seen for the Document management related best practices.

The Summary of top ten significant practices from three perspectives shown in the Table 4.10 is represented in a Venn diagram below Fig.4.4.



It can be seen the following sets related best practices A2.5, A4.3 and A4.6 have been intersected for three perspectives. Therefore, these three best practices are the most influential ones compared to the other as agreeable from the three perspectives. These three practices are discussed more elaborately in the next section.

However, the results obtained for contractors' perspective and overall perspective from the analysis are discussed below as these findings are the key factors that should be taken into consideration for efficient management of construction project delays.

(a) Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system: It is very essential fact that usage of previous knowledge repositories would be helpful to find many solutions for problems encountered to the ongoing projects during implementation

stage. Therefore, there should be a proper mechanism in the construction organizations to store and retrieve these information in a systematic manner so that these data and information can be recalled to find solutions for present or future problems of projects in the organization. Similarly, every project should maintain a lessons learnt document to record the cases and handover to the top management to recover in the knowledge base. Though the projects are unique in nature, it has been found that sharing the existing knowledge might give quickest and reliable inputs in order to substantiate the disputes arisen under contract administration etc. Therefore, all the construction companies should identify the value of maintaining a knowledge repository in the organization in order to protect them to the future activities. This can be achieved easily by means of current software packages available for document management etc.

(b) Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system: It is a known fact that construction projects handle large amounts of documents during every phases of the project in order to accomplish the expected objectives. These documents may be collected in the form of hardcopy base or electronic document base which need to be managed in a systematic manner from the very beginning to avoid creating complex situation with respect to the documents during middle and latter part of the project. Therefore, a systematic document management system would be helpful to manage these enormous quantity of documents for easier and quicker access whenever necessary. The efficient document management system has the facility to restrict and control the unauthorized access by others and secure the safety of stored documents. But it is believed that the expected outcomes would not be achieved with the traditional manual hardcopy management in construction projects due to collection of large numbers of documents to be handled. The effectiveness of the system will completely depend on how easily and quickly the team has accessed to the data securely. Therefore, most of the organizations nowadays use Electronic Document Management Systems (EDMS) for managing the documents electronically. However, it is very important to pay high attention on the continuous monitoring of the system to ensure successful implementation irrespective of organization use electronic or manual document management system. Finally,

successful document management system may eventually give direct input to the company's knowledge base or the project historical record repository.

- (c) Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers:** The team members should have a proper technical knowledge in all the areas related to construction process as well as adequate general knowledge in contract administration. Even though, the level of knowledge expected is different from team member to team member depending on the level of operation, everybody should have some sort of knowledge in these critical areas to early address most of the contractual issues. Also those who perform work on a particular specialized area should have all the required knowledge in the subject area and these knowledge should be updated time to time in order to meet complying with emerging technologies around the world. Therefore, these goals would be achieved by conducting regular training and development programs to the team members with the assistance of top management and allocating required funds. Though some construction companies have developed a separate section for training and development to facilitate providing the required services to the team members, some companies may reluctant to spend or allocate funds thinking it is a money wastage. Some of the projects implement such practices in order to reduce the cost of non-conformance during execution of projects.

In addition, the Contractors need to pay attention on the following practices despite its significance which are discussed below in order to implement the Internal Team Collaboration process efficiently.

- (d) Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hands** under construction management. This is a very crucial issue which commonly happen in any sector of construction projects during execution stage. When there is no proper document control system in the project, field officers rarely get the updated drawings and other documents on time and tend to follow the old versions for construction works. This might cause to do rework of some deliverables to comply with expectations of the employer during inspection for acceptance of deliverables. Also there can be a tendency of field officers to follow wrong version of document, when the old versions of documents were not recollected from them at the time of issuing the latest documents. In addition to this,

there should be a mechanism to transmit the documents to the filed on time and get the acknowledgments for receipt of such documents to avoid future withdrawal in disputes. This is very essential factor in road construction and pipe network construction projects, since the construction sites would be scattered everywhere and communication may be very difficult with the main project office during implementation. In this situation, some organizations follow the strategy to circulate or distribute the soft copy of the relevant document through emails and social media like WhatsApp, Viber etc., until they receive the hardcopy of the documents through regular transmission.

- (e) Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties:** Team members must be aware of the primary obligations of the contractors with respect to the delay management under contract administration. Whenever there is an identified or foreseeable delay event which would impact on schedule or cost of the project, it is the obligation of the contractor to aware the client about the impact and possible consequences to the project. Then the client has the opportunity to take necessary prior actions in order to avoid or mitigate the delays and can issue necessary instructions to the contractor to follow up. Also the contractor should have given necessary prior notifications and taken necessary precautionary or migratory actions to entitle for any event of claiming for such delay events. Therefore, the team members' awareness on the obligations are very crucial factor in order to satisfy these prerequisites with respect to the administration of construction project delays. Sometimes, Engineers and middle level managers of the team may have certain knowledge on contractual obligations with respect to the contract, but most of field officers in the capacity of technical officer, supervisor, work Forman etc., do not have such basic knowledge and therefore, they pay less attention and neglect some of the critical works which might lead to a disputes at the end of the project unknowingly. Therefore, it is the responsibility of higher level officers of the team who manage the projects to aware the field officers about the importance of paying high attention on such critical activities to avoid contractual implications during work execution. This is further related to the training and development to be given to the team members to enhance the basic knowledge related to the construction contracts.

(f) Get expertise ideas and/or refer lessons learnt from previous projects to incorporate with addressing delay claim issues: There are many circumstances where the resolution cannot be determined independently or the existing knowledge may not be sufficient in order to tackle the present situation with the available best approach. Then, expertise ideas and knowledge could be utilized to come up with a most preferable solution in such situations. Additionally, lessons learnt from previous projects also would be helpful to cater and simulate the current situation for resolution. Therefore, when the organization does not possess internal resources to get expertise knowledge, external outsourcing is the alternative solution available for gathering required knowledge temporarily to address the situation successfully. Most of the contractor organizations currently tend to get expertise services for special works as well as for contractor claims. If delay claim was not properly prepared as per the contract, it would be very difficult to substantiate the claim and get necessary contractual entitlements in relation to the contract administration.

(g) Select a familiar planning & scheduling software to all team members which can produce faster, accurate and contractual report requirement:

There are many planning & scheduling software packages available in the construction industry today which can produce required planning & scheduling documents to the project. The planning & scheduling software should have the capability to produce the more comprehensive reports in relation to the planning and scheduling process as well as reporting requirements of the projects. Similarly, the reports generated by the software would be helpful the team to monitor and control the project and identify future trends of the project constraints during execution stage. Also it should be ensured of reports generated are accurate and reliable based on the project information. Therefore, the planning and scheduling software must be familiar to everybody of the project team for easy usage and maintenance throughout the project period. Similarly, those who are not familiar with using the software application should be arranged training programs to the project team members.

(h) Conducting regular meetings and discussions for sharing resources within the team, aware them about time targets, and discuss solutions for pending issues has become one of the most significant best internal practice that should be

implemented in the project for construction delay management based on the overall analysis of the study. Generally, construction site meeting is one of the oldest as well as current way of managing construction problems and other pending issues pertain to the project. The effective site meetings have been identified as one of the sustainable construction management tool that can be adopted for enhancing the project success. Also most of the conflicts and disputes can be resolved and prevented through management of time using programme charts, checking costs and communicating problems at early stage in the site meetings. Further, complying quality of works to the company/project standards are checked, discussed and addressed for workmanship, materials etc., at the site meetings as well as to meet the contractual requirements of the project. In addition, it will ensure the adherence to the safety requirements or any lapses in safety matters and deployment of skilled and qualified workforce to the project activities. Moreover, the site meetings should be arranged in such a way that it would help to develop project team regarding the technical and financial issues pertain to construction activities (Ayodeji et al., 2016). Meetings should be held weekly to discuss and aware the project status, to provide any assistance required to the team members from supportive services, sharing of internal resources within the team members, and any burning issues that needs solutions (Ludwig, 2018). However, there should be a key person, mainly the project manager to conduct the meeting and minutes of meeting should be prepared and followed up for every meeting. In addition, establishment of ground and administrative rules and assignment of responsibilities are some of the key factors that needs special attention for site meetings (AZhar, 2015). However, it is very significant to record all the meeting minutes in proper manner and get the signatures from participants to the meeting. Also these minutes should be recorded and documented so that those are easily and readily accessible to the concerned parties for future references related to the project disputes etc.

- (i) **Implement a convenient method of handling and managing the project documents (hard copies /digital copies) to ensure the well organize, fast access and security control:** There are two ways in which the project document can be handled and managed during the execution of the project. Though hard copy based document management is the oldest and the traditional method, it is still being used for small and large scale projects. Today, electronic based document management

system is more popular due to its fastness and easiness. The clients of government organizations are still expecting to communicate through hard copy based document system to comply with government conventional procedures of documents management. Therefore, most of the organizations still use both method of document management system in construction projects. However, the team members should follow a convenient method of document management system for hard copy based, electronic based documents or combination of two methods to handle and control the valuable project documents. The team members should have the facility to faster access and security control of the document management system for making it more efficient and effective to the project activities during execution stage.

4.2.3 Analysis of evaluating the current barriers to internal collaborative approaches

Section-C of the questionnaire form is separated for evaluating the current barriers to internal collaborative approaches based on different perceptions of the parties to the contract. Similar Likert scale was used in the Questionnaire in order to check the acceptance level of the proposed current barriers to internal collaboration by the respondents. Based on the data collected from the questionnaire survey for Section-C, Relative Importance Index (RII) was calculated for the acceptance criteria of each case. After that, all the factors were ranked in descending order based on the values of Relative Importance Index which was calculated using the equation defined in the previous chapter. This process was done for the data collected for client/ consultant, contractor and the overall perspectives for comparison of the outcome.

4.2.3.1 Analysis on client /consultant perspective

A comprehensive analysis was performed based on the data collected in the questionnaire survey for client/consultant perspective. The results obtained from the data analysis are tabulated in Table 4.12 of Appendix-1. Accordingly, following top six barriers were identified in the descending order based on their relative significance calculated through the analysis; (1) Cultural and geographical differences during remote team operation, (2) Restrictions imposed during pandemic or epidemic situation etc., by the government and health services, (3) Company's reluctance to spend on team building activities and related facility development, (4) Restraints from the field

officers due to challenges in working environment (5) Communication technology barriers and breakdowns and (6) Stress and fatigue due to tight schedules and work overload. These results are presented as follows in Table 4.13 for quick reference.

Table 4.13: Top six significant barriers from client/consultants' perspective

RII	Rank	Description of current barriers to internal collaboration	#
0.735	1	Cultural and geographical differences during remote team operation	B14
0.688	2	Restrictions imposed during pandemic or epidemic situation etc., by the government and health services.	B13
0.676	3	Company's reluctance to spend on team building activities and related facility development	B5
0.641	4	Restrictions from the field officers due to challenges in working environment	B7
0.629	5	Communication technology barriers and breakdowns.	B12
0.624	6	Stress and fatigue due to tight schedules and work overload	B4

4.2.3.2 Analysis on contractor's perspective

Similar analysis was performed from the contractor's perspective and results are presented in Table 4.14 of Appendix-1. The summary of top significant barriers identified from the data analysis is presented in Table 4.15 below.

Table 4.15: Top six significant barriers from contractor's perspective

RII	Rank	Description of current barriers to internal collaboration	#
0.632	1	Cost implications for co-locating of teams	B11
0.568	2	Cultural and geographical differences during remote team operation	B14
0.568	2	Difficulties in converging many ideas to reach conclusions	B10
0.548	4	Restrictions imposed during pandemic or epidemic situation etc., by the government and health services.	B13
0.535	5	Communication technology barriers and breakdowns.	B12
0.529	6	Company's reluctance to spend on team building activities and related facility development	B5

Then the following factors were identified as the most significant five factors in the ranking order based on its relative significance; (1) Cost implications for co-locating of teams, (2) Cultural and geographical differences during remote team operation, (2)

Difficulties in converging many ideas to reach conclusions, (4) Restrictions imposed during pandemic or epidemic situation etc., by the government and health services, (5) Communication technology barriers and breakdowns, and (6) Company's reluctance to spend on team building activities and related facility development.

4.2.3.3 Analysis on overall perspective

The outcome of the overall analysis has shown the following most significant six barriers in the descending order; (1) Cost implications for co-locating of teams, (2) Cultural and geographical differences during remote team operation, (3) Restrictions imposed during pandemic or epidemic situation etc., by the government and health services, (4) Company's reluctance to spend on team building activities and related facility development (5) Restraints from the field officers due to challenges in working environment /Communication technology barriers and breakdowns, and (6) Communication technology barriers and breakdowns. The overall result is presented in Table 4.16 of Appendix-1, while most significant six factors are presented in Table 4.17 for reference.

Table 4.17: Top six significant barriers from overall perspective

RII	Rank	Description of current barriers to internal collaboration	#
0.591	1	Cost implications for co-locating of teams	B11
0.588	2	Cultural and geographical differences during remote team operation	B14
0.566	3	Restrictions imposed during pandemic or epidemic situation etc., by the government and health services	B13
0.545	4	Company's reluctance to spend on team building activities and related facility development	B5
0.542	5	Restraints from the field officers due to challenges in working environment	B7
0.542	5	Communication technology barriers and breakdowns	B12

4.2.3.4 Comparison of results obtained from the Analysis

Out of many barriers that have been affected on internal team collaboration, following top most significant barriers from three perspectives have been identified as shown in Table 4.18 below in order to pay high attention in this regard.

Table 4.18: Summary of top six significance barriers from three perspectives	
Client/consultants' perspective	{B4,B5,B7,B12,B13,B14}
Contractors' perspective	{B5,B10,B11,B12,B13,B14}
Overall perspective	{B5,B7,B11,B12,B13,B14}

The Summary of top six significant barriers from three perspectives shown in the Table 4.18 is represented in a Venn diagram below Fig.4.5.

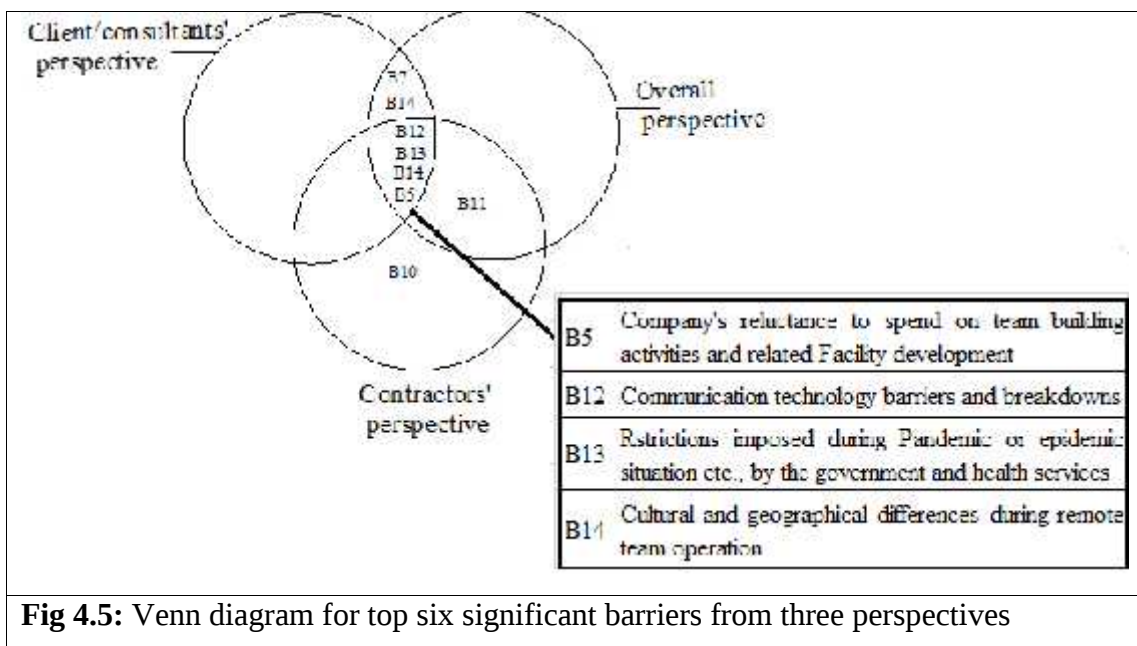


Fig 4.5: Venn diagram for top six significant barriers from three perspectives

It can be seen the following sets related barriers B5, B12, B13 and B14 have been intersected for three perspectives. Therefore, these four barriers are the most influential ones compared to the other as agreeable from the three perspectives. These four barriers are discussed more elaborately in the following section.

(a) Company's reluctance to spend on team building activities and related facility

development: There should be a coordination to carry out team building activities within team members. This will motivate the team to enhance the trust within the team and work together by developing strengths of team members. These events could be in any of the form such as outbound tanning, day outings and motivational programs. A trained person should be consulted to get the desired output. The main objective of such team building activities should be to encourage the collaboration rather than competition among the team members. Some projects follow the

mechanism to arrange milestone parties with all the team members to celebrate the accomplishments in order to make the team feel that it is a team achievement. But most of the projects do not allocate funds for this type of activities or due to budget restrictions and therefore find it difficult to implement such team building activities within the project. However, recent research has found that these activities would enhance the collaboration within the project team members.

(b) Communication technology barriers and breakdowns: Communication is the key for effective internal team collaboration. This is very essential for the success of construction industry and to achieve the desired outcomes of construction projects. In most of the construction projects such as road networks, pipe network, irrigation projects the construction works are scattered in a large area and therefore the communication is the media that would bind the team together to perform the work on time. Therefore, it is very important factor in selecting a proper communication media to the project based on availability of network systems, reliability and financial viability. There may be technical barriers in remote area operation such as poor network coverage, noisy environment etc. that would break up the continuous communication.

(c) Restrictions imposed during pandemic or epidemic situation etc., by the government and health services: During epidemic or pandemic situation in any country or the world, there can be many restrictions such as maintaining social distances during working together, conducting regular meetings, team discussions, collective team activities etc., affecting to the collaborative approaches immensely. This would sometimes completely reduce the work collaboration and effect on productivity of team members. Also team may have to obey the health and government guidelines during this period. The team should be able to identify strategic approaches that can be implemented to minimize the damages at this type of critical situations such as limiting the number in work groups, scattering the teams, arranging meetings & discussions in virtual means etc. Even though other industries can survive the full operation with alternative options, it would be very difficult to reach to that level in the construction industry.

(d) Cultural and geographical differences during remote team operation:

The team members should have a proper understanding over cultural and geographical differences during remote team operation. Especially, the

communication should happen between team members respecting to each other and factors considered above. Otherwise, there can be communication breakdowns within the team members that would retard the work collaboration. Also if one channel is broken, it might affect heavily to the success of the project. However, social activities and events can be organized in order to feel the team members for the value of respecting to these factors to keep the team engaged with work collaboration continuously.

In addition, the Contractors need to pay attention on the barriers discussed below in order to take necessary precautions in implementing the Internal Team Collaboration process.

(e) Cost implications for co-locating of teams: The word co-locating means bringing all the team members to one work location to carry out the work. Then, the project needs to bear all the direct and indirect cost as well as other ancillary costs during implementation. However, this additional cost incurred to the project can be reduced by arranging the team members working from home or working at sub offices. But, this method may not enhance the work collaboration between the team members. Considering the involvement of many activities, co-locating is a must in construction industry compared to manufacturing, the software industry or any other knowledge work base consultancy work etc. In this context, all construction team members needs to be collocated in the project to get maximum benefit of the work collaboration despite additional cost implications over the matter discussed.

(f) Restraints from the field officers due to challenges in working environment: Generally, construction teams are working under very tense environment where they are expected to achieve many targets within limited time periods. Especially, the field officers are facing many difficulties and challenges with limited resources, environmental changes, communication issues and stakeholder restraints etc., which may become a barrier to the internal collaboration. Therefore, the project manager should follow a strategic approach to coordinate the work for smooth operation so that internal work collaboration can be continued throughout all phases of the project among the internal team members. Therefore, they should be given required facility for communication etc., to keep them engaged with the collaboration process.

4.2.4 Analysis of identification of significant methods and techniques to enhance the internal collaboration

The data collected from questionnaire survey under section-D was used to analyze to identify significant methods and techniques for enhancing the internal team collaboration. Relative importance index (RII) was calculated for all the attributes and ranked them based on the value obtained. This analysis was performed in three stages separately for client/consultant perspective, contractors' perspective and the overall perspective.

4.2.4.1 Analysis from client /consultant perspective

Data analysis was performed based on the data collected from the questionnaire survey on client/consultant perspective. The results obtained from the analysis are tabulated in Table 4.19 of Appendix-1. Top six significant techniques are tabulated in Table 4.20 given below.

Table 4.20: Top six significant techniques to enhance collaboration from client/consultants' perspective

RII	Rank	Description of Methods and techniques to enhance internal collaboration	#
0.765	1	Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.	C1
0.765	1	Continuous implementation of training and development events or activities.	C8
0.717	3	Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail.	C1
0.735	4	Select team members who possess positive attitudes	C7
0.729	5	Usage of web or cloud based document management system for proper document handling and knowledge sharing.	C3
0.729	5	Appointing a focal point having strong interpersonal skills	C10

Accordingly following top six methods and techniques were identified as the most significant methods and techniques to enhance internal collaboration in the following ranking order: Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.; Continuous implementation of training and development events or activities; Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail; Select team members

who possess positive attitudes; Usage of web or cloud based document management system for proper document handling and knowledge sharing and Appointing a focal point having strong interpersonal skills.

4.2.4.2 Analysis from contractor's perspective

The similar calculation was performed to find the significant of methods and techniques to enhance the internal collaboration for the data obtained from contractor's perspective, following results were obtained in the ranking order as presented in Table 4.21 of Appendix-1. Following table (Table 4.22) represents the top six significant methods and techniques obtained from the data analysis.

Table 4.22: Top six significant techniques to enhance collaboration from contractors' perspective

RH	Rank	Description of Methods and techniques to enhance internal collaboration	#
0.729	1	Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.	C4
0.723	2	Continuous implementation of training and development events or activities.	C8
0.723	2	Develop the team members through continuous performance evaluation, promoting and appraising members	C12
0.718	4	Select team members who possess positive attitudes	C7
0.710	5	Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and	C1
0.703	6	Introduce incentives program to motivate the teams based on target achievement	C6

The above table shows the most significant factors: Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.; Continuous implementation of training and development events or activities; Develop the team members through continuous performance evaluation, promoting and appraising members; Select team members who possess positive attitudes; Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail and Introduce incentives program to motivate the teams based on target achievement.

4.2.4.3 Analysis from overall perspective

The results obtained for the analysis from overall perspective is shown in Table 4.23 of Appendix-1. Following table shows (Table 4.24) the top most significant methods and techniques to enhance the internal team collaboration.

Table 4.24: Top six significant techniques to enhance collaboration from overall perspective

RIT	Rank	Description of Methods and techniques to enhance internal collaboration	#
0.234	1	Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.	C4
0.233	2	Continuous implementation of training and development events or activities.	C8
0.228	3	Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail.	C1
0.227	4	Select team members who possess positive attitudes.	C7
0.226	5	Develop the team members through continuous performance evaluation, promoting and appraising members.	C12
0.218	6	Implementation of Enterprise Resource Planning (ERP) system by integrating all the key functions related to the construction process.	C5

However, the top most six significant factors are: Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.; Continuous implementation of training and development events or activities; Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail; Select team members who possess positive attitudes; Develop the team members through continuous performance evaluation, promoting and appraising members and Implementation of Enterprise Resource Planning (ERP) system by integrating all the key functions related to the construction process.

4.2.4.4 Comparison and discussion of results obtained from the Analysis

The results obtained from the data analysis from three perspective is discussed below to give an understanding of importance of these methods and techniques for internal team collaboration process. The summary of top six methods are presented in Table 4.25.

Table 4.25: Summary of top six significant techniques to enhance collaboration from three perspectives

Client/consultants' perspective	{C1,C3,C4,C7,C8,C10}
Contractors' perspective	{C1,C4,C6,C7,C8,C12}
Overall perspective	{C1,C4,C5,C7,C8,C12}

The Summary of top six significant barriers from three perspectives shown in the Table 4.25 is represented in a Venn diagram below Fig.4.6.

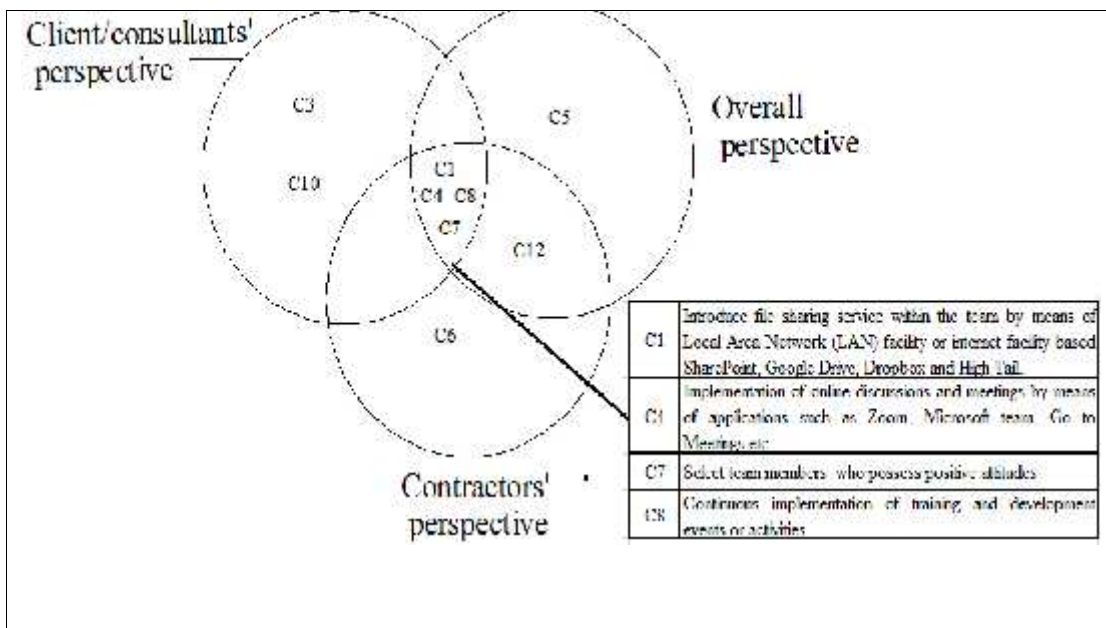


Fig 4.6: Venn diagram for top six significant methods and techniques from three perspectives

It can be seen the following sets related methods and techniques C1, C4, C7 and C8 have been intersected for three perspectives. Therefore, these four methods and techniques would be the most influential ones compared to the others as agreeable from the three perspectives. These four methods and techniques are discussed more elaborately in the following section.

(a) Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail:

Team members have to exchange many documents in hardcopy base or softcopy base for successful implementation of projects during execution stage. These documents may comprise of technical, administrative, contractual, procurement or any other areas pertain to the project activities. Sharing of hard copies are done based on the company procedures through different reliable techniques. But, this is found to be a tedious task. However, maintenance of softcopies are getting popular and convenient to share enormous number of files within the team vary fast to a very low cost for meeting with project activities. Provision of Local Area Network (LAN) facility was the most preferable option available until year 2000. Later, most of them moved to share the files through internet facilities. In addition, there are widely used internet based file sharing services such as SharePoint, Google Drive, Dropbox and High Tail etc. which have been more popular in many industries including the construction industry. This has ensured the collaboration of work team by enhancing the reliability of communication through document sharing system.

(b) Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.:

There are many stakeholders involved with construction projects including the project team. Everyone is having different work schedules relevant to the project as well as external commitments. Therefore, arranging meetings and discussions in construction projects would be very difficult task. Also some of the team members may have to travel long distances to attend for the meetings by spending more travelling time than the time duration allocated for the meeting. Also there may be situations, participation of top management or other stakeholders could be essential to take part for immediate decisions on project requirements of the project. But these may be hampered from unavoidable circumstances of their busy schedules. In addition, there may be restrictions during pandemic or epidemic situation to travel to the required destinations or social gathering.

In order to address such extreme situations, many people prefer to arrange virtual meetings by using applications like Zoom, Microsoft team and Go to meeting etc. Similarly, field officers have the ability to join for the meeting without affecting to

the ongoing construction works at site. Even though there are technical barriers and breakdowns, it could be much more effective and attractive way of collaborating the teams with respect to the time and cost. However, this may require additional cost allocation for providing IT infrastructure facilities to the team members. Comparatively, most of the construction companies and other industries are currently encouraging to use this kind of virtual team collaboration techniques after the Covid-19 pandemic situation to overcome the barriers in continuation of work in respective industries. But security of communication process must be ensured to safeguard confidentiality of business process of the company.

(c) Select team members who possess positive attitudes:

Different people have different perceptions, characteristics, attitudes and behaviors in their life style. Team members are also the same. Therefore, most of the project managers prefer to work with the same team members of the previous project since they are assured than those who are recruited newly to the project. Similarly, the internal team collaboration is also very high and lead to better performance. Further, when selecting team members to a project, they are expected to have positive attitudes to increase the work collaboration within the team members.

(d) Continuous implementation of training and development events or activities:

Today, the technology is evolving very fast. Therefore, team members should be updated about the new technology to compete with other organizations. Similarly, all the team members should be developed with the time to retain them in the organization for long period. This also effects on the sustainability of the organization as well. Therefore, proper training and development should be given to the team members to achieve these targets. In addition, senior team members may require the knowledge of latest technologies to mix with the young generations who are updated with new technologies in the industry. Therefore, the company should have allocated sufficient funds to meet this objectives

In addition, following is some other method and technique that can be considered by the Contractor in order to implement the Internal Team Collaboration processes successfully.

(e) Develop team members through continuous performance evaluation, promoting and appraising members: Team members need to be undergone development process over the time to keep them engaged with collaboration process. Also this will enhance the motivation among team members in order to continue the performance. Then they would expect motivational factors such as sense of personal achievement, status, recognition, promotion, growth. In addition to the hygiene factors salaries, wages and other benefits, job security, work-life balance etc. Therefore, most of large construction projects carry out performance evaluation in every year by coordination with the human resource department of the company to evaluate the performance of the individuals. Based on the data collected from individual performance evaluation, they may be considered for promotions and annual increments. Therefore, it always creates a competitive environment within the team members and give rise to enhance the internal team collaboration indirectly otherwise they cannot reach to the expected performance level through individual operation.

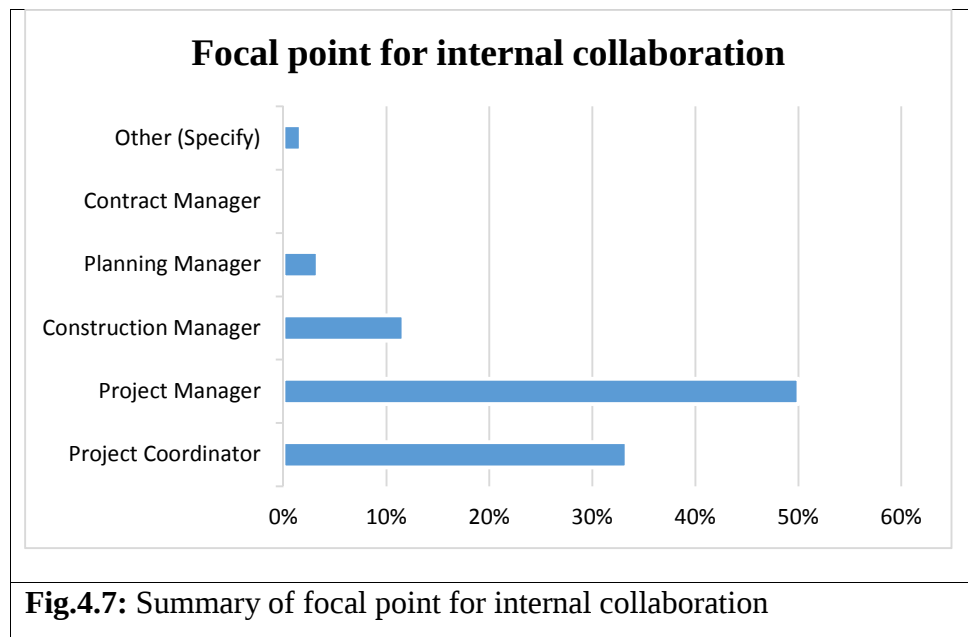
4.2.5 Analysis of identifying the focal point for internal collaboration in the project

Analysis was performed based on the data gathered from the Questionnaire survey to identify the focal point for the internal collaboration in the project. The results of the analysis are presented in Table 4.26 and Fig.4.7. Accordingly majority of the respondents have agreed that project manager should act as the focal point for the internal collaboration in a construction projects to enhance the internal team collaboration.

Table 4.26: Results of focal point for internal collaboration

Identifying the focal point for internal collaboration in the project	Client/ Consultant	Contractor	Overall	%age	Rank
Project Coordinator	13	9	22	33.3%	2
Project Manager	19	14	33	50.8%	1
Construction Manager	1	6	7	10.8%	3
Planning Manager		2	2	3.1%	4
Contract Manager			0	0.0%	6
Other (Specify)	1		1	1.5%	5

The graphical presentation of the results are as shown below (Fig.4.3):



Accordingly the Project manager is the right person who is engaging fulltime on project activities in the project in order to act as the focal point for implementing the Internal Team Collaboration process. These designations might change from company to company and project to project depending on the organizational structure of the company or the project and complexity of the project.

4.3 Further discussions of results in comparison to the literature

It has been revealed from the literature survey that more focus had been given by the researchers on mitigating and avoiding the construction project delays. Therefore, it was identified the importance of managing the construction project delays as project delays are required to be anticipated at any instance of the project. Therefore, Project parties need to find long term solutions in order to address this complex situation. The previous studies have revealed that application of tacit and explicit knowledge, tools & techniques, different approaches and best practices would relieve the parties in reaching to the desired objectives. Planning & scheduling, construction management, delay claim management and the document management are the four main dimensions that should be considered for effective management of construction project delays. However, the study have been revealed that these four dimensions are equally contributed for construction project delay management. Similarly, the contractors need to pay high attention on Document management practices in comparison to the other

dimensions in order to fulfil the contractual management of the project delays. Also it is identified the importance of Integrating these four dimensions to achieve the desired objectives. Generally, the isolated operating behavior of individual team members of contractors' organizations have been a major issue during execution of project activities. Therefore, Industry expertise must identify the ways and means of maintaining the collaboration among the team members belong to these four categories. The nature of construction projects are varied from project to project compared with the other industries. But, the basic concept lies in such a way that previous knowledge used could be utilized or applied fully or partially to the new projects. Though there are massive construction projects which had been completed in olden days, no comprehensive details and information available about the methodology or other strategies followed during implementation of those projects. Therefore, we have missed the opportunity to utilize and integrate to present scenarios in construction industry. Therefore, the preservation of knowledge to the future generation is found to be an essential requirement that needs to be taken in to consideration by industry practitioners.

There are many approaches on team collaboration that have been suggested and implemented in the industry. Implementation of Integrated Project Delivery (IPD) in which the main purpose is to engage the client, design consultants, contractors, sub-contractors, vendors into one team, with incentives to establish a structure to ensure that everyone works together to achieve agreed shared targets. All the team members are expected to share incentives of gain and pain depending on success or the failure of the project. Lack of appropriate policies and fitness of available Contracts, lack of mutual trust among project key stakeholders regarding managerial and financial issues and lack of proper definition of responsibilities of each of parties of the contract are the major limitations in implementing the IPD concept. European countries have amended these contracts to suit and incorporate with New Engineering Contracts and Engineering and Construction Contracts etc. However, Collaboration within the internal team members is found to be much more achievable and feasible solution with the current procurement policies and procedures during implementation of the construction projects for sharing and utilizing the internal & external resources efficiently. Further, development of agile framework concept is likely to reduce the time overrun in infrastructure projects. Agile is applicable to highly flexible

environment and methodology has been found to improve the reliability of project delivery by decomposing the project into a smaller manageable parts and completing these parts with greater delivery value. This concept is more practicable to software industry due to its flexibility on Changes whereas the construction industry is more complex and difficult to incorporate the changes in flexible environment. However, Enterprise Resource Planning (ERP) integrates the company's processes in order to utilize its resources efficiently and its full capacity. There are many technical, financial and other barriers and constraints in implementing the system in every construction organizations of different categories. Application of Building Information Modelling (BIM) technique or similar would help to mitigate the delays in construction under four main ways; improving communication and coordination between all members, effective and accurate sequencing of construction activities, accurate visualization of design to be constructed and producing accurate cost estimates and schedules. Therefore, the proposed Internal Team Collaboration (ITC) is another approach that can be tested to implement in the construction industry for efficient management of project delays. According to the suggestions made in the research, the practitioners need to apply best practices under four main dimensions namely planning & scheduling, construction management, contract administration and document management. Following the best practices for different applications in construction industry have been identified as a more popular method and efficient way to find solutions pertaining to issues in construction projects during execution. The understanding of the significance of ITC process among the internal team members would be a paramount factor for the successful implementation. Similarly, most of the practices are currently being used by the team members in the day to day routine operation of the project without much integration among the major processes. The team comprises of different levels, age groups belonging to different generations. The active participation of all team members to the internal team collaboration process would be very essential requirement in construction projects to overcome the knowledge vacuum that may happen over the time. Similarly, the collaborative working arrangement within the internal team can be arranged to make their mind set for working together on gain or pain share arrangement depending on the success or failure of the project. This would be worthwhile to give them an impression to engage more with team collaboration process. The success of the ITC approach would contribute to achieve the strategic objectives of the company in the long run in addition to increase of project performance,

increase business relationship with the client, consultant and other stakeholders of the project. Most importantly, these practices are expected to be integrated through proper channels and in proper sequence by the appropriate persons to achieve desired aspirations or objectives of concepts proposed through the studies. The research had identified the Project Manager as the key person to act as coordination body in implementing the ITC approach. His full time involvement and contribution would be essential in order to achieve the desired objectives of the ITC approach. Also the team members should be driven in the correct path with proper understanding of significance of best practices and collaboration process. The designation of the project manager might change depending on the size of the company, its organizational structure and size and complexity of the project. But, there has to be a focal point and the focal point has the sole responsibility irrespective its designation to execute under four dimensions during project implementation. The main expectation of all the parties to the project is to complete in successful manner and close without harming to the business relationship. Therefore, the team members need to have proper understanding about the basic contract administration procedures and obligations of the parties in addition to the construction management knowledge essential for the work. Considering the differences of knowledge level of individuals, required training and development should be arranged individually or as groups to enhance the weak areas for the betterment of personal development as well as reaching the project objectives. Therefore, proper evaluation of team members are required by the focal point time to time so that the team members could be developed and motivated to maintain continuous engagement and participation for team collaboration. Also, the company's top management needs to allocate funds for team development activities without neglecting these valuable key factors. Therefore, the focal point should be strategic enough to utilize his interpersonal skills during implementation of the ITC approach.

The study has shown that there are many barriers to Internal Team Collaboration that need to be considered to overcome the challenges faced during implementation of this approach. There had been three significant barriers for internal team collaboration out of fifteen which were identified for the study. Most of the construction companies are reluctant to spend on team building activities and related facility developments since there is no budget allocation for this during the project initiation stage. Also the tight schedule in the project also does not make a feasible environment to engage or

implement such events or activities. Arrangement of milestone parties, day outings and outbound training programs are such examples for these events and activities. These would help to increase the cohesiveness of team members and tend to work together rather than concentrating on individual working behavior. Therefore, it is the responsibility of the project manager to convince the company's top management to get required fund allocations for the benefits of the project.

Also the communication technology barriers and breakdowns has been identified as another significant barrier to the internal team collaboration. The communication is the key factor to effective team collaboration. The team members should actively involve with communication process in order to accomplish the success of the project. Even though there have been many technological advancement in the communication industry, the transmission might differ from one area to another causing disruptions to the effective communication. Also all the team members might not use the latest advanced communication technology devices and the projects may not provide to all team members.

Construction teams experienced lot difficulties to collaborate on project activities during recent Covid-19 pandemic situation. In addition the government and the health authorities had imposed many restrictions to prevent the physical collaboration of public. Therefore, the people shifted to virtual means of collaboration process. But the effectiveness is comparatively less and unproductive.

As construction practitioners understand, project environment is temporary. Also the composition of the team members may change at different stages of the project to reduce the cost of staffing. The team members keep continuing the team collaboration, when all team members have an understanding to shift to another projects, once the current project is over. But this may not be always possible to achieve. Therefore, the key players need to follow team motivation and trust building activities in order to maintain the same positive environment throughout the project period. Similarly, the key players needs to see the subordinates as members of the project not as the individual disciplines. This will eliminate individuals thinking on working the competitive environment individually. The individuals' competitive working environment is very temporary compared to the team work environment. It is good for long term sustainability of the projects. The senior members of the team should have a better

understanding and responsibility in this regard to create and maintain a feasible environment in the project.

In order to develop and strengthen the internal team collaboration, the industry expertise recommend to include the right people, mutual trust & respect and management of different agendas. The person that you have chosen to the project should have characteristics of best fit for your project. Therefore, the persons you have selected should be flexible to adjust the mind set for cultural and behavioral change etc., to suit with the existing project environment. Executives or seniors of the team should initiate a culture within the team to respect each other and increase the trust building. Similarly, Team members should be prioritized the works based on the roles and responsibilities which they have been assigned in the project.

The internal team collaboration can be easily achieved for private sector organizations where there is a flexibility to adjust company policies and procedures suited to the business objectives. But, the government sector organizations are bonded to follow the working procedures set through government guide lines or the circulars. Therefore, they cannot operate independently and take collective quick decisions beyond the set boundary limit. Therefore, the performance and productivity of private organizations are becoming very high in comparison to the government sector organizations. However, new concepts are being introduced by governments to increase the performance and productivity through new technology.

However, there are new tools and techniques and emerging technologies available in the current market to enhance the Internal Team Collaboration that can be utilized to make this happen successfully. The emerging technologies in the communication and IT industry has created a feasible environment and has played a vital influence to any industry for enhancing the team collaboration. The usage of latest technology to adopt with the business process is very popular in manufacturing and software industry compared to the construction industry. But this obstacle can be addressed, when more user friendly applications are introduced to the industry which are required for day to day operations. The initial investment for this type of changes are very high whereas long term benefits are much more valuable. Young generations are more and more proactive and adoptable than the older people, when introducing new technologies to the construction industry. Therefore, there should be a systematic approach within the

organization to accompany all the generations together to reach the targeted destination. For example, mobile phones are very popular today among people at every age group levels. It provides the facility not only to verbal communication but also video and other data storage facilities to make it more interactive. Therefore, mobile phones are the cheapest and fastest device that can be utilized in order to disseminate project information from office level to the field level officers who may sometimes operate far away from the office in road and water network projects etc., since everyone is having handheld mobile phone at any time of the day. Different mobile applications suited to the communication requirement can be identified to utilize throughout the project.

Most of them believe effective collaboration may lead to produce many benefits to the project such as time and saving cost, less errors and unnecessary reworks, value addition and the innovation. In addition, High customer satisfaction, functioning as per specification, achieving expected quality requirements and completion within time schedule etc., are some of the outcomes achieved through this concept.

This process should commence from the early planning stage of the project by major players of the project. Their strong leadership is required to handle, drive and control the issues of projects through different phases until completion. The communication is the media that would enable to keep the team together focusing on one objective. There are many integrated software solutions and techniques such as Cloud based project management software, Building Information Modeling and devices smart phones, tablets etc. that would facilitate to make this objective reality.

Internal team collaboration provides a major influence to resolve most of the contractual issues arisen during execution of the project. The internal team collaboration enhances the proper integration between these processes and gives prior resolutions. The understanding on the key areas planning & scheduling, construction management and document management would address the key issues pertaining to delay claims made by the contractor party. The link between the understanding on obligations as per contract and proper documentation would be very much appreciable to get resolved contractual entitlements of contractor parties. It is not guaranteed that project claims can be completely avoided. There are certain requirements such as understanding the causes of claim and understanding of contractual terms that need to be fulfilled to avoid the disputes. Therefore, contractor's team should have read the

whole contract for understanding the contractual rights, obligations and its liabilities. Similarly, Contractor's team members should have clear understanding of the performance of the project, liabilities and obligations of contractor, delay rectification, notifying the delays and timely submission of claims in order to manage the construction delays contractually in an effective manner. However the contractor should adopt the general techniques such as working overtime, working by multiple shifts, adding more workers and working by extended days to meet up the time targets set in the project, when there are limited resources available in the project.

4.4 Chapter Summary

Based on the final outcome of the analysis, it could be identified that best practices under four dimensions related to; Planning & scheduling, Construction management, Contract administration and Document management are equally important and contributed for Internal Team Collaboration process. However, high attention should be paid for the Document management related best practices. Further, it could be identified that Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers; Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system; Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system are the are the most influential three best practices assisting for ITC process compared to the other as agreeable from the three perspectives.

Similarly, it could be identified that there are three barriers which are most influential ones compared to the other during implementation of the ITC Process. These barriers are Company's reluctance to spend on team building activities and related facility development; Communication technology barriers and breakdowns and Restrictions imposed during pandemic or epidemic situation etc., by the government and health services which are needed to pay high attention by the Contractors.

However, the analysis has shown that four methods and techniques are most influential and significance to enhance the ITC process. These are introducing file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail; Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go

to Meetings etc.; Select team members who possess positive attitudes and Continuous implementation of training and development events or activities.

Moreover, the research has revealed that the Project manager is the right person who is engaging fulltime on project activities in the project in order to act as the focal point for implementing the Internal Team Collaboration process.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

There were four main objectives of this study to identify the significance of internal team collaboration (ITC) approaches under planning & scheduling, construction management, contract administration and document management for efficient management of construction project delays. These objectives were; Identifying the best internal collaborative practices for the performance of construction delay management, identifying current barriers to internal collaborative approaches, finding out how to enhance the internal team collaboration and identifying the focal point in the project for implementing internal team collaboration

The study revealed that the best practices under four dimensions related to; Planning & scheduling, Construction management, Contract administration and Document management are equally important and contributed for Internal Team Collaboration process. However, more emphasis could be identified for the Document management related best practices.

Based on the outcome of analysis for best internal collaboration practices, three best practices could be identified as the most influential ones which should be taken into consideration by the industry practitioners for efficient management of construction project delays. These best practices were; Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system, Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system and Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers.

Similarly, the study identified four main current barriers to internal team collaborative approaches in which more attention to be given during implementation. These four barriers were; Company's reluctance to spend on team building activities and related facility development, Communication technology barriers and breakdowns, Restrictions imposed during pandemic or epidemic situation etc., by the government

and health services and Cultural and geographical differences during remote team operation.

Moreover, the analysis conducted for identifying the significant methods and techniques to enhance the internal team collaboration revealed that four methods and techniques would be the most influential ones compared to the others. These four methods and techniques were; Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail, Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc., Select team members who possess positive attitudes and Continuous implementation of training and development events or activities.

Finally, the study revealed that the Project manager is the right person who is engaging fulltime on project activities in the project in order to act as the focal point for implementing the Internal Team Collaboration process. This designations might change from company to company and project to project depending on the organizational structure of the company or the project and complexity of the project

5.2 Recommendations

The Internal Team Collaboration (ITC) process is one approach that can be implemented in construction projects by the contractor out of many approaches introduced in the previous studies. However, following recommendations are suggested to enhance the internal team collaboration for efficient management of project delays based on the outcome of the research.

(a) Create a suitable supportive environment in the project for internal team collaboration

People are different from one person to another in their personnel character. They have different perceptions, beliefs and behaviors in their lifestyle. Then, it is very difficult task to keep concentrating on one target to everybody in order to reach expected objectives. Therefore, leaders of team members should create a supportive environment where team members feel their contribution is more essential and valuable to the project in meeting the expectations of project performance. The construction companies must be flexible enough to adopt the changes in the project environment and aligning with the procedures suitably for the betterment and

addressing the future challenges. Also there should be a mechanism to maintain and develop this artificial environment throughout the project life cycle in order to receive the expected results. Selection of suitable team members during recruitment would contribute immensely to make this effort successful in reality.

(b) Implement awareness and training programs to develop the team members

The project manager needs to coordinate training and development programs to the team members based on their job description and level of operation in the project. Also regular awareness programs should be implemented to make them understood of cost and time implications to the project due to improper practices followed during execution of work and also the importance of Continuous Professional Development (CPD) for their career enhancement. This will be a great benefit to the project in the long run since it will reduce the cost of non-conformance and to achieve the long term sustainable targets of the company.

(c) Allocate required funds for internal team collaboration

Construction companies should identify the importance of allocating funds required on implementation of internal team collaboration process in the projects. These requirements should be initiated by the project manager and convinced the top management with facts to take their attention highly in this regard. Though the initial investment for this requirement is high, the return or the benefit would be long lasting and beneficial to the strategic objectives of the company. However, these facilities should be monitored and maintained properly in the long run to prevent wastage of allocated funds and idling of useful resources.

(d) Monitor & control the integration process under four main dimensions

Even though individual team members get involve with application of best practices under the four dimensions; planning & scheduling, construction management, contract administration and document management, these four areas should be integrated properly as a daily, weekly, monthly, yearly routine or any other frequencies in order to regularize the process. The project manager should get involve with this and make every effort to aware the team members for better implementation of the correct process or the procedure. Similarly, a system should be developed to monitor and control it for the sustainability and progress of the concept during implementation. Project manager's strategical approach is highly essential for the success of this objectives.

(e) Focus on emerging technologies to encourage team collaboration

The technology in any industry would get evolved over the time rapidly. The usage of new technology may help to enhance the efficiency and the productivity of the internal team collaboration process. Usage of online platform for communication is one such example which comprises of sending and receiving information, ask questions, document sharing, and finding the information. Also the automation in construction industry is another latest aspect that must be focused to implement during execution for construction machinery and equipment. There can be many barriers to introduce these emerging technologies to the internal team members at once, but they may get used to them over the time.

(f) Motivate the team members and build the trust among them

The internal team members' engagement on team collaboration would enhance the project performance and the productivity. The construction companies' culture, environment and the reward system would have a major influence and contribution to their motivation and trust building. The team members can be motivated in many ways such as; feeling them that they are belong and connected with the work group, assessing their roles and contribution, arranging continual learning, introducing a system to balance lifestyle at home and workplace, encouraging them to voice for views and new ideas, treating team members fairly and consistently, security and certainty of the position, awareness on purpose and their contribution etc. Moreover, introduction of flexible working arrangement, attractive benefit packages and work overload & work-life integration should be taken into consideration to increase the trust between the employer and the team members. In addition, the project manager can introduce team building activities such as day outing, inbound training programs etc. in order to enhance the trust among the individual team members.

(g) Implement Electronic Document management (EDM) and Enterprises Resource Planning (ERP) system to integrate all the process under one platform

Project documents which are in the soft copy base and hardcopy base should be managed properly from the beginning of construction project due to accumulation of enormous quantity of documents during project execution. Therefore, construction companies can introduce suitable electronic based document

management system to cater this situation. This will facilitate to store, retrieve, transmit and access control for the security and easy access to the documents.

Further, construction companies should be able to manage its resources in an efficient manner to get the maximum return of the available resources. Therefore, key modules of the company such as tendering, project management, procurement, logistic, finance etc. can be integrated under one platform to increase the efficiency and productivity of these processes rather than implementing individual manual operation. Enterprise Resource Planning plays today very important role making significant milestone in the construction industry today. Therefore, these new technologies should be introduced and utilized to the construction projects for increasing the project performance and avoiding project disputes.

5.3 Future research areas

The Internal Team Collaboration process is a development of skills to use best practices in order to manage the construction delays efficiently. Therefore, it is suggested that the future research should be explored under internal team collaboration by conducting case studies in order to justify the feasibility of proposed methods in the practical points of view.

In addition, the study can be further considered to identify the validity of implementing from the points of view of client and consultant organizations during project execution. Also the level of assistance to increase the efficiency of Integrated Project Delivery (IDP) concept which involves more stakeholders in addition to key project parties like Client, Consultant and the Contractor.

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APPENDICES

APPENDIX-1

TABLES

Table 4.4: Analysis of internal team collaboration practices from Client/consultant perspective

#		Proposed Internal team best practices for delay management		Acceptance					Frequency of applicability					Significance					
														(SLD)={F.I (SE.I)}/100	X Rank				
				1	2	3	4	5	SE.I	1	2	3	4			5	F.I		
A1	Under Planning & scheduling																		
A1.1	Identify the risks and constraints of the project to include with planning & scheduling, technical and contractual documents.			Acc	1	5	7	7	14	76.471								39.135	4
				Freq. App	6	9	13	6	0		6	9	13	6	0	51.176			
A1.2	Finalize the most suitable method of construction and required resources in compliance to technical and contractual requirement.			Acc	0	4	4	15	11	79.412							38.304	10	
				Freq. App	6	12	12	4	0		6	12	12	4	0	48.235			
A1.3	Select a familiar planning & scheduling software to all team members which can produce faster, accurate and contractual report requirement.			Acc	1	10	4	11	8	68.824							37.246	14	
				Freq. App	4	11	11	7	1		4	11	11	7	1	54.118			
A1.4	Select and assign the suitable resources (staff, workers, plant, machinery & equipment), with sufficient quantity and at right time to match with contractual and approved project documents.			Acc	2	6	8	7	11	71.176							33.913	24	
				Freq. App	7	13	10	2	2		7	13	10	2	2	47.647			
A1.5	Organize discussions with industry expertise who have similar project experience and review the lessons learnt documents of previous similar projects of the company.			Acc	2	3	6	15	8	74.118							35.315	21	
				Freq. App	7	11	12	4	0		7	11	12	4	0	47.647			
A1.6	Prepare the detailed internal procurement schedule to ensure meeting of time targets and comply with contractual requirements.			Acc	3	5	1	13	12	75.294							31.446	25	
				Freq. App	10	14	7	3	0		10	14	7	3	0	41.765			
A1.7	Finalize project Quality Health Safety & Environmental (QHSE) policies and procedures aligned with organizational needs and comply with contractual requirements.			Acc	2	6	6	9	11	72.353							35.325	20	
				Freq. App	9	8	11	5	1		9	8	11	5	1	48.824			
A1.8	Select most suitable modes and means of project communication system which is convenient and non-disruptive.			Acc	1	4	7	9	13	77.059							38.076	11	
				Freq. App	4	18	5	6	1		4	18	5	6	1	49.412			
A2	Under construction management																		
A2.1	Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hands.			Acc	2	3	9	10	10	73.529							36.765	17	
				Freq. App	6	12	11	3	2		6	12	11	3	2	50.000			

Table 4.4: Analysis of internal team collaboration practices from Client/consultant perspective

Table 4.4: Analysis of internal team collaboration practices from Chenu/consultant perspective																			
#	Proposed Internal team best practices for delay management	Acceptance					Frequency of applicability					Significance		Rank					
		1	2	3	4	5	SE.I	1	2	3	4	5	F.I		(SLD={(F.I) (SE.I)}\100				
A2.2	Conduct regular meetings and discussions for sharing resources within the team, aware them about time targets, and discuss solutions for pending issues.	4	2	6	7	15	75.882								29.907	26			
A2.3	Ensure to follow the approved QHSE policies and procedures to avoid rework and prevent site accidents.	15	10	4	5	0		15	10	4	5	0	39.412						
A2.4	Coordinate with supportive services (purchasing and logistic etc.) to ensure timely receiving of goods and services as per internal procurement schedule.	1	4	7	13	9	74.706								40.869	3			
A2.5	Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers.	5	10	10	7	2		5	10	10	7	2	54.706						
A2.6	Organize events to share the challenges, experience and knowledge gained by the team members after completion of milestones.	3	3	6	12	10	73.529								35.035	22			
A3	Under contract administration/delay claim management	6	13	11	4	0		6	13	11	4	0	47.647						
A3.1	Produce claim notices on time and submit comprehensive delay claims by following the correct contractual procedure.	2	3	11	7	11	72.941								38.616	9			
A3.2	Educate the team members to enhance the correct record keeping and reporting requirement in order to substantiate the claims.	4	12	11	6	1		4	12	11	6	1	52.941						
A3.3	Develop a delay claim tracking system for easy monitoring purpose until closing the matter.	4	1	8	8	13	74.706								35.595	19			
A3.4	Maintain the full control of handling Change orders through contract administration team.	6	14	9	5	0		6	14	9	5	0	47.647						
A3.5	Get expertise ideas and/or refer lessons learnt from previous projects to incorporate with addressing delay claim issues.																		
		2	6	6	4	16	75.294								35.875	18			
		10	10	6	7	1		10	10	6	7	1	47.647						
		4	1	4	12	13	77.059								38.076	11			
		9	9	9	5	2		9	9	9	5	2	49.412						
		2	4	11	9	8	70.000								38.706	6			
		4	12	9	6	3		4	12	9	6	3	55.294						
		1	4	8	11	10	74.706								38.671	7			
		4	12	12	6	0		4	12	12	6	0	51.765						
		1	2	8	10	13	78.824								42.657	1			
		6	9	10	7	2		6	9	10	7	2	54.118						

Table 4.4: Analysis of internal team collaboration practices from Client/consultant perspective

#			Acceptance										Frequency of applicability					Significance	
																		(S.I.D)={F.I.D} X (S.E.D)} / 100	Rank
			1	2	3	4	5	SE.I	1	2	3	4	5	F.I					
A3.6	Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties.	Acc	1	4	6	6	17	80.000										37.176	15
A4	Under document management	Freq. App	6	14	11	3	0												
A4.1	Implement a convenient method of handling and managing the project documents (hard copies /digital copies) to ensure the well organize, fast access and security control.	Acc	1	3	6	11	13	78.824										34.775	23
		Freq. App	10	10	11	3	0												
A4.2	Conduct awareness and training programs on proper document handling procedures for storing, sharing, and retrieval and securing data.	Acc	1	3	11	12	7	72.353										38.730	5
		Freq. App	5	7	17	4	1												
A4.3	Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system.	Acc	2	1	9	14	8	74.706										38.671	7
		Freq. App	5	12	12	2	3												
A4.4	Depute a focal point for full control of the document and the documents management system of the project.	Acc	0	6	3	12	13	78.824										37.093	16
		Freq. App	7	12	11	4	0												
A4.5	Provide access control mechanism based on authority levels to avoid transparency of important documents.	Acc	0	6	7	13	8	73.529										37.630	13
		Freq. App	3	14	12	5	0												
A4.6	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	Acc	1	4	6	14	9	75.294										42.519	2
		Freq. App	5	8	12	6	3												

Table 4.6: Analysis of internal team collaboration practices from contractors' perspective

#	Proposed Internal team best practices for delay management		Acceptance					Frequency of Applicability					Significance Index	Rank		
			1	2	3	4	5	SE.I	1	2	3	4			5	F.I
A1	Under Planning & scheduling															
A1.1	Identify the risks and constraints of the project to include with planning & scheduling, technical and contractual documents.	Acc	1	2	4	6	18	84.516							37.623	20
		Freq. App	14	5	5	5	2		14	5	5	5	2	44.516		
A1.2	Finalize the most suitable method of construction and required resources in compliance to technical and contractual requirement.	Acc	0	5	2	13	11	79.355							38.398	16
		Freq. App	7	12	6	4	2		7	12	6	4	2	48.387		
A1.3	Select a familiar planning & scheduling software to all team members which can produce faster, accurate and contractual report requirement.	Acc	2	0	5	10	14	81.935							41.232	5
		Freq. App	7	10	7	5	2		7	10	7	5	2	50.323		
A1.4	Select and assign the suitable resources (staff, workers, plant, machinery & equipment), with sufficient quantity and at right time to match with contractual and approved project documents.	Acc	1	2	3	14	11	80.645							38.502	14
		Freq. App	7	10	9	5	0		7	10	9	5	0	47.742		
A1.5	Organize discussions with industry expertise who have similar project experience and review the lessons learnt documents of previous similar projects of the company.	Acc	0	3	2	14	12	82.581							37.294	23
		Freq. App	9	12	4	5	1		9	12	4	5	1	45.161		
A1.6	Prepare the detailed internal procurement schedule to ensure meeting of time targets and comply with contractual requirements.	Acc	0	3	5	7	16	83.226							37.586	21
		Freq. App	11	7	8	4	1		11	7	8	4	1	45.161		
A1.7	Finalize project Quality Health Safety & Environmental (QHSE) policies and procedures aligned with organizational needs and comply with contractual requirements.	Acc	0	5	5	6	15	80.000							36.129	24
		Freq. App	9	12	5	3	2		9	12	5	3	2	45.161		
A1.8	Select most suitable modes and means of project communication system which is convenient and non-disruptive.	Acc	1	2	7	7	14	80.000							38.194	17
		Freq. App	6	13	7	4	1		6	13	7	4	1	47.742		
A2	Under construction management															
A2.1	Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hands.	Acc	2	2	1	6	20	85.806							42.626	1
		Freq. App	8	10	7	2	4		8	10	7	2	4	49.677		

Table 4.6: Analysis of internal team collaboration practices from contractors' perspective

#	Proposed Internal team best practices for delay management		Acceptance					Frequency of Applicability					Significance Index				
			1	2	3	4	5	SE.I	1	2	3	4	5	F.I	(SLD)={ $\frac{(F.I)}{(SE.I)}$ }/100	X	Rank
A3.6	Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties.	Acc	0	4	4	7	16	82.581							42.622		2
A4	Under document management	Freq. App	6	11	6	6	2		6	11	6	6	2	51.613			
A4.1	Implement a convenient method of handling and managing the project documents (hard copies /digital copies) to ensure the well organize, fast access and security control.	Acc	1	3	1	13	13	81.935							40.703		7
A4.2	Conduct awareness and training programs on proper document handling procedures for storing, sharing, and retrieval and securing data.	Freq. App	7	12	5	4	3		7	12	5	4	3	49.677			
A4.3	Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system.	Acc	0	2	8	13	8	77.419							38.959		13
A4.4	Depute a focal point for full control of the document and the documents management system of the project.	Freq. App	7	9	8	6	1		7	9	8	6	1	50.323			
A4.5	Provide access control mechanism based on authority levels to avoid transparency of important documents.	Acc	0	2	5	15	9	80.000							40.774		6
A4.6	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	Freq. App	7	8	9	6	1		7	8	9	6	1	50.968			
A4.7	Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system.	Acc	0	2	5	15	9	80.000							40.258		8
A4.8	Depute a focal point for full control of the document and the documents management system of the project.	Freq. App	5	12	9	3	2		5	12	9	3	2	50.323			
A4.9	Provide access control mechanism based on authority levels to avoid transparency of important documents.	Acc	1	2	7	15	6	74.839							39.109		12
A4.10	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	Freq. App	3	15	7	3	3		3	15	7	3	3	52.258			
A4.11	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	Acc	0	3	5	16	7	77.419							42.456		3
A4.12	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	Freq. App	2	10	15	2	2		2	10	15	2	2	54.839			

Table 4.8: Analysis of collaboration practices from Overall perspective

#	Proposed Internal team best practices for delay management	Acceptance criteria															Frequency criteria					Significance	Rank
		Client/Consultant					Contractor					Overall					Overall						
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	F1	(SLI)-(F.1) X (SE.D)/100
A1	Under Planning & scheduling																						
A1.1	Identify the risks and constraints of the project to include with planning & scheduling, technical and contractual documents.	1	5	7	7	14	1	2	4	6	18	2	7	11	13	32	80.308						
	Freq. App	6	9	13	6	0	14	5	5	5	2							20	14	18	11	2	48.000
A1.2	Finalize the most suitable method of construction and required resources in compliance to technical and contractual requirement.	0	4	4	15	11	0	5	2	13	11	0	9	6	28	22	79.385						
	Freq. App	6	12	12	4	0	7	12	6	4	2							13	24	18	8	2	48.308
A1.3	Select a familiar planning & scheduling software to all team members which can produce faster, accurate and contractual report requirement.	1	10	4	11	8	2	0	5	10	14	3	10	9	21	22	75.077						
	Freq. App	4	11	11	7	1	7	10	7	5	2							11	21	18	12	3	52.308
A1.4	Select and assign the suitable resources (staff, workers, plant, machinery & equipment), with sufficient quantity and at right time to match with contractual and approved project documents.	2	6	8	7	11	1	2	3	14	11	3	8	11	21	22	75.692						
	Freq. App	7	13	10	2	2	7	10	9	5	0							14	23	19	7	2	47.692
A1.5	Organize discussions with industry expertise who have similar project experience and review the lessons learnt documents of previous similar projects of the company.	2	3	6	15	8	0	3	2	14	12	2	6	8	29	20	78.154						
	Freq. App	7	11	12	4	0	9	12	4	5	1							16	23	16	9	1	46.462
A1.6	Prepare the detailed internal procurement schedule to ensure meeting of time targets and comply with contractual requirements.	3	5	1	13	12	0	3	5	7	16	3	8	6	20	28	79.077						
	Freq. App	10	14	7	3	0	11	7	8	4	1							21	21	15	7	1	43.385
A1.7	Finalize project Quality Health Safety & Environmental (QHSE) policies and procedures aligned with organizational needs and comply with contractual requirements.	2	6	6	9	11	0	5	5	6	15	2	11	11	15	26	76.000						
	Freq. App	9	8	11	5	1	9	12	5	3	2							18	20	16	8	3	47.077
A1.8	Select most suitable modes and means of project communication system which is convenient and non-disruptive.	1	4	7	9	13	1	2	7	7	14	2	6	14	16	27	78.462						
	Freq. App	4	18	5	6	1	6	13	7	4	1							10	31	12	10	2	48.615
A2	Under construction management																						
A2.1	Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hands.	2	3	9	10	10	2	2	1	6	20	4	5	10	16	30	79.385						
	Freq. App	6	12	11	3	2	8	10	7	2	4							14	22	18	5	6	49.846
A2.2	Conduct regular meetings and discussions for sharing resources within the team, aware them about time targets, and discuss solutions for pending issues.	4	2	6	7	15	1	1	3	5	21	5	3	9	12	36	81.846						
	Freq. App	15	10	4	5	0	11	11	3	3	3							26	21	7	8	3	41.846
A2.3	Ensure to follow the approved QHSE policies and procedures to avoid rework and prevent site accidents.	1	4	7	13	9	0	4	5	12	10	1	8	12	25	19	76.308						
	Freq. App	5	10	10	7	2	5	16	7	2	1							10	26	17	9	3	50.462
A2.4	Coordinate with supportive services (purchasing and logistic etc.) to ensure timely receiving of goods and services as per internal procurement schedule.	3	3	6	12	10	0	3	6	5	17	3	6	12	17	27	78.154						
	Freq. App	6	13	11	4	0	8	9	9	4	1							14	22	20	8	1	47.692
A2.5	Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers.	2	3	11	7	11	0	1	6	15	9	2	4	17	22	20	76.615						
	Freq. App	4	12	11	6	1	2	11	15	3	0							6	23	26	9	1	52.615

Table 4.8: Analysis of collaboration practices from Overall perspective

#		Proposed Internal team best practices for delay management	Acceptance criteria																								Frequency criteria					Significance		Rank																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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A2.6		Organize events to share the challenges, experience and knowledge gained by the team members after completion of milestones.	4	1	8	8	13	1	3	4	9	14	5	4	12	17	27	77.538																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			

Table 4.12: Analysis of current barriers to internal collaboration from Client/consultants' perspective

#	Current barriers to internal team collaboration	1	2	3	4	5	RII	Rank
B1	Culture and politics of the organization	10	13	6	3	2	0.447	14
B2	Generational diversity	11	12	7	3	1	0.412	15
B3	Differences of individuals' professional qualifications and experience	6	13	8	5	2	0.476	12
B4	Stress and fatigue due to tight schedules and work overload	4	10	9	9	2	0.624	6
B5	Company's reluctance to spend on team building activities and related facility development	2	13	12	4	3	0.676	3
B6	Companies' traditional human resources management policies and procedures	4	10	11	8	1	0.553	9
B7	Restraints from the field officers due to challenges in working environment	2	16	7	3	6	0.641	4
B8	Senior officers' reluctance to diversify from the traditional working system	7	12	8	5	2	0.471	13
B9	Project budget limitations on IT tools and techniques required for collaboration	4	10	12	5	3	0.588	8
B10	Difficulties in converging many ideas to reach conclusions	4	13	13	4	0	0.524	11
B11	Cost implications for co-locating of teams	3	10	14	6	1	0.553	9
B12	Communication technology barriers and breakdowns.	4	12	9	7	2	0.629	5
B13	Restrictions imposed during pandemic or epidemic situation etc., by the government and health services.	0	11	16	6	1	0.688	2
B14	Cultural and geographical differences during remote team operation	0	12	10	11	1	0.735	1
B15	Individuals' personnel conflicts	4	15	11	3	1	0.618	7

Table 4.14: Analysis of current barriers to internal collaboration from contractors' perspective

#	Current barriers to internal team collaboration	1	2	3	4	5	RII	Rank
B1	Culture and politics of the organization	10	14	2	4	1	0.419	15
B2	Generational diversity	10	12	6	0	3	0.432	12
B3	Differences of individuals' professional qualifications and experience	7	15	6	3	0	0.432	12
B4	Stress and fatigue due to tight schedules and work overload	10	11	4	4	2	0.452	11
B5	Company's reluctance to spend on team building activities and related facility development	3	13	8	6	1	0.529	6
B6	Companies' traditional human resources management policies and procedures	3	16	8	3	1	0.490	10
B7	Restraints from the field officers due to challenges in working environment	4	15	4	7	1	0.510	8
B8	Senior officers' reluctance to diversify from the traditional working system	8	17	2	1	3	0.432	12
B9	Project budget limitations on IT tools and techniques required for collaboration	6	10	9	6	0	0.497	9
B10	Difficulties in converging many ideas to reach conclusions	2	9	13	6	1	0.568	2
B11	Cost implications for co-locating of teams	2	7	9	10	3	0.632	1
B12	Communication technology barriers and breakdowns.	5	12	4	8	2	0.535	5
B13	Restrictions imposed during pandemic or epidemic situation etc., by the government and health services.	1	13	12	3	2	0.548	4
B14	Cultural and geographical differences during remote team operation	1	12	10	7	1	0.568	2
B15	Individuals' personnel conflicts	3	12	13	2	1	0.510	7

Table 4.16: Analysis of current barriers to internal collaboration from overall perspective

#	Current barriers to internal team collaboration	Client/Consultant					Contractor					1	2	3	4	5	RII	Rank
		1	2	3	4	5	1	2	3	4	5							
B1	Culture and politics of the organization	10	13	6	3	2	10	14	2	4	1	20	27	8	7	3	0.434	14
B2	Generational diversity	11	12	7	3	1	10	12	6	0	3	21	24	13	3	4	0.431	15
B3	Differences of individuals' professional qualifications and experience	6	13	8	5	2	7	15	6	3	0	13	28	14	8	2	0.471	12
B4	Stress and fatigue due to tight schedules and work overload	4	10	9	9	2	10	11	4	4	2	14	21	13	13	4	0.514	10
B5	Company's reluctance to spend on team building activities and related facility development	2	13	12	4	3	3	13	8	6	1	5	26	20	10	4	0.545	4
B6	Companies' traditional human resources management policies and procedures	4	10	11	8	1	3	16	8	3	1	7	26	19	11	2	0.523	9
B7	Restraints from the field officers due to challenges in working environment	2	16	7	3	6	4	15	4	7	1	6	31	11	10	7	0.542	5
B8	Senior officers' reluctance to diversify from the traditional working system	7	12	8	5	2	8	17	2	1	3	15	29	10	6	5	0.468	13
B9	Project budget limitations on IT tools and techniques required for collaboration	4	10	12	5	3	6	10	9	6	0	10	20	21	11	3	0.529	8
B10	Difficulties in converging many ideas to reach conclusions	4	13	13	4	0	2	9	13	6	1	6	22	26	10	1	0.532	7
B11	Cost implications for co-locating of teams	3	10	14	6	1	2	7	9	10	3	5	17	23	16	4	0.591	1
B12	Communication technology barriers and breakdowns.	4	12	9	7	2	5	12	4	8	2	9	24	13	15	4	0.542	5
B13	Restrictions imposed during pandemic or epidemic situation etc., by the government and health services.	0	11	16	6	1	1	13	12	3	2	1	24	28	9	3	0.566	3
B14	Cultural and geographical differences during remote team operation	0	12	10	11	1	1	12	10	7	1	1	24	20	18	2	0.588	2
B15	Individuals' personnel conflicts	4	15	11	3	1	3	12	13	2	1	7	27	24	5	2	0.502	11

Table 4.19: Analysis of method and techniques to enhance internal collaboration -Client/consultants' perspective

#	Methods and techniques to enhance internal team collaboration		1	2	3	4	5	RII	Rank
C1	Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail.	Acc	2	2	8	13	9	0.7471	3
C2	Promote forming different internal team groups through social media such as whatsapp, viber, facebook, twitter etc. for sharing details and information at faster.	Acc	3	5	6	13	7	0.6941	10
C3	Usage of web or cloud based document management system for proper document handling and knowledge sharing.	Acc	1	6	6	12	9	0.7294	5
C4	Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.	Acc	1	3	7	13	10	0.7647	1
C5	Implementation of Enterprise Resource Planning (ERP) system by integrating all the key functions related to the construction process.	Acc	2	5	7	13	7	0.706	8
C6	Introduce incentives program to motivate the teams based on target achievement	Acc	3	7	9	10	5	0.6412	12
C7	Select team members who possess positive attitudes	Acc	1	8	3	11	11	0.7353	4
C8	Continuous implementation of training and development events or activities.	Acc	2	5	4	9	14	0.765	1
C9	Changing the workplace and/or job site culture	Acc	2	5	9	11	7	0.694	10
C10	Appointing a focal point having strong interpersonal skills	Acc	3	1	9	13	8	0.7294	5
C11	Execute social gathering and team building activities	Acc	3	5	4	15	7	0.7059	8
C12	Develop the team members through continuous performance evaluation, promoting and appraising members.	Acc	4	3	6	10	11	0.7235	7

Table 4.21: Analysis of method and techniques to enhance collaboration-Contractors' perspective

#	Methods and techniques to enhance internal team collaboration		1	2	3	4	5	RII	Rank
C1	Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail.	Acc	4	3	3	14	7	0.710	5
C2	Promote forming different internal team groups through social media such as whatsapp, viber, facebook, twitter etc. for sharing details and information at faster.	Acc	5	5	5	6	10	0.671	9
C3	Usage of web or cloud based document management system for proper document handling and knowledge sharing.	Acc	5	6	5	8	7	0.6387	11
C4	Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.	Acc	1	7	4	9	10	0.729	1
C5	Implementation of Enterprise Resource Planning (ERP) system by integrating all the key functions related to the construction process.	Acc	5	3	5	9	9	0.690	7
C6	Introduce incentives program to motivate the teams based on target achievement	Acc	2	7	5	7	10	0.7032	6
C7	Select team members who possess positive attitudes	Acc	2	5	4	13	7	0.716	4
C8	Continuous implementation of training and development events or activities.	Acc	3	5	5	6	12	0.723	2
C9	Changing the workplace and/or job site culture	Acc	2	8	6	12	3	0.639	11
C10	Appointing a focal point having strong interpersonal skills	Acc	2	5	10	10	4	0.658	10
C11	Execute social gathering and team building activities	Acc	2	6	6	11	6	0.684	8
C12	Develop the team members through continuous performance evaluation, promoting and appraising members.	Acc	2	5	7	6	11	0.723	2

Table 4.23: Analysis of method and techniques to enhance collaboration-Overall perspective

#	Methods and techniques to enhance internal team collaboration	Client/consultant					Contractors'					Overall					RII	Rank
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		
C1	Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail.	2	2	8	13	9	4	3	3	14	7	6	5	11	27	16	0.228	3
C2	Promote forming different internal team groups through social media such as whatsapp, viber, facebook, twitter etc. for sharing details and information at faster.	3	5	6	13	7	5	5	5	6	10	8	10	11	19	17	0.213	10
C3	Usage of web or cloud based document management system for proper document handling and knowledge sharing.	1	6	6	12	9	5	6	5	8	7	6	12	11	20	16	0.214	9
C4	Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.	1	3	7	13	10	1	7	4	9	10	2	10	11	22	20	0.234	1
C5	Implementation of Enterprise Resource Planning (ERP) system by integrating all the key functions related to the construction process.	2	5	7	13	7	5	3	5	9	9	7	8	12	22	16	0.218	6
C6	Introduce incentives program to motivate the teams based on target achievement	3	7	9	10	5	2	7	5	7	10	5	14	14	17	15	0.210	11
C7	Select team members who possess positive attitudes	1	8	3	11	11	2	5	4	13	7	3	13	7	24	18	0.227	4
C8	Continuous implementation of training and development events or activities.	2	5	4	9	14	3	5	5	6	12	5	10	9	15	26	0.233	2
C9	Changing the workplace and/or job site culture	2	5	9	11	7	2	8	6	12	3	4	13	15	23	10	0.209	12
C10	Appointing a focal point having strong interpersonal skills	3	1	9	13	8	2	5	10	10	4	5	6	19	23	12	0.217	7
C11	Execute social gathering and team building activities	3	5	4	15	7	2	6	6	11	6	5	11	10	26	13	0.217	7
C12	Develop the team members through continuous performance evaluation, promoting and appraising members.	4	3	6	10	11	2	5	7	6	11	6	8	13	16	22	0.226	5

APPENDIX-2

QUESTIONNAIRE SURVEY FORM

UNIVERSITY OF MORATUWA-SRI LANKA
MASTER OF SCIENCE IN CONSTRUCTION PROJECT MANAGEMENT
QUESTIONNAIRE

Name: A.C.P.C.P. Dhammika

Research Supervisor: Dr. L.L. Ekanayake

Research Title:

Feasibility study of contractor's internal collaborative practices to efficient management of construction project delays during implementation stage.

Research objectives:

- To study the best internal collaborative practices and its relative significance on the performance of construction delay management.
- To evaluate current barriers to internal collaborative approaches based on different perceptions.
- To identify significant methods or techniques to enhance internal collaboration.

This questionnaire consists of four (4) sections:

SECTION A: Respondent Background

SECTION B: Identification of best internal collaborative practices and its significance

SECTION C: Evaluating current barriers to internal collaborative approaches based on different perceptions

SECTION D: Identification of significant methods and techniques to enhance the internal collaboration

Note: Your answer will be treated confidentially. The findings of the study will be solely used for academic purposes. Your name is optional in this questionnaire.

Thank you for your corporation

SECTION A

Respondent Background

A1. Respondent's organizational information:

Please select your choice by marking "X" mark on the relevant box where appropriate:

A1.1	Type of organization	Government ☐	Private sector ☐	Foreign ☐	
		Client ☐			
		Consultant ☐			
		Contractor ☐			
A1.2	Capacity of the organization	Government service provider ☐			
		CIDA Grade for contractors C1 ☐ C2 ☐ CS1 ☐ CS2 ☐			
		Other ☐ (Specify) _____			
A1.3	Sector	Roads/Bridges ☐	Buildings ☐	Water/Sewerage ☐	Other (Specify) ☐
A1.4	Current project value	▪ Less than LKR 1 Billion ☐ ▪ Between LKR1-5 Billion ☐ ▪ Between LKR 5-10 Billion ☐ ▪ Above LKR 10 Billion ☐			

A2. Respondent's personal information

A2.1	Designation Level	▪ Director and above ☐ ▪ Managerial ☐ ▪ Engineer ☐ ▪ Other ☐ (_____)
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A2.2	Education level	Postgraduate ☐ Degree ☐ Diploma ☐ Other ☐ (Specify) _____
A2.3	Experience in the industry	Above 30 years ☐ 21-30 years ☐ 11-20 years ☐ 5-10 years ☐
A2.4	Highly specialized area	Project management related ☐ Construction management related ☐ Contract/Claim management related ☐ Planning & scheduling related ☐ Other (Specify) ☐

SECTION B

B.1 Identification of best internal collaborative practices and its significance

Please select your choice by marking "X" mark on the relevant box according to the following number scale for the selections:

Acceptance		Frequency	
Strongly disagree	1	Never	1
Disagree	2	Rarely	2
Neutral	3	Sometimes	3
Agree	4	Often	4
Strongly agree	5	Always	5

#	Proposed Internal team best practices for delay management	Acceptance					Frequency				
		1	2	3	4	5	1	2	3	4	5
A1.0	Under planning & scheduling										
A1.1	Identify the risks and constraints of the project to include with planning & scheduling, technical and contractual documents.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A1.2	Finalize the most suitable method of construction and required resources in compliance to technical and contractual requirement.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A1.3	Select a familiar planning & scheduling software to all team members which can produce faster, accurate and contractual report requirement.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A1.4	Select and assign the suitable resources (staff, workers, plant, machinery & equipment), with sufficient quantity and at right time to match with contractual and approved project documents.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A1.5	Organize discussions with industry expertise who have similar project experience and review the lessons learnt documents of previous similar projects of the company.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A1.6	Prepare the detailed internal procurement schedule to ensure meeting of time targets and comply with contractual requirements.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A1.7	Finalize project Quality Health Safety & Environmental (QHSE) policies and procedures aligned with organizational needs and comply with contractual requirements.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A1.8	Select most suitable modes and means of project communication system which is convenient and non-disruptive.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A2.0	Under construction management										
A2.1	Issue the latest approved documents and regular revisions of drawings etc. immediately to the field officers and get back the old version of documents from their hands.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

#	Proposed Internal team best practices for delay management	Acceptance					Frequency				
		1	2	3	4	5	1	2	3	4	5
A2.2	Conduct regular meetings and discussions for sharing resources within the team, aware them about time targets, and discuss solutions for pending issues.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A2.3	Ensure to follow the approved QHSE policies and procedures to avoid rework and prevent site accidents.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A2.4	Coordinate with supportive services (purchasing and logistic etc.) to ensure timely receiving of goods and services as per internal procurement schedule.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A2.5	Conduct regular training and development programs to improve the efficiency and productivity of the staff and workers.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A2.6	Organize events to share the challenges, experience and knowledge gained by the team members after completion of milestones.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A3.0	Under contract administration/delay claim management										
A3.1	Produce claim notices on time and submit comprehensive delay claims by following the correct contractual procedure.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A3.2	Educate the team members to enhance the correct record keeping and reporting requirement in order to substantiate the claims.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A3.3	Develop a delay claim tracking system for easy monitoring purpose until closing the matter.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A3.4	Maintain the full control of handling Change orders through contract administration team.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A3.5	Get expertise ideas and/or refer lessons learnt from previous projects to incorporate with addressing delay claim issues.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A3.6	Aware the team members to take mitigation or avoiding the delay events in order to comply with contractual obligations of the parties.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A4.0	Under document management										
A4.1	Implement a convenient method of handling and managing the project documents (hard copies /digital copies) to ensure the well organize, fast access and security control.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A4.2	Conduct awareness and training programs on proper document handling procedures for storing, sharing, and retrieval and securing data.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A4.3	Carry out continuous monitoring and evaluation to ensure successful implementation of the document management system.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A4.4	Depute a focal point for full control of the document and the documents management system of the project.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A4.5	Provide access control mechanism based on authority levels to avoid transparency of important documents.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A4.6	Facilitate to share the knowledge and information of previous projects and knowledge banks through document management system.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Any other collaboration practices that can be implemented or proposed by the respondent:

1	Planning and scheduling related:
2	Construction related:
3	Contract administration/Delay claim management related:
4	Document management related:

SECTION C

C.1 Evaluating the current barriers to collaborative approaches based on different perceptions

Please select your choice by marking “X” mark on the relevant box according to the following number scale for the selections:

Acceptance	
Strongly agree	1
Mildly agree	2
Neither agree or disagree	3
Mildly disagree	4
Strongly disagree	5

#	Current barriers to internal team collaboration	Acceptance				
		1	2	3	4	5
B1	Culture and politics of the organization	☐	☐	☐	☐	☐
B2	Generational diversity	☐	☐	☐	☐	☐
B3	Differences of individuals’ professional qualifications and experience	☐	☐	☐	☐	☐
B4	Stress and fatigue due to tight schedules and work overload	☐	☐	☐	☐	☐
B5	Company’s reluctance to spend on team building activities and related facility development	☐	☐	☐	☐	☐
B6	Companies’ traditional human resources management policies and procedures	☐	☐	☐	☐	☐
B7	Restraints from the field officers due to challenges in working environment	☐	☐	☐	☐	☐
B8	Senior officers’ reluctance to diversify from the traditional working system	☐	☐	☐	☐	☐
B9	Project budget limitations on IT tools and techniques required for collaboration	☐	☐	☐	☐	☐
B10	Difficulties in converging many ideas to reach conclusions	☐	☐	☐	☐	☐
B11	Cost implications for co-locating of teams	☐	☐	☐	☐	☐
B12	Communication technology barriers and breakdowns.	☐	☐	☐	☐	☐
B13	Restrictions imposed during pandemic or epidemic situation etc., by the government and health services.	☐	☐	☐	☐	☐
B14	Cultural and geographical differences during remote team operation	☐	☐	☐	☐	☐
B15	Individuals’ personnel conflicts	☐	☐	☐	☐	☐

Any other **barriers to collaboration approach** proposed by the respondent:

SECTION D

D.1 Identification of methods and techniques to enhance the internal collaboration

Please select your choice by marking “X” mark on the relevant box according to the following number scale for the selections:

Acceptance	
Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

Usage	
Currently being practiced(used) in my organization	Y
Currently not being practiced(used) in my organization	N

#	Methods and techniques to enhance internal team collaboration	Acceptance					Usage	
		1	2	3	4	5	Y	N
C1	Introduce file sharing service within the team by means of Local Area Network (LAN) facility or internet facility based SharePoint, Google Drive, Dropbox and High Tail.	☐	☐	☐	☐	☐	☐	☐
C2	Promote forming different internal team groups through social media such as whatsapp, viber, facebook, twitter etc. for sharing details and information at faster.	☐	☐	☐	☐	☐	☐	☐
C3	Usage of web or cloud based document management system for proper document handling and knowledge sharing.	☐	☐	☐	☐	☐	☐	☐
C4	Implementation of online discussions and meetings by means of applications such as Zoom, Microsoft team, Go to Meetings etc.	☐	☐	☐	☐	☐	☐	☐
C5	Implementation of Enterprise Resource Planning (ERP) system by integrating all the key functions related to the construction process.	☐	☐	☐	☐	☐	☐	☐
C6	Introduce incentives program to motivate the teams based on target achievement	☐	☐	☐	☐	☐	☐	☐
C7	Select team members who possess positive attitudes	☐	☐	☐	☐	☐	☐	☐
C8	Continuous implementation of training and development events or activities.	☐	☐	☐	☐	☐	☐	☐
C9	Changing the workplace and/or job site culture	☐	☐	☐	☐	☐	☐	☐
C10	Appointing a focal point having strong interpersonal skills	☐	☐	☐	☐	☐	☐	☐
C11	Execute social gathering and team building activities	☐	☐	☐	☐	☐	☐	☐
C12	Develop the team members through continuous performance evaluation, promoting and appraising members.	☐	☐	☐	☐	☐	☐	☐

Any other **Methods and techniques to enhance the internal collaboration** implemented in the company or proposed by the respondent:

D.2 Identifying the focal point for internal collaboration in the project

Please select your choice by marking “X” mark on the relevant box

In your opinion who shall be the most suitable personal for coordinating the internal collaboration of the project?	
Project Coordinator	☐
Project Manager	☐
Construction Manager	☐
Planning Manager	☐
Contract Manager	☐
Other (Specify)_____	☐

Signature of the respondent

Date

Thank you very much for spending on your valuable time for this Questionnaire survey

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APPENDIX-3

RESEARCHER'S CONSTRUCTION EXPERIENCE

RESEARCHER'S EXPERIENCE IN CONSTRUCTION INDUSTRY

Period	Position / Company / Projects involved	Relevant technical and management experience
Jun/2014 to Up to now	Senior Project Manager Maga Engineering (Pvt) Ltd The researcher has involved in the Construction & Planning of the following projects 1. Kelani Right Bank WSP - Stage II (KRB 2), LKR 8.0 Billion project 2. Town East of Colombo District Water Supply Project - Package II, LKR 5 Billion project 3. Galagedara - Mawathagama WSP), LKR 6 Billion project In addition, he has contributed to tendering and estimating process of the above projects.	Project management Construction management Planning & scheduling Contract administration Tendering & Estimating
Jun/2013 to May/2014	Project Manager Salcon Engineering Berhad / KES Engineering (Pvt) Ltd Kalu Ganga Water Supply project-Phase-1 Stage 2 (Kandana-Horana Treatment plant Extension project under JICA fund (SLRs. 1200 Million) Construction work Planning & Coordination of a. Reinforce concrete Flocculation & Sedimentation basins (Processing capacity 60,000m³/per day) 3 units b. Filtration unit - 4nos (Filtering capacity 60,000 m³/day)	Project management Construction management Planning & scheduling Contract administration

Mar/2011 to May/2013	Construction Manager NCC & Sierra Waterworks (Pvt) Ltd. (JV) Kaluganga Water Supply Project –Phase I (Stage II) The Supply and Laying of Ductile Iron (DI) TM and SM (Dia 1000mm DI – 10.89Km, 800mm DI – 3.64Km, Dia 450mm DI – 4.6Km, Dia 400mm DI – 2.1Km) from Bandaragama to Piliyandala & in Surrounding Areas Construction work Planning & Coordination of Precast pile driving in marshy areas, Fabrication and erection of steel pipe bridge on bored piles. Pipe laying in Marshy areas	Construction management Planning & scheduling
Nov/2010 to Feb/2011	Officer In-charge - Pipe Laying (PS3 & PS5 Area) China Geo Engineering Corporation Waste water Disposal systems for Ratmalana / Moratuwa & Ja-Ela / Ekala areas. Project Cost US\$ 90.1 million under Swedish International Development (SIDA) Loan. Dia 1200mm GRP – 2Km, Dia 800mm GRP – 5.0Km - Overall Planning & management for Laying of Dia.800mm, 1100mm (GRP)-Gravity main, Dia. 450mm, 230mm, 160mm CPE –Rider and Dia. 630mm, 315mm PPE Force main in Ratmalana –Moratuwa	Construction management Planning & scheduling
Jun/2008 to Oct/2010	Senior Project Engineer United Nations Office for Project Services (UNOPS) Development of Negombo Fishery Harbour.	Planning & scheduling Procurement management
Sep/2007 to May/2008	Procurement/Construction Engineer United Nations Office for Project Services (UNOPS) Construction of 50,000 gal Capacity Above ground Water sump, Pump house and Pipe works and Renovation of Existing Over head Tank. Construction of Water & Sanitation Facilities (WATSAN) in Galle & Matara Districts. – Construction work supervision.	Construction management Planning & scheduling Procurement management
Nov/2006 to Sep/2007	Construction Engineer United Nations Office for Project Services (UNOPS) Construction of 50,000 gal Capacity ground Water Sump, Pump house, Pipe works and Renovation of Existing Over head Tank in Base Hospital, Balapitiya. - Construction work supervision.	Construction management Planning & scheduling
Nov/2005 to Nov/2006	Project Engineer United Nations Office for Project Services (UNOPS) Construction of Two Storied building for Office of the Medical Officer of Health at Beruwala in Kalutara District. - Construction work supervision.	Construction management Planning & scheduling Contract administration

Jan/2004 to Nov/2005	Project Engineer China Geo Engineering Corporation Kaluganga Water Supply Project (KG-3) - Project Cost 10,000 million under JBIC Loan. Dia 800mm DI Pipe – 6Km, Laying of Dia.800mm, 600mm, 450mm, 250mm DI TM from Panadura to Moratuwa along Galle Road (A2) Laying of Dia. 225mm, 160mm, 110mm, 90mm UPVC DM Panadura & Moratuwa Area. Coordination of Pressure Testing & Road re- instatement.	Construction management Planning & scheduling
Apr/2003 to Jan/2004	Site Officer In-Charge (Site OIC) China Geo Engineering Corporation Kaluganga Water Supply Project (KG-2) - Project Cost 9,350 million under JBIC Loan. Dia 1200mm DI Pipe – 10Km, Dia 800mm DI Pipe – 9Km - Laying of Dia.1200mm & 800mm DI TM from Bandaragama to Horana along A8 Road. Coordination of Pressure Testing & Road re-instatement.	Construction management Planning & scheduling
Jun/2002 to Mar/2003	Site Engineer AL-MAS,AD CO. FOR ROADS LTD., Kingdom of Saudi Arabia. Majma'ah Hafer al Batin Express Way Dualization from Saudi Arabia to Kuawit Boarder. - Construction work supervision.	Construction management Planning & scheduling
Aug/2001 to Jun/2002	Site Engineer Lanka Trading & Construction Co. (Pvt) Ltd. Construction of Electronics & Telecommunication Department Building for University of Moratuwa. - Construction work supervision.	Construction management Planning & scheduling
Jul/2001 to Aug/2001	Academic instructor University of Moratuwa.	Laboratory testings

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APPENDIX-4
DETAILS OF EXPERTISE AND THEIR VIEWS & IDEAS

COLLECTION OF EXPERTISE IDEAS/VIEWS ON CONSTRUCTION DELAY MANAGEMENT

1	Name : Eng. A.M. Cassim Organization: Maga Engineering (Pvt) Ltd. Designation: Additional General Manager Qualification: B.Sc.Eng (Hons), PGD(Hyd. Eng), C.Eng., MIE(SL),MICE(London) Experience : 46 years Date: 12-06-2020 Time: 10.00 a.m Communication mode: Face to face
	Generally, contractors have found it difficult to receive the full Extension of Time (EOT) as requested in the EOT application. Therefore, they tend to keep a buffer intentionally to the EOT applications assuming the owner/consultant can cut down certain quantities in order to achieve the target completion date. The contractor's staff usually struggle to find the contemporary records required for the preparation of EOT applications and related cost implications, since there is no focal point in the project for managing the project document in a systematic way. Sometimes, field daily records are not in line with the needs of the claim preparation and substantiating the claim. The lack of knowledge and language issues of field staff etc. may cause in presenting the incomplete field records to the file. Also field staff is lack in knowledge of contract administration requirements of the project and only focus on construction activities. Many reworks occur at site due to following the wrong version of drawings by the field officers. There is no proper mechanism at site to receive the latest updated drawings, method statements etc., from project office to the hand of the field officer. Sometime, field officers do not have proper understanding on time targets set in the contract and to take initiatives for delayed items.

2	Name : Eng. N.A. Shantha Organization: National Water Supply & Drainage Board Designation: Deputy General Manager (Project Coordination) Qualification: BSc. Eng., CEng. MIE(SL), PGDip(Structural) Experience : 31 Years Date: 09-04-2020 Time: 9.00a.m Communication mode: Telephone
	Contractors need to select most suitable resources with adequate quantities to the project to prevent project delays. The staff should be qualified and experienced enough to get the required service for quality product and cater the requirements given in the contract document. The selected workers should be skilled and capable enough to achieve the deliverables on time as per the contract. The materials should be available on time with sufficient stocks as to continue the works to the workers without any disruption. Therefore, procurement plan should have been prepared in line with the time schedule to meet the project objectives. The team should follow up every major and minor items from procurement schedule up to the delivery of items to the site. The machinery and equipment should have sufficient capacities and quantities to get the maximum output in more productive manner. Also there should be proper plan for addressing to frequent machinery breakdowns. Storage of spare parts, regular machinery maintenance and outsource hiring arrangements are possible solutions in this regard. Conducting regular weekly, by weekly or monthly meetings would help team members to present their issues in carrying out the works, discuss to come up with possible solutions through knowledge sharing, ability to share the company resources within the groups and understanding on status of project and where they are currently. But meetings should be conducted based on preplanned agenda maintaining the ground rules by participating the relevant people and preparing the minutes of meeting.

3	Name : Mr. Asoka Jayaweera Organization: KDA Weerasinghe & Co. (Pvt) Ltd. Designation: Deputy General Manager Qualification: Institution of Engineers Sri Lanka, Part I&II Experience : Over 30 years Date: 08-12-2019 Time: 1.00a.m Communication mode: Mobile phone
	Contractors' most of delay claims are rejected due to notices are not given on time as per the conditions of the Contract. Sometimes they fail to submit the claim on time. Also Non identification of events in the critical path due to its dynamic behavior and only major items are taken into consideration based on the experience. Therefore, owners usually approve only EOT but cost is not paid in most of the occasions. Project team members find it difficult to accumulate records required in substantiating the delay claims when some staff members are transferred or leaving the company. Therefore, maintain records through a focal point is an essential requirement to avoid losing project data and information. Even though field officers commit on construction activities, they tend to work in an independent competitive environment to achieve their targets. Project managers pay less attention on team building activities due to budget and top management restrictions etc. in the project. Company resources are not utilized fully due to no focal point to share the resources and get maximum output. Most of Construction Companies have moved to use ERP system for effective management of company resources. But there are many issues pertain to this due the complex and dynamic nature of construction industry. There are many issues related to contractor's work programme. The work programme may not reflect the actual conditions of the project. Therefore, this should be monitored and controlled throughout the project to take initiatives to any delay events. The planning engineer or the manger should have a full control over the planning & scheduling process in coordination with the project manager. When the programme is deviated from the base line, catchup or amended programme should be prepared and implemented to avoid further delays. Also the construction companies do not record the lessons learnt from the ongoing or recently completed projects. This will cause to prevent utilizing or incorporating past records to future and ongoing projects. Also these knowledge repositories can be utilized in preparing documents for contractual documents, claims etc. Therefore, company should initiate a proper mechanism to store these data and information more safe and accessible manner in order to refer and extract for future references.

4	Name : Eng. T.L.R. Thilak Silva Organization: Maga Engineering (Pvt) Ltd. Designation: General Manager Qualification: BSc.Eng(Hons), MEng(Const.Mgmt), CEng., MIE(SL), MICE, PMP(USA), MSSE(SL) Experience : 35 Years Date: 25-09-2019 Time: 1.15p.m Communication mode: face to face
	Contractors need to take proactive measures to identify and address issues pertain to schedule delays and cost overruns due to turbulent nature of business environment in today's context. Therefore, strategic plans should be initiated in order to address for potential shortfalls in materials, equipment and labour etc., and also to measure the poor performance of subcontractors. There are many drivers leading to success of the construction projects in which most of the construction organizations pay less attention. Some of them are suitable management system for project governance, capability of managing risks, activity management in line with delivery management, proper resource planning & scheduling and capacity management and stakeholder management. Therefore, proper management of these drivers would mitigate construction delays and associated costs.

5	Name : Eng. N.P. Jayawardane Organization: Oriental Consultants & CEA JV Designation: Senior Resident Engineer Qualification: BSc. Eng., CEng. MIE(SL), PGDip(Cons. Project Management) Experience : 43 Years Date: 18-11-2019 Time: 8.30p.m Communication mode: Mobile phone
	It is believed that the factors like planning, progress monitoring and making adjustments, effective communication and good project collaboration would be most influential to effective construction project management. The planning strategies should be determined by properly studying the scope, resources availability, risks and constraints depending on the complexity of the project. Application of same methods, tools and techniques of previous similar projects would not be always viable solution for the current project and only a guiding document. Further, construction team should always be alert with the budget and schedule by monitoring and controlling closely and regularly. When it is detected any deviation of any of these, the root cause should be investigated and necessary actions should be initiated and executed immediately in order to get the project back on track. Similarly, Effective communication is an essential parameter for improving teamwork and leading better project collaboration. Finally, good collaboration within internal and external teams of the project can be lead to achieve the tasks or the project deliverables on time. This sets everyone's mind set on single target.

6	Name : Eng. P.P. Mahela Fernando Organization: Tudawe Brothers (Pvt) Ltd Designation: Deputy General Manager(Infrastructure) Qualification: BSc. Eng, CEng., MIE(SL) Experience : 30 Years Date: 03-01-2020 Time: 8.30p.m Communication mode: Mobile phone
	It has been identified that construction delay claims are unavoidable in most of the projects. Contractors always expect to receive extension of time and associated costs for the delays occur during execution of work. But contractors get its full entitlement very rarely due to many reasons. Many of them fail to notify the client regarding the delay events and impacts to the time and cost. Also the obligations of the contractor in order to minimize or avoid the situation. And submission of claim within the period stipulated in the conditions of contract. Lack of knowledge on contract clauses and non-identification of concurrency may always cause to fail the contractor's submissions. In addition, improper documentation, lack of contemporary records and information would not support to establish a good delay claim in favor to the contractor. Also lack of knowledge in case laws and wrong selection of delay analysis techniques are the major factors that influence to refuse the contractors' claims. Therefore, it is suggested to adopt the following strategies to overcome this unpleasant situations in the construction industry. Professionals in the construction industry do not possess the required knowledge and skills regarding contract administration. Also they need to enhance the knowledge in case law for successful evaluation of the current case. Most essentially, the quality of the contractor's work programme should be enhanced by providing the essential requirements and guide lines to make the realistic output. Construction practitioners should keep updating the work programme periodically based on the actual information received from the site time to time. Similarly, all the site records should be accurately and properly documented for future references. The contractor should be careful about the completeness, accuracy and timeliness of the delay claims from the notice initiation for winning its entitlement.

7	Name : Eng. P.M.R. Saman Polhengoda Organization: Sinohydro Corporation Limited Designation: Construction Manager Qualification: BSc. Eng, CEng., MIE(SL), PGDip(Cons. Project Mgt.) Experience : 26 years Date: 05-08-2019 Time: 7.30p.m Communication mode: Mobile phone
	The lack of proper integration under the key construction processes within the internal team has been one of the major issue in the current context leading to project delays during project execution stage. Similarly, this current individual or isolated performance behavior of internal team members has been led not to identify their responsibilities and, accountabilities for each and every activities under the project. In order to achieve the objectives of integrations of the processes, there should be a collaboration mechanism within the internal team members of the respective disciplines of the project. Similarly application of best practices would lead to enhance the processes efficiently at more practicable manner. There are many methods and techniques to enhance the collaboration of the team members with evolving information technology. But there are many barriers in the initial stage due to high investment cost and management restraints for transition from traditional system to new system etc. But, Strategic management of these system would provide many benefits to the project in the long run. However, it is important that all the team members are in positive mind set to make it more successful during implementation. In addition, social gatherings and team building activities may give major contribution in addition to the latest technologies. Also team members should be trained and developed continuously to maintain the collaboration process throughout the project.

8	Name : Eng. A.H.C. Silva Organization: National Water Supply & Drainage Board Designation: Additional General Manager Qualification: BSc.Eng, C.Eng, MIE(SL), PGDip(Sanitation), PGDip(Cons. Project Mgt.), PGDip(Env. Eng) Experience : 45 Years Date: 04-10-2019 Time: 8.30a.m Communication mode: Mobile phone
	Most of the construction projects get delayed due to negligence of parties to the Contract. There are many causes of delay related to client/owner, consultant and contractor which would be impacted to the project schedule. If they can work together for one target to achieve the project objectives during execution, most of these causes can be prevented. Therefore, collaboration between parties should be enhanced for this purpose. But, contractual terms and obligations can have a negative influence on this process. Moreover, contractors' should have a thorough understanding on the contractual terms and conditions and related contractual obligations. Especially, the field officers have less knowledge on this and these knowledge areas should be improved to avoid many issues pertain to the Contract administration. Also field staff should be aware about the importance of data & information as required for substantiation of claim.

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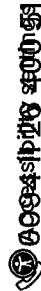
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