UNDERLYING LAPSES IN PROJECT PLANNING AND MONITORING OF BUILDING CONSTRUCTION PROJECTS IN SRI LANKA

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Declaration

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

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Abstract

The building sector contributes greatly to the economic growth and social stability of nations and in most countries, and it is often the largest contributor to the Gross Domestic Product (GDP). Planning in constructions, is a key concern of contractors, and the process of planning is increasingly growing in complexity, since it can be regarded among the managerial roles of building projects to be the most critical role that gives results to any given process. Planning in building constructions, is described as setting out a series of instructions in appropriate detail to inform the project team precisely what needs to be completed, where and what tools to be used to effectively achieve the project's deliverables. Monitoring is also an important aspect as planning.

Accordingly, a thorough literature analysis is conducted with the aim of identifying the planning and monitoring methods, processes and to identify the lapses in project planning and monitoring in the Sri Lankan construction context. In this context, several planning and monitoring methods which are used in the construction industry were identified such as project scheduling, critical path method, programme evaluation and review technique, network diagrams, 3D and 4D modelling, project planning tools. Further, several lapses in planning and monitoring namely, vague definition of the scope of project budget and schedules, adversarial attitudes of project participants, deficient communication between project partners, shortage of site workers and technical personal were also identified through the literature. Thereafter, comprehensive semi-structured interviews were conducted with industry experts selected from four (04) construction projects to identify their views on the insights gained from the literature review.

Based on the research findings, it can be identified that considering the impact of identified lapses in project planning and monitoring and their impacts on project deliverables such as cost, quality and time is significant. Accordingly, it is important to analyse and to identify the underlying lapses in project planning and monitoring of building constructions in Sri Lanka.

Keywords: Construction industry, Lapses, Planning, Monitoring, Sri Lanka

Dedication

This study is sincerely dedicated to my loving family, my parents, my devoted wife, and my children, who have been a continual source of inspiration in my life. They have given me the motivation and immense support to undertake this work with enthusiasm and commitment. This endeavour would not be possible without their love and support.

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Abbreviations

ADC- Automatic Data Capture

CPS - Cyber-Physical System

CSF - Critical Success Factors

GDP - Gross Domestic Product

LOB- Line of Balance

LOD- Linear Scheduling Method

NFC- Near Field Communication

PMO - Project Management Office

PDM- Product Data Management

PERT- Program Evaluation and Review Technique

RFID- Radio Frequency Detection

RTLS- Real-Time Location Sensing

RPM- Repetitive Project Model

TSSM- Time Space Scheduling Method

UHF- Ultra-High Frequency

VPM- Vertical Production Method

CHAPTER ONE

1.0 INTRODUCTION

1.1 Introduction

Planning and monitoring can be identified as two of the main aspects in the construction process, when discussing their application for the construction industry (Becerik-Gerber, et al., 2012). Even though use of project management has been widely discussed in numerous studies, still the construction industry is exposed to numerous long-term challenges during the early stages and execution of construction projects. In this context, Pan and Zhang (2023) identified that at the present context, there are numerous issues related to planning and monitoring of construction projects. These challenges are invisible if proper planning and monitoring principles were not thoroughly considered prior to execution of constructions. However, it is necessary to realize the issues first, that are currently involved in planning and monitoring of construction projects. Considering this research gap, this study focused to identify the lapses of planning and monitoring in building constructions in Sri Lankan construction industry. Accordingly, this chapter has provided the findings of background study that was undertaken for the aforementioned research aim.

1.2 Background

When considering the meaning of 'Planning', Bryson (2018) defines 'planning' as the process comprising of organizing and structuring the decision-making aspects through breaking down, clarifying, and justifying actions that needs to be followed during execution. Further, Shenhar (2011) explains that planning is the preparatory step before taking action. In addition, Nickols (2016) identified different stages of planning to be: formulating objectives, milestones and organizing strategic plans to achieve the defined goals and objectives. It helps to examine the current situation by realizing ways of fulfilling desired outcomes in future. Besides, planning encompasses the systematic process of achieving efficiency and effectiveness in the task delivered (Bryson, 2018). Importantly, planning deals with preparing different scenarios and combines with the forecasting. Accordingly, planning can be considered as a significant aspect in overall management of construction projects (Guo & Zhang, 2022). From project management

point of view, it is the most significant project management technique which becomes along with sequential steps to attain specific goals.

In construction context, “Planning” is widely perceived as the process that initiates with conceptual planning and initiated at the early stages of a construction project (Serrador, 2013). It was further mentioned that planning has a major part in the construction industry at present due to numerous reasons (He, et al., 2023). Proper and effective construction project planning can lead to the success of projects while ensuring that the quality and time constraints are matched to the expectations (Silva, et al., 2016). It is mentioned that a construction site which is properly planned ensures the efficiency of construction processes and safety of construction activities. According to existing literature, project planning can drastically impact project success (Serrador, 2013). Hence, for a proper building construction, planning cannot be avoided and disregarded.

“Monitoring” is the process of maintaining or ensuring that the project is running according to the plans where related measures in monitoring include evaluation of project performance, rectifying the existing project problems and getting necessary corrections to confirm that the project is proceeding within the pre-determined budget, time and scope (Aziz & Hafez, 2013). It is the method of overseeing all the project activities to ensure that the project is implementing as planned.

From a construction perspective, the aim of monitoring in construction context is considered as the evaluation and identification of undesirable deviations against the accepted plan (Li, Li, Skitmore, & Wang, 2022). Thus, the need of monitoring the sequential process of construction related activities has become extremely important. Significantly, it is argued that the monitoring is an effective step that is required to be undertaken as an essential part of the management of construction projects (Amade, et al., 2015). Moreover, it should be based on a structured and systematically developed observation of construction progress not only during the monitoring phase but also in the planning phase.

However, as mentioned by Serrador (2013), planning and monitoring can be considered as simultaneously important concepts in the construction industry. Even

though these two scenarios are well incorporated in project management, Kuchta and Sukpen (2013) defined that planning and monitoring are aspects that are currently neglected by many industry practitioners. This is well proven by Nickols (2016), stating that the success of project performance is heavily reliant upon the appropriate planning and monitoring process. Project execution is determined based on a proper project plan that is achievable through an effective control and monitoring methodology.

Therefore, there is a clear relationship existing among project planning and monitoring, and their contribution to successful project completion (Mohsin, 2021). In support of this, Hornstein (2015) stated that establishing effective project monitoring measures is an essential aspect of project planning. It is well-established that poor attention to planning and monitoring can lead to project failure in construction projects (Choma & Bhat, 2010). As the monitoring process involves tracking and checking at periodical intervals within a construction project which is being implemented based on a target, it delivers essential sources of information. Furthermore, it specifies the extent to which the project objectives are being implemented while giving early warnings on potential issues and giving solutions to ensure the project success. Therefore, initiating proper plans for monitoring during the planning stage becomes a must (Choma & Bhat, 2010).

However, even though literature reveals the need of proper planning and monitoring for construction projects, still there are deficiencies and gaps in between these two actions. As asserted by Jerbrant (2014), effective construction planning is still at an uncertain and challenged status due to the insufficient information of ongoing processes and required changes within the construction process. It is evident that construction projects are exposed to a large number of errors and failures due to the issues embedded in planning, monitoring, and controlling (Amandin & Kule, 2016). As accepted widely, construction projects are suffering from project delays, cost overruns and catastrophic changes to the project which make the project progress ineffective and decelerated. This makes disruptions to the construction activities resulting in less productivity, increased costs due to time overruns, claims and

desertions by third parties and finally, termination of projects (Akinsiku & Akinsulire, 2012).

Furthermore, the problems encountered along with the use of different systems, lack of integration of project participants, lack of appropriate flow of necessary information from project inception to project execution can also be considered as issues arising due to poor planning (Walasek & Barszcz, 2017). Further, conflicting interpretations and definitions in the contractual documents such as, not having clear definitions and specifications of project deliverables, responsibilities and sudden changes in legal and statutory requirements can also lead to issues arising dur to inefficiencies in planning and monitoring of construction projects (Gan, et al., 2015).

Nevertheless, as revealed in the literature, only few researchers have been focused on the identification of lapses and issues of planning and improvement of planning process. In this context, Iyer and Banerjee (2016) further indicated that there should be a properly designed plan for construction projects with measures to guide both planning and monitoring. Besides, Taherdoost (2018) stated that efforts to imposing more time for planning and monitoring has become less important nowadays, which has resulted in further issues. Accordingly, ineffective ways for planning, increased diverse technological projects and not clear explanations have been assumed for the less awareness for planning and monitoring.

Despite the continuous developments in enhancing project performance, lack of concentrations still presents in project planning, controlling and monitoring of construction projects causing numerous shortcomings in desired project goals (Collyer, et al., 2010). Evidently, there are lack of research efforts focusing on practical issues of construction planning and monitoring. Considering the Sri Lankan context, even though the overall challenges and barriers have been extensively discussed in the literature under the scope of project management, still there are no studies focused on identifying specific issues in planning and monitoring of construction projects. According to Jayasundara, Jayawicrema and Sivagananathan (2013), there are challenges to the use of project management principles and tools for the Sri Lankan projects. Further, Bandulahewa (2013) asserted that there are challenges in effective project communications in building projects in the construction industry in Sri Lanka.

As per the prevailing literature, it can be argued that the studies focusing on planning and monitoring in construction projects are considerably less in Sri Lanka. Hence, this research aimed to identify the lapses in planning and monitoring in building constructions considering the local context. The findings of this research can be consdiered significantly important especially for project managers and all other project participants to successfully achieve the desired project goals ae well as the objectives.

1.3 Problem Statement

According to Oke (2023), planning and monitoring can be identified as crucial elements in the construction industry. However, only a negligence amount of attention have been given to these areas in prevailing literature. Though principles of project management have been broadly discussed with its application to construction projects, similar challenges and issue are continuously discussed in other industries that are very commonly seen. Though the success of project management has been proved as a whole, the hidden issues and challenges of planning and monitoring and its adverse effects that discourage project success are still remaining without any solutions made. Furthermore, Formoso et al. (2021) mentioned that construction delays are inevitable in many construction projects at present, and therefore, more advanced methods need to be developed to address these. As recognized by, Project Management Institute (2008), identification of such invisible issues is the foremost requirement to realize how those issues decelerate the project performance prior to the identification of potential solutions. In relation to the context of construction industry in Sri Lanka, it is obvious that construction industry is still suffering due to the challenges of project performance. This clearly indicates a gap in academic research, where the focus of this research has been adopted from. Accordingly, this research is focused on identifying the lapses in project planning and monitoring in building constructions in Sri Lanka.

1.4 Aim and Objectives

1.4.1 Aim

The aim of this research is to determine the effect of underlying lapses, especially focusing on the hidden issues and challenges in project planning and monitoring, to the project success in building construction projects in Sri Lanka.

To achieve the above aim, following objectives were established.

1.4.2 Objectives

1. Critically review the concepts of planning and monitoring currently existing in building construction projects
2. Analyse the processes and methods used in planning and monitoring in building construction projects in the Sri Lankan construction industry.
3. Investigate the underlying lapses existing in the processes of planning and monitoring in building projects in Sri Lankan construction industry.
4. Evaluate the impact of identified lapses in project planning and monitoring for the performance and success of building construction projects in Sri Lanka

1.5 Methodology

A detailed and a thorough literature review has been completed initially to assess the concepts of construction project planning and monitoring and the sequential process involved with them. Based on the findings gathered from literature, the study further involves in identifying current practices, methods and processes used in construction project planning and monitoring in building construction projects identified from Sri Lanka. To achieve that, this study follows qualitative strategy by selecting four construction projects that can relate to this study area. In this context, all four selected projects have completed the construction. Using this approach, the aim of this study is to identify the prevailing issues and lapses engaged with each and every procedure of planning and monitoring. Finally, the findings are evaluated to identify the possible solutions to overcome the issues towards project success. Accordingly, 1st objective of this research is achieved through the literature review while 2nd, 3rd and 4th objectives are achieved through the data collection and analysis.

1.6 Scope and Limitations

In order to identify the effect of underlying lapses in project planning and monitoring to the project success in building construction projects in Sri Lanka, this research is only focused on identifying the context of building construction projects, Further, the focus of this study is directed to assess only the construction industry of Sri Lanka.

1.7 Chapter Breakdown

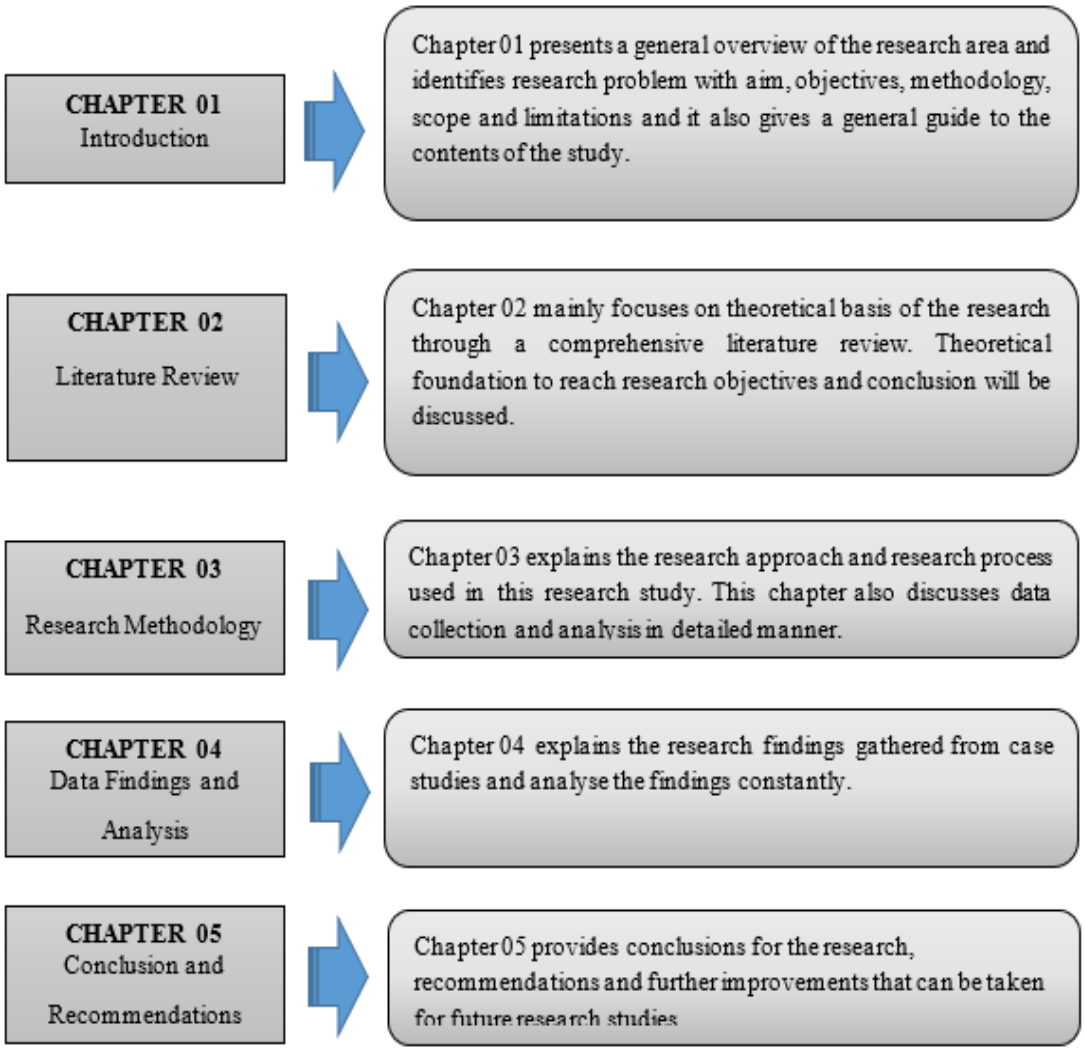

Figure 1.7-1: Chapter Breakdown

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter provides a comprehensive literature synthesis on construction industry, planning, planning in construction, importance of building construction planning, monitoring in building constructions, processes and methods used in planning and monitoring in building construction projects, modern technologies and processes used in planning and monitoring., Cyber-Physical System (CPS) Approach, real-time monitoring and progress determination, data acquisition technologies used for planning and monitoring and lapses of planning and monitoring in building construction projects. Accordingly, literature sources such as journal articles, conference proceedings as well as other electronic sources were reviewed to identify the existing body of knowledge regarding the study area.

2.2 Construction Industry

The building industry is converting a variety of services into physical, economic and environmental infrastructure (Formoso, et al., 2021). It can be considered as one of the most prominent industries in the world. Further, the building industry makes a major contribution to the gross domestic product (GDP) of almost all countries (Bandulahewa, 2013). Therefore, it can be pointed out that the construction industry plays a significant role in the economic development and social stability of countries, with many countries having it as the primary contributor to their Gross Domestic Product (GDP). Several studies have demonstrated a positive correlation between the development of the building sector and the macroeconomic growth of developed countries (Khan, Liew, & Ghazali, 2014). In addition to the above, a significant number of participants are involved in the building sector. Contractors, consultants, federal officials and private investors are major stakeholders and among these stakeholders, there are important backward links, such as supply and machinery manufacturers, accountants, attorneys and insurers, as well as others benefiting from income gained and resources given (forward linkages such as retailers, transporters and exporters) (Bandulahewa, 2013).

Over the past few decades, the Sri Lankan construction industry has experienced significant growth owing to the country's thriving economy, increasing urbanization, and tourism industry. The industry plays a crucial role in Sri Lanka's economic development, contributing to foreign exchange earnings, providing employment opportunities, and contributing to the Gross Domestic Product (GDP). Therefore, applying effective project planning to construction industry can be seen a critical component of the construction industry, involving the development of comprehensive plans, designs, and specifications for construction projects. The planning process in Sri Lanka is influenced by various factors, including government regulations, local customs, and practices, and resource availability. In this context, as stated by Jayalath and Gunawardhana (2017), effective project planning is essential to ensure that construction projects are finished within budget, on schedule, and to the required quality standards.

2.3 Planning in Construction Projects

Planning in constructions, can be seen as a key concern of contractors and the execution of effective construction planning is increasingly growing in complexity (Kermanshachi, Dao, Shane, & Anderson, 2016). According to Sears et al (2015), the top-performing projects are those that are thoroughly planned in achieving project objectives. Accordingly, effective planning can be considered as the most critical factor for success in building projects. The general consensus is that effective planning is crucial, and the more comprehensive the planning, the more likely the project will succeed. Adequate planning can mitigate risks and improve project performance. Conversely, insufficient planning can lead to project failures (Doloi, Sawhney, Iyer, & Rentala, 2012). In fact, poorly planned projects have resulted in the squandering of billions of dollars. Accordingly, planning is an ongoing, goal-oriented, intellectual, decision-making, and managerial process (Ghorbani, 2023).

Figure 2.3-1: Major areas of planning

Source: (Khan, 2020)

2.4 Planning in Building Construction Projects

Planning in building construction projects, is described as setting out a series of instructions in appropriate detail to inform the project team precisely what needs to be completed, where and what tools to be used to effectively achieve the project's deliverables (Liphadzi, Aigbavboa, & Thwala, 2015). Accordingly, building construction planning involves ratifying decision-making processes through decomposition, articulation, and rationalization. In the context of building projects, pre-project planning refers to the time between project planning and implementation when agreements are initiated. Another concept of building construction planning is "what happens before intervention" (Shenhar, 2011). Building construction planning is a key and demanding activity in the administration and implementation of building (Shehu, Endut, Akintoye, & Holt, 2014). According to Serrador (2012), building construction planning involves selecting the suitable technology, outlining work tasks,

assessing the required resources and time for each task, and recognizing relationships between different tasks. A successful building plan serves as the basis for creating a budget and project schedule. Although not always formally documented, developing a building plan is a critical task in building management (Harris, McCaffer, Baldwin, & Edum-Fotwe, 2021). Along with the technical aspects of building construction planning, organizational decisions must also be made regarding the partnership between project members and organizations involved in the project. For instance, the extent to which subcontractors are involved in a project is typically determined during the construction planning phase (Heravi, Coffey, & Trigunarsyah, 2015).

Forming a building plan can be considered as a very difficult process. In the development of a building plan, it is normal to place the primary focus either on cost management or on scheduling control (Kerzner, 2017). Building plans are mainly classified into expenditure groups with related expenses. In other instances, the planning of building project is expense/cost oriented. Under the category of spending, a differentiation is made between the costs incurred explicitly in carrying out the operation and the costs incurred indirectly in carrying out the project (Bocchini, Frangopol, Ummenhofer, & Zinke, 2014). In building construction planning, expenses like interest costs for project funding and overheads are typically considered as indirect costs. Proper sequencing of job events over time is critical in most tasks and emphasized during the planning phase. The manager responsible for the project makes sure that tasks are prioritized correctly, and the required resources are optimally scheduled (Vanhoucke, 2012).

Traditional planning procedures prioritize the management of priority tasks (resulting in crucial route scheduling procedures) or the optimal utilization of capital over time (resulting in job shop scheduling procedures). Finally, more complicated schemes need analysis of both expense and timing over time, meaning that arrangement, tracing and record keeping must take into account both measurements. The incorporation of timetable and expenditure details is a big problem in these scenarios (Jayasundara et al., 2013).

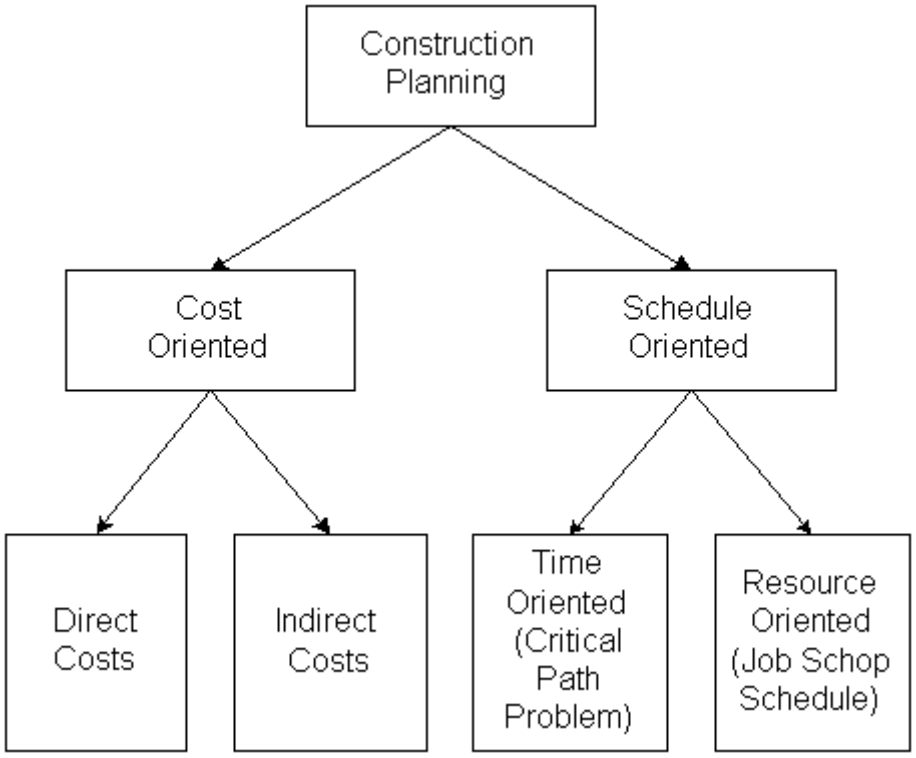

Figure 2.4-1: Construction planning

Source: Mogalli & Hussein (2017)

The primary result of the planning process in a project is the project plan, which is developed by project management during initial planning stages (Serrador, 2013). The project plan consists of several components, including a summary, project priorities, general strategy, contractual aspects, plans, finances, staff, risk control plan, and assessment procedures (Meredith, Shafer, & Mantel Jr, 2017). Accordingly, several management procedures can be carried out in order to establish a project schedule.

2.5 Importance of Building Construction Planning

Davoudi, et al 2012, argues that building construction planning is useful from a conceptual point of view. Authors further argue that "how can it be that project managers are expected to draw up a comprehensive project plan where either the actions cannot be foreseen or rely on the results of previous activities?". Further, Formoso et al (2021) points out that insufficient planning will reduce innovation in research and development (R&D) ventures.

Collyer et al. (2010) have presented examples of building construction planning failures, such as the Australian submarine and Iridium satellite projects. The authors argue that too much information in the initial phase of a project can be deceiving in a competitive environment, despite being helpful as a roadmap. Additionally, Serrador (2013) claims that developing complex and extensive long-term strategies in complex situations wastes time and money and may create unrealistic expectations. Further, Saeed et al (2021) have suggested that overly rigid planning processes have hindered the speed of at least one surveyed project management office (PMO). Finally, Love and Ahiaga-Dagbui (2018) noted that senior management may not rely on forecasts produced by the planning process.

"Plans become the backbone of every project; accordingly, planning is a prevalent practice in the sense of a project." (Blomquist, et al. (2010). This becomes a recurring theme where planning is fundamentally vital to the completion of the project, otherwise one might claim that project management will not work. Further, Bentahar, Tywoniak, and Loilier (2023) stated that improved process of planning is the standard in high-and super-high-technological projects. This was shown to relate uniformly to the deliverables usually generated during the planning process. In a rigorous analysis, Serrador (2013) noted the association between aspects of the planning process and the success of the project. Further, the initiative in preparing procedures was found to be less critical to the progress of the project than to define the practical and technological specifications of the projects.

As mentioned in the literature project planning has a substantial effect on the success of the project (Harris, McCaffer, Baldwin, & Edum-Fotwe, 2021). The responsibility for planning rests at the hands of project manager, who must take actions, so that the project is carried out correctly and to the full benefit of all applicable parties. Major benefits of good project planning are, eliminating or growing uncertainty, improving the quality of the operation, greater comprehension of the goals of the project and providing a framework for managing and managing work (Serrador, 2013).

2.6 Monitoring in Building Construction Projects

The purpose of monitoring is to accomplish the goals of the project, which will cause the least possible difficulties (Serrador, 2013). It is founded on observation, formal success measurement, the identification of variances and the implementation of corrective/preventive measures as well as the management of adjustments. The proposals of technical bodies and traditional project management organisations have accepted that the monitoring process leads to the minimization of variances during the implementation and to the production of better performance (De Marco, 2018). This shows the value of this method for the implementation of the subject and for the advancement of studies on approaches, tools and new developments (Whittemore, 2017).

Construction Progress Monitoring is an assessment that guarantees that the new construction is compliant with the funds requested by the contractor (Hamledari & Fischer, 2021). Successful building project monitoring improves protection, reduces repair costs and builds a solid foundation for sustainability. Construction monitoring offers a straightforward picture of the success of the project which helps to solve the issues before and when they occur (Lizza, 2017). Construction Progress Monitoring often verifies whether the finished construction is compliant with the designs and requirements. It is an accurate and constructive way to verify the efficiency, accuracy and success of the construction project (Abdel-Wahhab & Elazouni, 2010). Monitoring is also a mechanism that protects the needs of the customer against the threats involved with their interest in a development that is not under their direct control (Álvares & Costa, 2018).

The literature review undertaken by Hamledari and Fischer (2021) highlights the relevance of monitoring over the life cycle of projects and the absence of adequate methodologies despite the advancement of discipline. Further, Abdel-Wahhab and Elazouni (2010), indicate that much of the reasons of project delays can be due to lack of coordination and management, emphasizing the role of monitoring in achieving the objectives and improving the success of the project.

Table 2-1: Main areas covered by project monitoring

Main areas covered by project monitoring / **Authors**	Álvares & Costa, 2018	Lin & Golparvar-Fard, 2020	Khairadeen Ali, 2020	Vick & Brilakis, 2017
Construction environment	√			
Quality management and control	√			√
Timeliness and achievement of deadlines	√	√	√	√
Contracts, vendors and supplier results	√			
Health and safety	√			
Costs	√			
Equipment and materials	√			
Compliance with planning specifications	√			√
Change, variation needs			√	
Unintended results from the project execution			√	

Project monitor acts as an advisor and investigator for the client, rather than taking over the responsibilities of the project manager or developer. Basically, the project monitor attends as the client's representative during the development phase, keeping a

watchful eye over the project's progress (Lin & Golparvar-Fard, 2020). Project monitoring systems may be performed with a variety of various categories of clients:

- Apply to a financing agency which, upon completion, will gain the project as an investment.
- A resident or purchaser who, upon completion, undertakes to lease or buy a project.
- A bank or construction financing firm.
- Grant funders.
- Supporters of the Private Finance Initiative (PFI) (Álvares & Costa, 2018).

The project monitor functions independently and impartially to evaluate project success. They take a proactive approach by serving as an early warning system, anticipating potential issues that could affect project implementation, and providing the client with constructive feedback. The project monitor can also benefit the developer by ensuring well-informed decision-making. Making decisions based on unverified evidence can lead to poor outcomes, which can be a waste of resources. Therefore, it is essential to monitor project performance diligently and use the data collected to make informed decisions. The monitoring process can address a range of questions, as outlined by Khairadeen Ali (2020).

2.7 Processes and Methods Used in Planning and Monitoring in Building Construction Projects

Various sources offer possible lists of planning processes and as identified below.

Table 2-2: Processes used in planning and monitoring in building construction projects

Process of Planning and Monitorig	Vick & Brilakis, 2017	Zwikael and Globerson, 2006	Neale et al, 2016
Definition of project **goals**	√		√
Identification of **operations/tasks**	√	√	√
Creation of **project schedule/ Critical path**		√	√
Determination of project **delivery time**	√		
Determination of **resources** need to achieve objectives	√		
Organizational preparations		√	
Acquisition of **staff**		√	
Coordination and communication		√	
creation of a **project strategy**		√	

Accordingly, various planning methods are used in construction projects, including work breakdown structures, Program Evaluation and Review Technique (PERT) charts, and Gantt charts, according to Banfield (2019). Work breakdown structures divide the work into specific tasks that are the responsibility of individual team members. PERT charts, on the other hand, arrange activities in sequence to determine which tasks need to be done before others can begin. Gantt charts are horizontal bar charts that provide an overview of the project's progress and depict the project duration (Banfield, 2019).

2.8 Modern Technologies and Processes Used in Planning and Monitoring

The latest technologies used in planning and monitoring makes it possible to combine the natural world with the simulated one in order to create an atmosphere in which tangible and digital artifacts communicate in real time. As an example, a coupling technology Radio Frequency Identification (RFID) is used for the identification of building site properties during the planning process (Jayatilaka & Ranasinghe, 2016).

The frequently dynamic design of construction project management systems provides a tremendous incentive for more simplified processes to produce high quality, relatively cost-effective projects consistently (Konyukh, 2011). Keeping tabs on the progress of construction projects is crucial to ensuring their success, but it's a complex and demanding task due to the constantly changing conditions on-site. Although traditional construction site management typically relies on visual inspections and paper-based checklists, modern technologies are increasingly being used by project stakeholders such as owners, engineers, contractors, and subcontractors to update data and gather performance details from the site. Examples of construction site innovations that enable labeling of construction tools but otherwise work on the basis of wireless signals are: global positioning systems for machine site use and location monitoring (Kubba, 2010), Radio Frequency Detection (RFID) for location and monitoring of content on and off site and Ultra-wideband for real-time assets monitoring and work zone protection (Lucas, Burgett, Hoover, & Gungor, 2016). Examples of field technology that do not need physical instruments to be placed on the target but otherwise rely on optical measures that require line-of-sight for monitoring are, laser rangefinders for system guidance and positioning, and laser scanners for three-dimensional point cloud calculation (Richardson, 2019; Kubba, 2010; Oke & Aigbavboa, 2017) respectively. Above innovations have shown the significance of using such technologies for planning and monitoring than conventional approaches due to automatic and enhanced calculation precision and, at the same time, by offering a considerable amount of savings through improved efficiency (Aigbavboa, 2017).

Several other academic studies have recently examined the incorporation of physical building elements and their simulated models with the use of RFID technologies. Early studies in the building sector, however, centered on RFID applications for on-site

concrete processing, cost coding, material management and equipment monitoring (Trubetskov et al., 2015). Later, a modern monitoring architecture built on an embedded building asset tracking device is implemented for construction monitoring, incorporating RFID and ultrasound signals. Product Data Management (PDM) Systems and Near Field Communication (NFC) Technologies is being implemented to provide progress data for the construction project to all stakeholders, which is used as process during monitoring (Richardson, 2019). Studies have been carried out to assess the success of the building process by developing a management model focused on automatic data accumulation of the job site and an electronic monitoring system for the design of buildings (Gotfryd, 2015). Another methodology proposed an information management solution consisting of three components is the RFID data portion, the knowledge base and the optimization portion. The foundation of the knowledge base can be identified as ontology, that explains the contents and relationships related to on-site modeling processes in a systematic matter (Demachkieh & Abdul-Malak, 2018). One of the current research projects suggested a solution focused on the Real-Time Location Sensing (RTLS) technology to allow the Cyber-Physical System (CPS) for the sharing of knowledge for better monitoring the project. While this method has a promising outcome, the cost of such a solution hinders widespread application in the building industry (Tanik & Begley, 2013).

2.9 Cyber-Physical System (CPS) Approach

In construction, CPS can be mentioned as a connection among virtual ideologies and physical construction that allows for the synchronization of data in both directions (Akanmu & Anumba, 2015). The CPS architecture consists of abstract models, tangible entities, and interfaces that enable data acquisition technologies such as RFID. This bi-directional communication between the physical building elements and their computer model is real-time and facilitated by CPS. Therefore, CPS is not just a passive recognition mechanism, but an active reaction and collaborative process that is tightly integrated with the control system. CPS aims to provide reliable and prompt updates of information throughout the building process, aiding in both planning and monitoring (Anumba, Akanmu, Yuan, & Kan, 2021).

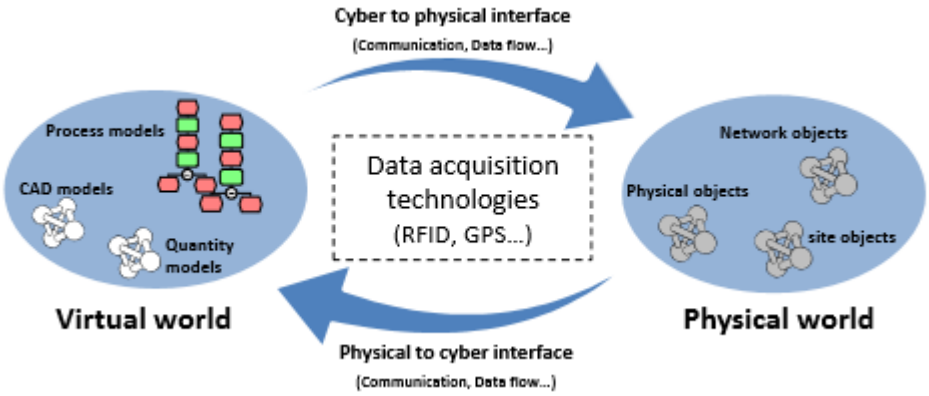

Figure 2.9-1: Cyber Physical Approach

Source: (Zhao et al., 2019).

Figure 2.3 illustrates the fundamental architecture of CPS, that based on the communication between the virtual and physical worlds through the use of data acquisition technologies such as RFID systems, GPS, and sensors.

2.10 Real-time Monitoring and Progress Determination

Continuous monitoring is a crucial process that sequences continuously during all phases of a project's life cycle (Kerzner, 2017). It links the physical objects involved in the CPS to the virtual world through the application of data acquisition tools such as RFID, GPS, and sensors. This technology generates data streams, including time, location, and identification, for all on-site resources, resulting in real-time status updates. To translate this raw data into concrete activities that can be interpreted by applications, several studies have been conducted. The real-time monitoring process involves coordinating the CPS and aligning it with the construction phase, which can be broken down into sub-processes (Akanmu & Anumba, 2015).

2.11 Data Acquisition Technologies used for Planning and Monitoring

The use of Automatic Data Capture (ADC) technology (including RFID, GPS, Barcode, Laser scanning, etc.) has the potential to automate the planning and monitoring process. However, in the building industry, there are currently only a limited number of available designs that can be practically implemented. Of these technologies, RFID is preferred due to its relative advantages and ability to collect and

amassed data about real-world objects such as products, equipment, shipments, and personnel information. By using RFID, it is possible to gather data and track the status of a project, allowing for an assessment of its success (Chuang, 2017).

The three primary categories of RFID tags include inactive, active, and semi-active (Nagpurkar & Jaiswal, 2015). Passive tags depend on the reader's power to send data and are less expensive with a shorter range and limited storage capacity. Meanwhile, active tags have a built-in battery to transmit data, are more expensive, and have a longer range and larger storage capacity. In construction sites, Ultra-High Frequency (UHF) RFID systems are used to identify both stationary and moving objects, including products, equipment, and workers. (Chaideftos, 2020; Pjevalica et al., 2019).

To effectively manage a building project, monitoring is essential during both the planning and implementation phases (Harris, McCaffer, Baldwin, & Edum-Fotwe, 2021). Linear building projects are currently managed using computer applications that rely on cyclogram graphics and traditional bar charts or network diagrams. However, these methods do not include time-space diagrams or graphs to display progress monitoring. The Line of Balance (LOB) and other interactive mapping forms are used during construction activity, but not for progress monitoring (Sumathi, 2014; Grottker & Schilling, 2017; Pjevalica et al., 2019).

As identified above, different methods used in planning and monitoring in construction projects can be summarised as per the findings of different sources as below.

Table 2-3: Methods used in planning and monitoring in building construction projects

Methods used in planning and monitoring in construction projects	Banfield, 2019	Jayatilaka & Ranasinghe, 2016	Kubba, 2010	Lucas, 2016	Richardson, 2019	Trubetskov et al., 2015	Tanik & Begley, 2013	Akanmu & Anumba, 2015)	Kerzner, 2017	Chuang, 2017	Nagpurkar & Jaiswal, 2015	Chaideftos, 2020; Pjevalica et al., 2019	Sumathi, 2014
work breakdown structures	√												
Program Evaluation and Review Technique (PERT)	√												
Gantt charts	√												√
Line of Balance (LOB)													
Product Data Management **(PDM)**					√								
Systems and Near Field Communication **(NFC)**					√								
Radio Frequency Identification (**RFID**) to identify site properties		√		√		√			√	√	√	√	
Global positioning systems for machine site use and location monitoring			√						√	√			
Ultra-wideband for real-time assets monitoring and work zone protection				√									
Laser rangefinders for system guidance and positioning					√								
Real-Time Location Sensing **(RTLS)**							√						
Cyber-Physical System **(CPS)**							√	√					
Automatic Data Capture **(ADC)**										√			

2.12 Underlying Lapses of Planning and Monitoring in Building Construction Projects

Underlying lapses of planning and monitoring in building construction refer to the fundamental deficiencies or weaknesses in the planning and monitoring processes that can lead to project failure or suboptimal performance. These lapses may include inadequate initial planning, inadequate risk assessment and management, lack of clear communication and coordination among project stakeholders, insufficient monitoring of progress, inadequate quality control and assurance measures, and insufficient resources allocation. (Pjevalica et al., 2019). Further, the authors observed that despite extensive planning in construction organizations, some projects still have poor performance scores. Pathiranage and Halwatura (2010) suggested that further planning could lead to delays in the subsequent steps of the process. According to Ika (2012), there is usually pressure to shorten the time and resources spent on the design phase for most projects. The authors further highlight the fact that managers may simplify skip planning altogether, thinking it is better to start building as soon as possible. However, experience has shown that these beliefs are not accurate.

According to Serrador (2013), a poor project plan can be the root cause of even the most competent team's failure. They argue that starting a project on the wrong track can result in significant project failures. Dolage and Perera (2009) similarly found that decisions made at the initial stage of project definition set the context and can have long-lasting effects on the project's success. Moreover, if a project is flawed from the beginning, it is the project team's responsibility to ensure successful completion, but larger organizations may still view such projects as disappointments.

Interestingly, there has been a lack of study on the effectiveness of project planning. Byaruhanga and Basheka (2017) suggested that 2% of the overall cost should be allocated to planning schedule, 10% to requirements, and 40% to actual design, with minimal design done during implementation. In a similar vein, Chuan (2013) posits that plans and specifications may account for 6% of project costs, 16% of product design, and 25% of comprehensive design. However, there is limited empirical guidance on how much time should be spent on planning, and it is unclear whether this

is due to the ineffectiveness of such advice, changing technological landscapes, or other factors (Kazi & Memon, 2012).

According to Nottage (2015), there are two methods for estimating effort allocation: the three-fold programming rule and the life-cycle stage model. The three-fold programming rule involves estimating the time it will take to configure the machine and multiplying it by three to get the overall balance. For software product research, the same amount of effort is required for development. This means that one-third of the total effort is required for planning and other assorted activities. Further, Edkins, Geraldi, Morris, and Smith (2013) found that front-end operations took up at least 20% of the project duration, while planning process for building projects accounted for an average of 20% of the overall working time. Choma, Schaars and Groen (2019) observed that projects without significant planning elements had the poorest outcomes, suggesting that too much planning or a planning period that is too long can also be detrimental to project completion. According to Sanni (2016), monitoring and tracking are essential for project success in the construction industry, but can be challenging due to the dynamic nature of the construction site. Although the construction industry mostly relies on manual processes like visual inspections and paper-based checklists, project stakeholders including owners, engineers, contractors and subcontractors are increasingly utilizing technology to collect site performance data and update project information (Schaars & Groen, 2019).

Construction planning and monitoring must be a far more autonomous activity in order to deal with the potentially unpredictable existence of the length of the mission. Neale et al. (2016) argued, however, that construction managers can only perform "quality assignments" if they do not meet the following criteria:

(1) appropriately defined (to be organized with other work and inputs to be recognized and connected)

(2) prepared to start (materials, design and preceding work completed)

(3) provide precedence in the critical delivery path to custom work

Moreover, following issues of planning and monitoring have been identified by (Schaars & Groen, 2019; Dohmen, 2019).

1. Undefined objectives – Where targets are not explicitly specified, the whole project and the team will lose. Where upper management is unable to negotiate or endorse unknown objectives, there is usually no hope of success with the initiative in question. The project manager must pose the correct questions in order to develop and articulate concrete objectives from the outset (Schaars & Groen, 2019).

2. Scope Changes – The term "scope creep" refers to the expansion of a project's scope beyond its initial objectives, which can occur due to project management decisions. The project manager must carefully evaluate any changes proposed by clients or managers and communicate the associated impacts on budget and timelines to all stakeholders (Dohmen, 2019).

3. Inadequate Project Experience – A project often needs skills that the project's participants may not have. Project management planning will help the project leader identify the necessary competencies, evaluate the existing personnel and consider training, outsourcing or recruiting of additional staff (Sanni, 2016).

4. Lack of Accountability – The leadership of the project manager will shine as each member of the team assumes responsibility for his or her part in ensuring the progress of the project. Conversely, a lack of transparency could bring the project to a complete halt. Fingering and avoiding responsibility are unproductive, but all-too-common aspects of faulty project management. Learning to lead projects towards a shared purpose is an important part of planning (Neale et al., 2016).

5. Improper Risk Control – Learning how to work with and risk planning is another critical piece of planning and monitoring. Risk tolerance is usually a desirable feature of the project manager, since tasks seldom proceed exactly to the schedule. Gathering feedback, building confidence and learning which areas of the project are more likely to take off path are facets of the work of the project manager (Sanni, 2016).

6. Ambiguous Contingency Plans – It is crucial for project management to decide what path to follow in predefined "what-if" scenarios. If contingencies are not established, the whole project can become mired in an unforeseen series of problems. Asking someone to find possible trouble areas will contribute to a smooth and fruitful project (Neale et al., 2016).

7. Poor Communication – Project managers have guidance at any phase in the project, such that each team leader understands what is planned. Effective coordination among all those participating with the project is essential to its effective completion (Dohmen, 2019).

8. Unrealistic Deadlines – A good project manager realizes that constantly challenging a team for the impossible will easily lead to a decline in morale and efficiency. The chances of effectively executing a project within undue timeframes are usually not achievable goals (Kazi & Memon, 2012).

9. Resource Deprivation – Lack of resources is also referred as an issue of planning. Management must ensure that the project is managed safely and effectively (Dohmen, 2019).

2.13 Chapter Summary

The above chapter summarizes the existing body of knowledge regarding the study area through a thorough literature analysis. Accordingly, this chapter identified the common aspects of the construction industry, planning in construction, importance of building construction planning, monitoring in building constructions, processes and methods used in planning and monitoring in building construction projects, modern technologies and processes used in planning and monitoring., Cyber-Physical System (CPS) Approach, real-time monitoring and progress determination, data acquisition technologies used for planning and monitoring and lapses of planning and monitoring in building construction in a comprehensive manner.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

Research methodology, according to Mukherji and Albon (2018), is a procedure that gives the researcher direction as they look for solutions to an issue. Accordingly, the methodology of the research is described comprehensively in this chapter. The research approach, research strategy, methods for gathering and analysing data, and the research process make up the bulk of this chapter. The qualitative approach has been chosen as the research methodology, and the explanation for the choice has been provided in the research methodology section as well. In collecting data, qualitative approach has been chosen in accordance with the research strategy and its justification. The data collecting portion covers literature reviews and semi-structured interviews, and the same area also covers manual content analysis as the selected data analysis technique.

3.2 Research Approach

There are three research approaches specifically qualitative, quantitative, and mixed method (Creswell, 2014). Table 3-1 describes the different definitions for qualitative, quantitative, and mixed method from different authors.

Table 3-3-1: Research Approaches

Approach	Definition
Quantitative Approach	The quantitative research approach aligns with the principles of positivism and aims to collect factual data to investigate the associations between various facts and theories, as well as prior research outcomes (Mohajan, 2020). Using this approach, researchers can obtain results for a specific sample population. Saunders et al. (2009) explains that the quantitative approach relies on numerical data and statistical analysis.

Qualitative Approach	Understanding and examining the denotation that individuals or groups assigned to a social or human situation are key components of the qualitative method (Creswell, 2014). Additionally, using a qualitative approach allows for in-depth exploration of emergent research subjects and studies with a limited number of respondents (Yin, 2011).
Mixed Method Approach	A researcher can utilize a mix of quantitative and qualitative research methods to collect and analyse data, integrate the findings, and make inferences from them (Leavy, 2022). Additionally, by providing numerous possibilities for data observation, utilizing a mixed method approach enhances implications and increases the rationality and credibility of the data (Zohrabi, 2013).

3.3 Selected Approach for the Study

The sort of research topic or problem being addressed determines the appropriate research approach to use (Creswell, 2014). According to Table 3-1, a mixed technique is a blend of both qualitative and quantitative methodologies. It is used to evaluate a theory, or the conclusions of earlier research based on the data that has been gathered. As a result, mixed methods also include quantitative traits. Through techniques like focus groups or interviews, the qualitative research approach examines the experiences, behaviours, and attitudes of people (Leavy, 2022). The goal of this research is to pinpoint the fundamental flaws in Sri Lanka's project planning and construction monitoring processes. In order to achieve this goal, the researcher needs to evaluate people's viewpoints and understandings, and collect precise data on the current status of project planning and monitoring in Sri Lanka, the influence of project planning and monitoring on the construction sector of the country, and the consequences of any planning and monitoring deficiencies on building construction. As a result, the qualitative research approach can be considered as the best choice for carrying out the study.

3.4 Research Strategy

A systematic approach known as research design transforms the research challenge into a solution (Patten & Newhart, 2017). The authors claim that the study design offers logical support for every step of the research process. According to Punch (2014), the research approach affects the research plan. The primary research methods used in the qualitative approach are ethnography, grounded theory, narrative, phenomenology, interviews and case study (Creswell, 2014). The choice of research design is then informed by the research question. As this research aims to investigate the identify the underlying lapses in project planning and monitoring and their effect to project success in building constructions in Sri Lanka, qualitative approach with interviews has been selected as suitable research strategy.

3.5 Case Study

A case study is an empirical research method that examines a present occurrence in its real-life context, particularly when it is challenging to distinguish between the occurrence and its environment. (Yin, 2014). Case studies help researchers better comprehend the context of their research. Accordingly, case studies can be undertaken using a single instance or several instances of related incidents. The number of examples used in a research study relies on the level of assurance desired as well as the significance of the underlying theoretical hypotheses (Yin, 2014).

Hence, in order to comprehend the root causes of failures in project planning and monitoring, and their impacts on project success in the construction industry of Sri Lanka, it is crucial to examine several cases. According to Ramanathan (2008), investigating at least two and up to four cases is advisable for a broad research field. For this study, all four examples were chosen from the final stages of the projects. The two main strategies for selecting cases are random selection and information-oriented selection (Etikan, Musa, & Alkassim, 2016). To achieve the research objective, an information-oriented selection approach was used instead of random selection, which involves picking cases randomly. The information-oriented selection method utilized specific criteria for selecting cases.

- **Case Boundary and Unit of Analysis**

In order to determine the root causes of project planning and monitoring failures and how they affect project success in Sri Lankan building construction, this study focuses on those specific issues. Therefore, the case boundary is Sri Lankan construction projects, and the unit of analysis is underlying lapses in project planning and monitoring.

3.6 Data Collection Techniques

According to Polonsky and Waller (2011), it is important to carefully select the data collection method based on its logic, applicability, validity, and the amount of data required. Accordingly, Dewi (2021) provided various methods for qualitative research, such as, semi-structured or unstructured interviews, analysis of documents, surveys, and a combination of these methods. Based on the above, this research was conducted through primary data collection method of semi-structured interviews, after a thorough analysis of existing literature on the study area.

3.6.1 Literature Review

The purpose of conducting a literature review is to gain a thorough understanding of topics such as the construction industry, planning, planning in building constructions, the importance of building construction planning, monitoring in building constructions, methods and processes used in planning and monitoring in building construction projects, and data acquisition technologies used for planning and monitoring. The research is developed initially by discussing prior research by assessing and mapping the research area in order to validate the research hypotheses and questions as well as to inspire the research goal.

3.6.2 Semi-Structured Interviews

Under the qualitative methodology, semi-structured interviews were conducted, which combine structured and open-ended questions based on the study issue (Adams, 2015). According to the authors, open-ended questions allow the interviewer and subject to go into further detail about the topic while still defining the investigation's focus. Interviews with twelve (12) experts participating in various building projects were performed in three main groups. Different professionals who have worked on building

projects fall into categories 1, 2, and 3, correspondingly. The goal was to use interviews to acquire more in-depth qualitative data.

Category 1: Executive level

Category 2: Management level

Category 3: Staff level

3.7 Data Analysis

Collected data is analysed by using qualitative analysis tools.

3.7.1 Qualitative data analysis

Data analysis is the process of assessing the information produced by the literature review and data gathering stages in order to provide relevant information (Johnston, 2014). To display and analyse qualitative data obtained through interviews, content analysis in manual method can be employed as a qualitative data analysis technique (Renz, Carrington, and Badger, 2018). Thus, content analysis has been chosen for this investigation.

3.8 Research Process

The research process outlines a step-by-step approach that includes developing the research problem, defining goals and objectives, reviewing the literature, choosing a research method, collecting data, and analysing that data (Jonas, 2017). Figure 3.1 depicts the study's research methodology.

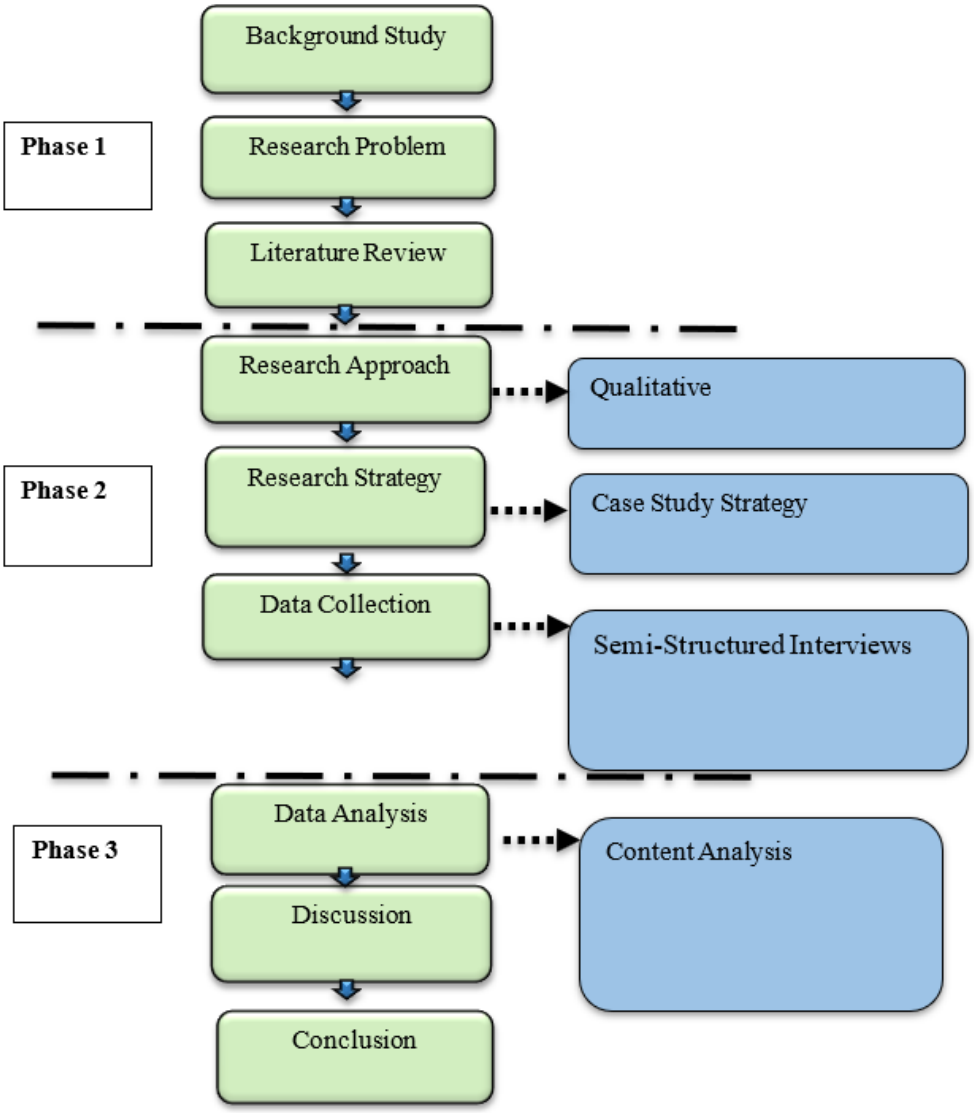

Figure 3.8-1: Research Process

3.9 Chapter Summary

This chapter focuses on providing a comprehensive understanding of the research methodology undertaken in conducting this study. Accordingly, this chapter highlights the aspects such as research process, research approach, research strategy as well as the data collection and analysis methods in general. In addition, this chapter illustrates the reasons for selecting different types of data collecting and analysis methods in order to facilitate the research aim and objectives.

CHAPTER FOUR

4.0 RESEARCH FINDINGS AND DATA ANALYSIS

4.1 Introduction

This chapter presents the results of the research conducted on achieving the identified research aim and objectives. Selected respondents from the four projects were interviewed to assess various aspects related to project planning and monitoring, including the importance of these processes in building construction, the current state of planning and monitoring practices in Sri Lanka, the impact of planning and monitoring on the success of the construction projects in the country, the different methods and tools used for planning and monitoring in the industry, the common lapses in these processes, and the effects of identified lapses on building construction in Sri Lanka. Further, semi-structured interviews were carried out with 12 respondents who were employed in the identified projects and the following sections provide their views and assessment of different aspects of construction planning and monitoring.

4.2 Profile of the Cases

This research is conducted through the analysis of four cases to gather data, which were named Case A, Case B, Case C, and Case D. In each case, three interviews from both the corporate and middle levels of employees were conducted. Although the four cases are not identical, they are comparable. Therefore, the analysis was carried out across all four cases. A summary of each case is presented in Table 4-1.

Table 4-4-1: Profile of the cases

Criteria	Case A	Case B	Case C	Case D
Type of Construction	Residential	Commercial	Commercial	Commercial
Year of establishment (Relevant Project)	2000	2010	1999	2006
Workforce (Number of people in relevant plant)	1200	1100	1350	1500

4.3 Profile of the Respondents

Semi-structured interviews were undertaken for data collection and the same number of respondents were selected from each case. An introduction to the interviewed respondents of the semi-structured interviews is shown in Table 4-2.

Table 4-4-2: Profile of the respondents

Case	Respondent	Year of experience	Designation
Case A	R1	21-30	Project Manager
	R2	21-30	Senior Quantity Surveyor
	R3	11-20	Residence project engineer
Case B	R4	21-30	Senior Manager - QS
	R5	11-20	Engineering Manager
	R6	More than 30	Senior Project manager
Case C	R7	11-20	General Manager
	R8	11-20	Engineer
	R9	11-20	Engineer
Case D	R10	11-20	Chief Engineer
	R11	21-30	Project Manager
	R12	11-20	Senior Engineer

All 12 respondents in the above 4 cases are responsible for the planning and monitoring activities in a particular organization, which is the underlying reason to selecting them for semi-structured interviews. Therefore, from each case, 3 semi-structured interviews were carried out.

4.4 Project Planning and Monitoring

Through the literature findings, several definitions for project planning and monitoring were identified. In comparing to the literature findings with the responses of the respondents, the respondents have emphasized few more definitions through the experience that they have gained through the industry work. R10 from Case D has highlighted that *"In the construction industry, project planning and monitoring are crucial factors. Project planning involves identifying the ultimate goal of the project and determining the necessary steps to achieve that goal. On the other hand, project monitoring involves protecting the client's interests from potential risks that may arise from a development that is not directly under their control*. According to the aforementioned definition it can be identified that the respondent has a broader idea about project planning and monitoring. This definition has been confirmed by R8 who is from the same case. However, R1 from case A has argued that *"planning is decided and make arrangements in advance, Monitoring is observed and check the progress and quality."* In comparing two definitions it can be identified that planning refers to defining the steps of the project in order to achieve the desired outcomes which have been explained at the beginning of the project. When discussing the essence of two defined definitions, monitoring can be referred as checking the progress of the project while ensuring the objective of delivering the clients requirements as it is.

Except to the identified definitions, the majority of the respondents have highlighted three parameters that should be based on planning and monitoring which are very crucial in every construction project. R6 have argued that the whole planning and monitoring process is based on time, cost and quality aspects. Further he commented that the planning process should be categorized as time, cost and quality planning at the early stage. Also, these three parameters should be totally based on the clients' requirements. Also, R5 commented that the whole monitoring process is about monitoring the different aspects of time, cost and quality in order to achieve the desirability of the project.

Furthermore, most of the respondents have highlighted the criticality of two aspects while explaining their expertise of planning and monitoring. R3 highlighted that "*The heart of the construction can be called as Planning and Monitoring which are the*

aspects should be closely monitored". Considering the above statement, it can be determined that the success of whole construction project is based on the aforementioned aspects. In supporting the argument of R3, R5 have commented based on the case A and case B, to keep the sustainability aspects of the project, since planning and monitoring are two important aspects of the project. Hence considering all the definitions and comments on the respondents it can be concluded that planning and monitoring are essential and critical aspects for effective management of a construction project.

4.5 Importance of Project Planning and Monitoring for Building Construction

Considering the importance of project planning and monitoring for building construction, all the respondents have commented that it is a critical aspect for effective completion of the construction projects. R2 has further highlighted that *"Project planning and monitoring are crucial components in managing a project efficiently from its initiation to completion, ensuring timely delivery and staying within the allocated budget.."* Considering the statement of R2 it can be identified that to complete the project within the pre-determined budget, planning and monitoring is an important aspect when it comes to residential projects. In adding to the statement of R2, R4 has commented that *"To limit and control the cost, quality and timing and to know the sequence of work items and resources requirement. Specially, allocation of funds is required planning."* By evaluating two statements thoroughly it can be concluded that the major importance of planning and monitoring is achieving the cost, quality and time parameters both residential and commercial projects. Nevertheless, the majority of respondents commented the same important aspect, R8 has commented that *"Through the project planning and monitoring it can be assess the progress of construction process and identify the deviations in order to take the corrective actions.* Through the statement of respondent R8 it can be determined that planning and monitoring can be used as assessing tool of the construction project. The same statement has been proved by R1 and R2 as well. Further respondents have elaborated that by using as a referencing tool, it can be identified the understanding the deviations of the existing process and identifying the corrective actions in efficient and effective manner are critical aspects in commercial projects.

Assurance of sustainability is an important aspect which was highlighted by R4 and R5. According to the respondents planning and monitoring is a critical aspect towards the sustainable built environment notwithstanding it is residential, commercial or any other type of construction project. Further respondents have commented that all construction companies are focusing on sustainability nowadays due to the growing awareness of adhere with the sustainable practices. Therefore, panning towards the assurance of sustainability goals while ensuring the time, cost and quality are important aspects of a project. The table 1 elaborates the major important factors on planning and monitoring from the different respondents.

Table 4-4-3: Importance of project planning and monitoring

Respondent	Important Factor			
	Time	Cost	Quality	Sustainability
R1	•	•	•	•
R2	•	•	•	•
R3	•	•	•	•
R4	•	•	•	-
R5	•	•	•	-
R6	•	•	•	•
R7	•	•	•	-
R8	•	•	•	•
R9	•	•	•	•
R10	•	•	•	•
R11	•	•	•	•
R12	•	•	•	•

Table 4.3 summarizes the findings of the section and it shows that all of the respondents have agreed that to keep the time, cost and quality within the pre-determined budget, planning and development have become important aspects. Also, the majority of the respondents have commented that sustainability is also one of the things that has been impacted from planning and monitoring.

4.6 Existing Situation of Planning and Monitoring in Sri Lankan Context

Considering the current situation of planning and monitoring in construction projects in Sri Lankan context most of the respondents have directly commented that the existing planning and monitoring process is at poor condition. In confirming with this R10 has commented that *"the planning and monitoring condition in Sri Lankan*

construction industry is at lowest level. The actions should be taken to avoid this kind of situations further". In confirming with this statement R5 and R8 commented that there is a big gap between planning and monitoring process and not only in commercial project but also in other projects as well. However, R12 has commented that planning and monitoring is at average level within the Sri Lankan context and still this needs to be improved. This comment is quite different from the other respondents. In addition to this most of the respondents have highlighted that there are several underlying reasons for this problem.

One of the major reasons which has been highlighted by R6 is *"Most of the professionals are not understanding the value of planning and monitoring due to lack of experience and knowledge. They are reluctant to adhere with the new tools, equipment and methods which are used for planning and monitoring process."* This implies that nevertheless planning and monitoring has become a critical requirement in construction projects, most of the stakeholders who are involved in the project are unaware of the methods which are used for planning and monitoring process. Therefore, in large-scale projects either its commercial, residential or multi development project education is an important aspect for planning and monitoring process. Further to respondent only theoretical education is not enough to carry out the planning and monitoring process, but also the experience is also one of the important aspects.

Except to the knowledge of the stakeholders R1 has commented that *"Less attention and support given by other stakeholders to project planning and Monitoring process but only looking at the end completion which makes the project unsuccessful. Initially they are reluctant to carry out the monitoring process as it is bit time consuming and costly. Therefore, within the pre-defined budget, quality and time they have become unable to complete the project in an advance manner. I have experiences this in residential projects".* This has been identified as one of the critical reasons for project failures. Because of this most of the projects have become unsuccessful. Though the stakeholders have adequate knowledge on planning and monitoring their lack of adherence with the practices due to heavy workload, give priority for other works, consider it as a cost consuming and time-consuming process have become critical

underlying reasons for project failures. Therefore, actions need to be taken to change the existing situation on construction project planning and monitoring. In addition to the statement of R1, R11 has commented *"Still there are several lapses in planning and monitoring construction projects in Sri Lanka. This has happened due to the lack of adherence of theoretical knowledge to the practical scenarios or lack of experts in the field"*. The respondent has presented different side that though the experts have enough theoretical knowledge application of practical situations are lacking. In addition to this statement R 12 has commented that *"There are several areas that need to be improved in current Sri Lankan context. Lack of coordination and communication between the parties have become critical reasons".* The coordination among the parties have identified as an important aspect for effective project planning and monitoring. According to the respondent poor communication between the parties have led to unsuccessful project planning and monitoring.

Therefore, it can be determined that, the current planning and monitoring of construction projects in Sri Lanka is at poor condition due to the lack of attention towards the planning and monitoring process.

4.7 Impact of Project Planning and Monitoring on the Success of Construction Projects in Sri Lanka

Considering the impact of planning and monitoring process for Sri Lankan construction industry, most of the respondents have commented that planning and monitoring has become a critical process in success of every construction project. R11 has commented that *"The whole commercial and other construction projects are basically dependent on planning and monitoring. Through the planning and monitoring project manager can assess the progress of the project which will lead to identify the gaps in order to take the corrective actions"*. Success of every construction project is based on achieving the pre-defined targets of the project. Therefore, to identify the deviation from the plan, planning and monitoring has become a critical aspect. Further the respondent has commented that *"Since the delay of handover, unable to complete the project within the pre-defined budget, and unable to complete the clients requirements as defined in the outset of the project have become common issues for every project in Sri Lankan context. Therefore, having planning and*

monitoring would be beneficial and use as a tool to identify the deviations of the project".

In similar to the statement of R11, R3 has commented that *"The success of a construction project is mainly based on three parameters namely cost effectiveness, timely completion and assurance of the quality. Since these aspects can be achieved through planning and monitoring, the majority of the success of construction projects depends on planning and monitoring".* Comparing the two statements it can be identified that planning and monitoring is the basis of success of every construction project such as commercial, residential, multi development, industrial, infra-structure etc in Sri Lankan context. R5 has emphasized that planning and monitoring would help to create the benchmark towards the success of the project. Create benchmark based on the project outcomes is a critical thing in every project. Therefore, planning and monitoring can be utilize as a reference materials for benchmarking of different aspects such as cost, quality and time of every construction project.

Minimizing the risk of the project is one of the important factors which can be achieved through planning and monitoring as explained by R4. According to the respondent *"Planning and monitoring can be used as a tool which will help to predict the risk associated with the whole construction project. Through the process it can be determined preventive or corrective actions which need to be in place in order to decide whether the risk is accepting, mitigating or transferring. This experience has gained from working several commercial construction projects".* Risk management is one of the major factors which need to be considered in every construction project. For construction failures, risk has become a critical factor. Therefore, planning for the risk at the earlier stage of every project and take the actions accordingly is an important part of every construction project. Through this manner the project can be effectively managed.

Except to the mitigation of risk, identification of roles and responsibilities of every stakeholder in efficient manner is another important factor which has been highlighted by R1. According to the statement of the respondent *"Through the proper planning and monitoring every stakeholder can identify their roles and responsibilities in the project which is help to the successful completion of the project. By planning the*

responsibilities and involvement of every stakeholder in earlier stage it can be avoided the conflicts between the parties who are involved in a project". By evaluating the statement of the respondent, it can be identified that through the planning and monitoring process it can be properly identified the roles and responsibilities of every stakeholder who are involved in the project, and they can get a proper idea about their responsibility towards the project which will reduce the conflicts. Furthermore, for the successful completion of every project everyone should complete their responsibilities in an acceptable manner. Therefore, it can be determined that planning and monitoring has become a critical aspect of the successful completion of the project.

Maximum utilization of the resources is one of the important requirements which should be fulfilled in order to properly achieve the project targets. According to R6 "*Proper planning of the resource utilization is important for success of every project. The resources can be human, financial and physical resources. Proper planning and monitoring of resources will help to maximum utilization of the resources which will be ultimately cause on successful completion of the project"*. In addition to this statement R7 has explained that the projects which have high budget such as commercial construction projects, this has become a common aspect.

Through the above statements of the respondents, it can be determined that planning and monitoring have become the underlying cause of every successful construction project within the Sri Lankan context.

4.8 Existing Planning and Monitoring Methods in the Sri Lankan Construction Industry

Through the literature findings modern planning and monitoring methods which are used in the construction industry has been identified. Through the literature findings it has been identified Project Scheduling, Critical Path Method, Metra Potential Method, Program Evaluation and Review Technique, Network Diagrams, 3D and 4D Modelling, Construction Virtual Prototyping, Project Planning Tools, Oracle's Primavera P6 professional Project Management, Project Planning Tools - MS Project , Line of Balance (LOB), Linear Scheduling Method (LOD), Line of Balance (LOB) ·Time Space Scheduling Method (TSSM), Line of Balance (LOB), Vertical

Production Method (VPM), Line of Balance (LOB), Velocity Diagrams, Line of Balance (LOB), Repetitive Project Model (RPM), Line of Balance (LOB), Line of Balance Scheduling, Radio Frequency Identification (RFID) technology, Digital Handheld Camera Photography and Graphical presentation of construction work progress method as major planning and monitoring tools which are used in the construction industry. Through the interviews, the identified tools presented to the respondents and **asked to identify the** planning and monitoring tools which are currently use in Sri Lankan construction industry. Table 4.4 represents the answers of respondents. Through the answers of the respondents, it has been identified that Project Scheduling, critical Path Method, program Evaluation and Review Technique, network Diagrams, 3D and 4D Modelling, project Planning Tools - MS Project, line of Balance (LOB), Linear Scheduling Method (LOD), graphical presentation of construction work progress are the major planning and monitoring tools which are used within the Sri Lankan context. None of the respondents have agreed with the other planning and monitoring methods.

Table 4-4-4: Planning and monitoring methods

Planning and Monitoring Method	**Reponses of Respondents**											
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
Project Scheduling	√	X	√	√	√	X	√	√	√	X	√	√
Critical Path Method	√	X	√	√	X	X	√	√	X	X	√	√
Metra Potential Method	X	X	X	X	X	X	X	X	X	X	X	X
Program Evaluation and Review Technique	√	X	√	√	X	√	√	√	√	X	√	√
Network Diagrams	X	X	√	X	X	X	X	X	X	X	X	X
3D and 4D Modelling	√	X	X	X	X	X	X	√	X	X	√	√

Construction Virtual Prototyping	X	X	X	X	X	X	X	X	X	X	X	X
Project Planning Tools - MS Project	√	√	√	X	√	√	√	√	X	√	√	√
Line of Balance (LOB)- Linear Scheduling Method (LOD)	X	X	√	√	X	X	X	X	X	X	X	X
Line of Balance (LOB) - Time Space Scheduling Method (TSSM)	X	X	√	√	X	√	X	√	X	√	X	X
Line of Balance (LOB) - Vertical Production Method (VPM)	√	X	√	√	X	X	√	√	√	X	X	X

Line of Balance (LOB) - Velocity Diagrams	√	√	√	×	√	√	×	√	√	×	×	×
Line of Balance (LOB) - Repetitive Project Model (RPM)	√	√	√	×	×	×	√	×	×	×	×	×
Line of Balance (LOB) - Line of Balance Scheduling	√	√	√	×	×	×	√	×	√	√	√	√
Radio Frequency Identification (RFID) technology	√	×	×	×	×	×	×	×	×	×	×	×

Digital Handheld Camera Photography	×	×	×	×	√	×	×	×	×	×	×	×
Graphical presentation of construction work progress	√	×	×	×	×	×	√	√	×	√	√	√

4.9 Other Planning and Monitoring Tools used in the Sri Lankan Construction Industry

Other than the identified technologies, R1, R3 and R5 commented that Primavera is another software application which is used in the industry.

- Primavera

The construction industry worldwide is facing increased demands, workload, and resource management challenges. To cope with these challenges, advanced methods and technologies are being adopted. One such technology is Primavera, a project management software owned by Oracle that can manage multiple projects, store various activities, resources, and target plans in commercial projects. According to R1, this suggests that Primavera could be beneficial for the Sri Lankan construction industry.

- Primavera in Construction Project Planning

Based on feedback from the survey participants, Primavera software is highly suitable for project planning and scheduling. Respondent R10 explains that the program can identify the actual relationships and sequence between on-site activities and quickly track project progress, allowing for parallel activities and avoidance of delays. Furthermore, the software enables users to load resources into activities, providing a clearer view of resource allocation. This suggests that the implementation of Primavera can improve project efficiency and effectiveness, enabling the project to achieve its objectives in an optimal manner.

- Primavera in Construction Project Monitoring

R10 has stated that Primavera can be used not only for project planning but also for project monitoring. The software allows for comparing the actual progress on-site with the baseline project. R8 has noted that Primavera has a unique feature of setting and maintaining multiple baselines, and it can analyze and identify the performance status of various aspects of the project using advanced reporting features. These encompass various elements such as driving activities, milestones, the longest path, the second-longest path, other float paths, and earned value indices. Additionally, Primavera has

a built-in tool called the Team Member tool, which makes it easy for the site team to report daily work progress using a computer or a phone.

4.10 Lapses in Planning and Monitoring

Through the literature review lapses which impact on the project planning and monitoring activities was identified. Table 4-5 presents the lapses that are relevant in the Sri Lankan construction industry as identified by the participants' responses. The most common lapses include unclear project scope, budget, and schedules, negative attitudes among project participants, poor communication among project partners, a scarcity of skilled workforces and technical personnel, delayed distribution of construction materials, conflicts with subcontractor schedules, low labor productivity, insufficient contractor experience, delayed progress payments by the owner, late procurement of materials, deficiencies in design specifications, and inadequate scheduling.

Table 4-4-5: Lapses in planning and monitoring

Planning and Monitoring Method	**Reponses of Respondents**											
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
Vague definition of the scope of project budget and schedules	√	√	√	√	√	√	√	√	√	√	√	√
Adversarial attitudes of project participants	×	√	√	√	√	√	√	×	√	√	√	√
Deficient communication between project partners	√	√	√	√	√	√	√	√	√	√	√	√
Shortage of site workers and	√	√	√	×	√	√	√	√	√	√	√	√

technical personal												
Late delivery of construction materials	√	√	√	√	×	√	√	√	√	√	√	√
Conflicts encountered with subcontractors' schedule	√	√	√	√	√	√	√	√	√	√	×	√
Low productivity of labour and inadequate contractor's experience	√	√	√	√	√	√	√	√	√	√	×	√
Delay in progress	√	√	√	√	√	√	√	√	√	√	×	√

payments by the owner												
Late procurement of material	√	×	√	√	√	√	√	√	√	√	√	√
Deficiencies in design specifications	√	√	√	√	√	√	√	√	√	√	√	×
Insufficient scheduling.	√	√	√	√	√	√	√	√	√	√	√	√

4.11 Other Lapses Impact on Planning and Monitoring in the Sri Lankan Construction Industry

Except to the factors identified through the literature review, majority of the respondents commented that lack of involvement of qualified project managers to the construction projects, unforeseen weather conditions, monopoly behavior of some of stakeholders, lack of adherence with novel technologies and lack of ability to application of theoretical aspects to practical situations.

- Lack of involvement of qualified project managers to the construction projects

The majority of the respondents commented that lack of involvement of qualified project managers is a critical aspect of every construction project which will cause to create a lapse between planning and monitoring process. R7 has elaborated that a qualified project manager can exchange knowledge on planning and monitoring with the team which can be effectively utilized for the projects. Further R10 has emphasized that *"With the past experience and academic expertise project manager can prepare an effective plan and schedule and place the monitoring techniques which can be effectively used".* This implies that it will create a lapse in planning and monitoring without a qualified project manager in every construction project.

- Unforeseen weather conditions,

Majority of the respondents have commented that, nevertheless the weather has been predicted at the initial stage of the project, unforeseen weather condition has become a barrier for every construction project which creates a lapse in planning and monitoring process. According to the respondents in a country like Sri Lanka it is hard to predict the weather. The major reason for this is there are no defined seasons within the country. Therefore, this reason will create the lapse in planning and monitoring process. This situation is common for every construction project in Sri Lanka.

- Monopoly behavior of some of stakeholders,

Stakeholder contributions towards the project are very important. Some of the respondents have highlighted that the monopoly behavior of the stakeholders has created lapse in planning and monitoring process. R7 highlighted that *"Some of the*

stakeholders of the project are reluctant to change the opinions and ideas of them and act with a monopoly behavior which will impact on planning and monitoring process". This behaviour has negatively impacted on project goals and outcomes." This statement has proved that the stakeholders have key role in planning and monitoring process and their monopoly behaviour will create lapses in planning and monitoring process.

- Lack of adherence with novel technologies

The global construction industry is utilizing several technologies for effective project delivery. The majority of the respondents have commented that due to the outdated technologies used in planning and monitoring is not providing effective input towards the project. Respondent R1 and R3 highlighted that accuracy is an important part of planning and monitoring process. Therefore, use of novel and trending technologies will provide accurate outcomes to the project in an advance manner.

- Lack of ability to application of theoretical aspects to practical situations.

R10 has highlighted that *"Nevertheless the industry practitioners have adequate knowledge on planning and monitoring tools, they are lacking applying such tools to the real-life scenarios. This is mostly happened due to their lack of experience."* Further to the respondent though the stakeholders have followed many educational programs on planning and monitoring still they are lacking application of such tools to the real-life practical situations.

4.12 Impact of Identified Lapses in Planning and Monitoring on Building Construction

Discussion of the impact of the identified lapses on the planning and monitoring is a critical aspect. The impacts are identified based on the responses of the interviewees. According to respondent R3 adversarial attitudes of project participants will cause to change the scope of the project frequently. Further to the respondent this is a critical impact on the planning and monitoring of the projects. Deficient communication between project partners is the critical lapse interpreted by respondents. According to R1 *"absence of communication and coordination among the parties will cause to change the budget and time period of the project due to change of different*

requirements of the parties." Further R2 has explained that *"changing the different requirements between the parties may cause to arise the conflicts between the parties which will negatively impact on the planning and monitoring process".* Respondent 11 and 12 explained that late delivery of construction materials can be identified as a critical lapse in planning and monitoring process. Further to the respondent's late delivery of construction materials has impact on timely completion of the project and failing to achieve expected project outcomes. Also, this will cause to change the planned budget of the project as well. Respondent 8 has explained that "Delay in progress payments by the client will cause to stop the works by contractor until the payment settlement". In addition to that respondent 7 has explained that "this will cause delay in timely completion of the project which is one of the major planning components". Deficiencies in design specifications is a critical lapse which was explained by the respondents. Further majority of the respondents explained that defficiencies in design specifications will impact on the quality outcome of the project. The deficiencies will misguide the contractor for design of the project which will be unable to fulfill the ultimate requirement of the client. Respondents have elaborated that lack of adherence with novel technologies. As an impact of this lapse Respondent 8 has added that *"lack of adherence with novel technologies will impact on the accuracy and transparency of the planning and monitoring process which will ultimately impact on the quality of the project."* The other identified lapses are discussed in table 4.6.

Table 4-6: Impact of identified lapses

Identified Lapse	Impact on planning and monitoring
Poorly defined boundaries and objectives of project cost and timeline.	Properly controlling the scope is crucial in a construction project. Scope creep, which refers to the expansion of the project beyond its initial goals, can negatively impact both the cost and schedule of the project. This may result in costly change orders and disruptions to the project schedule, which can be particularly challenging in a highly competitive environment.
Adversarial attitudes of project participants	Adversarial attitudes of project participants will cause to change the scope of the project frequently.
Deficient communication between project partners	Insufficient communication and coordination among the involved parties may result in alterations to the project's budget and timeline due to varying requirements from the parties.
A deficiency of site employees and technical personnel.	Shortage of site workers and technical personal has impact on timely completion of the project and failing to achieve expected project outcomes
Late delivery of construction materials	Late delivery of construction materials has impact on timely completion of the project and lack of completion of the project outcomes. Also, this will cause to change the planned budget of the project as well.
Conflicts encountered with subcontractors' schedule	Conflicts encountered with subcontractors' schedule will impact on the date of the completion

	of the project. Also, it will impact on the quality of total project.
Low productivity of labor	Lack of productivity of the labors will cause to impact on project cost, quality and time deliverables since the whole project is based on the human resources of the project
Inadequate contractor's experience	Inadequate contractor's experience will cause to quality of the project. Lack of fulfillment of clients requirement on time and within the pre defined budget is the main concern which is faced due to the inadequate of experience of the contractor. Also the contractor is responsible for managing the sub constructors of the project. Lack of experience will cause to ineffectiveness in handling the sub-contractors of the project which will impact on time, cost and quality of the whole project
Delay in progress payments by the client	Delay in progress payments by the client will cause to stop the works by contractor until the payment settlement. This will cause delay in timely completion of the project which is one of the major planning components
Late procurement of material	Late procurement of material will impact on the timely completion of the project. Because of this contractor is compelled to stop or slow down the work, waiting for the material and labour payments to complete the next step of the project
Deficiencies in design specifications	Deficiencies in design specifications will impact on the quality outcome of the project. The deficiencies

	will misguide the contractor for the design of the project which will make the builder unable to fulfill the ultimate requirement of the client.
Insufficient scheduling.	The project tasks are intended to be finished within predetermined time frames. However, unforeseen delays that occur during the project's duration may cause limitations in resource allocation and usage. This is due to the fact that some project planning methods do not account for the potential for such time lags.
Lack of involvement of qualified project managers to the construction projects	Based on the experience, qualified project manager is aware to achieve the project deliverables within the defined cost, quality and time. Not having proper qualified project manager will impact on whole deliverables of the project.
Unforeseen weather conditions,	Unforeseen weather conditions impact on timely delivery of the project. Due to the interruption of the work, it will be an additional cost for the project team as well.
Monopoly behaviour of some of stakeholders,	Monopoly behaviour of some of stakeholders, is a cause for lack of coordination and communication of the parties which will impact on the cost, quality and time of the project.
Lack of adherence with novel technologies	Lack of adherence with novel technologies will impact on the accuracy and transparency of the planning and monitoring process which will ultimately impact on the quality of the project.

Lack of ability to application of theoretical aspects to practical situations	Lack of ability to application of theoretical aspects to practical situations by project professionals will impact on the final project deliverables. Quality is one of the major parameters this can impact.

4.13 Summary of the Findings

The construction industry is a complex sector that involves numerous stakeholders, resources, and processes to deliver successful projects. The success of a construction project is dependent on the planning and monitoring of various activities throughout the project lifecycle. However, despite the criticality of project planning and monitoring, the construction industry is plagued with underlying lapses that impact project outcomes. In conclusion, the construction industry faces several underlying lapses in project planning and monitoring that impact project outcomes. These lapses include inadequate risk assessment and management, poor communication and collaboration among stakeholders, ineffective project scheduling, and poor project monitoring and control. Addressing these underlying issues requires a comprehensive and integrated approach that involves all project stakeholders to focuses on continuous improvement throughout the project lifecycle.

4.14 Chapter Summary

This chapter explains the findings of data collection. Through this chapter the planning and monitoring methods which are used in Sri Lankan context, lapses in planning and monitoring in Sri Lankan construction industry and impact on identified lapses on project planning and monitoring process was identified in addition to the initial data collected through literature review.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter comprises a summary of the research findings and recommendations for further studies. Furthermore, this chapter explains how research objectives were achieved throughout the study with the use if different approaches such as literature findings and interview findings. s

5.2 Conclusions

The Sri Lankan construction industry is a key contributor to the country's economy, and completing construction projects within the established budget, quality, and timeline has become a major priority in the industry. Planning and monitoring can be utilized as effective tools to avoid the deceleration and defiencies of construction project deliverables. However within the Sri Lankan context it has been identifed that planning and monitoring is at basic level due to the several lapses which are impacting on the process. Therefore through the study, lapses associated with planning and monitoring was identified and analysed in a thorough manner. Accordingly, the ultimate aim of this study was achieved with the accomplishment of the four (04) objectives of the study.

- **Objective One - Critically review the concepts of planning and monitoring currently existing in building construction projects**

The first objective of the study is focused on critically reviewing the planning and monitoring concepts in building constructions. Through the essence of the definitions, it has been identified that planning and monitoring are the two basis factors which will impact every construction project. Planning has been identified as setting out a series of instructions in appropriate detail to inform the project team precisely what needs to be completed, where and what tools to be used to effectively achieve the project's deliverables and the project manager has the sole responsibility for planning, and it is their duty to guarantee that the project is executed properly, and all relevant

stakeholders benefit fully. Monitoring has been identified as the process of maintaining project – related measures including the evaluation of project performances, rectifying project problems and getting necessary corrections to confirm that the project is running within the pre-determined budget, time and scope. These aspects were identified through the data collected in the literature review. Accordingly, this objective was achieved through the literature synthesis on the study area.

- **Objective Two – Analyse the processes and methods used in planning and monitoring in building construction projects in the Sri Lankan construction industry**

The second objective of the study is focused on analysing the processes and methods used in planning and monitoring in building construction projects in Sri Lanka. Project Scheduling, Critical Path Method, Metra Potential Method, Program Evaluation and Review Technique, Network Diagrams, 30 and 40 Modelling, Construction Virtual Prototyping, Project Planning Tools - Oracle's Primavera P6 professional Project Management, Project Planning Tools - MS Project, Line of Balance (LOB)- Linear Scheduling Method (LOO), Line of Balance (LOB) - Time Space Scheduling Method (TSSM), Line of Balance (LOB) - Vertical Production Method (VPM), Line of Balance (LOB) - Velocity Diagrams, Line. of Balance (LOB) - Repetitive Project Model (RPM), Line of Balance (LOB) - Line of Balance Scheduling, Radio Frequency Identification (RFID) technology, Digital Handheld Camera Photography and Graphical presentation of construction work progress method have been identified as the processes and methods used in planning and monitoring in building construction projects in Sri Lanka, through the literature findings. Except the identified methods above, Primavera has been identified as the software which is used for planning and monitoring process in Sri Lankan context through the findings of interviews. Accordingly, both literature and interview findings were used to achieve this objective.

- **Objective Three- Investigate the underlying lapses existing in the processes of planning and monitoring in building projects in Sri Lankan construction industry**

The third aim of the study was to explore the deficiencies in planning and monitoring in building construction projects in Sri Lanka, which was accomplished through interviews with industry practitioners. The major lapses identified include vague definition of project scope, budget, and schedules, adversarial attitudes among project participants, deficient communication between partners, shortages of site workers and technical personnel, delays in material delivery, conflicts with subcontractor schedules, low labour productivity, inadequate contractor experience, late progress payments, late procurement of materials, deficiencies in design specifications, insufficient scheduling, lack of involvement of qualified project managers, unforeseen weather conditions, monopoly behaviour of some stakeholders, inadequate use of novel technologies, and inability to apply theoretical aspects to practical situations.

- **Objective Four - Evaluate the impact of identified lapses in project planning and monitoring for the performance and success of building construction projects in Sri Lanka**

The last objective was to assess the effects of the detected deficiencies in project planning and monitoring on the performance and success of Sri Lankan building construction projects. Based on the results, it was found that all these lapses have an impact on key project outcomes such as cost, quality, and duration. Accordingly, considering all the key research findings, it can be concluded that the ultimate aim of this study was accomplished.

5.3 Contribution to Knowledge

This research mainly contributes to the knowledge on the identifying the underlying lapses in project planning and monitoring and its effect to project success in building constructions in Sri Lanka.

Research outcomes through the study can be elaborated in the following ways.

1 Identification of planning and monitoring process in construction industry
2 Planning and monitoring methods that can be used to effective planning and monitoring in the construction industry.
3 Understanding the underlying lapses in planning and monitoring process in construction industry
4 Recognizing the impact of identified lapses in project planning and monitoring for the performance and success of building construction projects in Sri Lanka

5.4 Recommendations for Industry Practitioners

Through the outcomes of this research, industry practitioners can identify the underlying lapses in planning and monitoring process and their impact on the planning and monitoring process. Some significant recommendations that can be given for industry practitioners are as follows.

1. Identification of the importance and planning and monitoring process for construction projects.
2. Enhancement of the knowledge of the employees on planning and monitoring methods which are trending and mostly utilized in global context.
3. Developing a proper discussion between the parties involved in the construction project when initiating planning and monitoring process.
4. Implement proper academic courses which share the knowledge on new planning and monitoring tools.
5. Establish training program for industry practitioners on planning and monitoring.

5.5 Recommendations for Academic Research

Although the aim and objectives of the research were achieved, some further development can be carried out for this research. Therefore, for further academic researchers, the following recommendation can be made.

- Propose suitable strategies to minimize the lapses in project planning and monitoring process in construction industry.
- Application of modern technologies for effective planning and monitoring process in construction industry

5.6 Further Research Area

Further research can be carried out in the following areas.

- Application of modem technologies for effective planning and monitoring process in construction industry
- Identifying the role of stakeholders m planning and monitoring process in the construction industry
- Developing the role of project manager in project planning and monitoring process in construction industry

5.7 Limitations

This study focused on identify the underlying lapses in project planning and monitoring and its effect to project success in building constructions in Sri Lanka. Furthermore, the study was limited to ideas and opinions of top-level and middle-level management. Therefore, ideas and opinions are limited to the two selected management levels.

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