A STUDY OF CRITICAL SUCCESS FACTORS BEYOND THE IRON TRIANGLE FOR BUILDING CONSTRUCTION PROJECTS IN SRI LANKA

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Degree of Master of Science

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DECLARATION

I declare that this is my own work and this thesis 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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DEDICATION

Liveliness Goes to:

Loveable and Generous,

Late and Great,

*Grandma **Leela***

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Abstract

Many scholars have researched the relationship between the level of project success and the level of success in project deliverables. In the initial era of the project success, it is merely straightforward and was measured using single measures of Critical Success Factors (CSFs) based on predesigned structures. In subsequent era, project success was measured based on subjective and objective measures, which was time and perspective reliance. In the final two eras it has been identified that project success is correlative with the CSFs. However, Sri Lankan Project Managers are working tediously for the balancing of the iron triangle. The ultimate project success can't be achieved at all the time by balancing the iron triangle because they are ignoring many other related factors.

The main purpose of this research is to identify the Critical Success Factors (CSFs) of construction projects beyond the iron triangle with respect to building construction projects in Sri Lanka. The mixed type research design approach was adopted. Quantitative research was based on questionnaires and semi-structured interviews. Whereas, qualitative research was conducted with the use of a literature survey and case studies.

This study reveals that project success must be measured not only up to the handing over stage, but it should be extended up to a sustainable period of time. The success must be measured through levels of satisfaction and benefits gained by all the relevant stakeholders. Further, the study identifies 21 CSFs to measure the success of a project at different levels. All 21 factors were critical in the first two levels of the project and criticality of the factors reduced with time. Political risk and Economic risk are the most significant factors throughout the whole life cycle of the project.

Keywords:

Hexagon of Project Success, Critical Success Factors, Key Performance Indicators, Micro and Macro Project Success, Project Management Success and Project Success, Project Output, Project Outcome, Project Impact.

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LIST OF ABBREVIATIONS

Abbreviation	Description
AC	Actual Cost
AHP	Analytical Hierarchy Process
AM	Arithmetical Mean
CL	Client
CO	Contractor
COC	Certificate of Completion
CPI	Cost Performance Index
CSFs	Critical Success Factors
CU	Customer
DLP	Defect Liability Period
EIA	Environment Impact Assessment
EOT	Extension of Time
EPPE	Ex-Post Project Evaluation
EU	End User
EV	Earned Value
GP	General Public
ICT	Information and Communication Technology
IN	Investor
ISO	International Organization for Standardization
KPI	Key Performance Indicators
LD	Liquated Damages
m^2	Square Meters
MR	Mean Rating
NETVAR	Net Variance
NPT	Network Planning Techniques
NPV	Net Present Value
PMBOK	Project Management Body of Knowledge
PO	Politician

PPEP	Project Post Evaluation Phase
PSM	Project Status Model
PT	Project Team
PV	Planned Value
R-A	Respondent A
R-B	Respondent B
R-C	Respondent C
R-D	Respondent D
R-E	Respondent E
R-F	Respondent F
RII	Relative Important Index
ROI	Return Of Investment
Rs.	Rupees
SPI	Schdule Performance Index
TMO	Temporary Multiple Organization
TQM	Total Quality Management
USD	United State Dollars
WBS	Work Breakdown Structures

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CHAPTER 1 - INTRODUCTION

1.1 Background

Traditionally, a project must deliver within the stipulated time period, within the agreed budget and fulfilling the quality standard that has agreed at the pre - contract stage. In most of the cases, if these criteria are met, it is assumed that the client or the end-user will be satisfied (Turner & Zolin, 2012). However, in the present world, project success is not limited to the above three aspects. According to the traditional concept, Time, Cost, Quality are considered as a rigid triangle and all the stakeholders work towards balancing the triangle. Consequently, this triangle is called as "Iron Triangle" because they are so strongly integrated (Barnes, 1988). As per Chan & Chan (2004), the concept of project success is developed to set criteria and standards by which project managers can complete projects with the most favourable outcomes. Furthermore, the criteria of project success can be defined as the set of principles or standards by which favourable outcomes can be completed within a set specification.

Iron Triangle model represents a limited view of project success since it only focuses on three aspects, it ignores many subjective and context specific issues. Further, it fails to take into account important success criteria relating to emergent properties of the project outcome. It would be beneficial to go beyond short-term measurements to long-term sustainable criteria (Stewart, 2015).

Similarly, as per Toor & Ogunlana (2010), traditional measures of the iron triangle are no more applicable to measuring performance on large public sector development projects. Other performance indicators are increasingly becoming significant and emergent. This implies that the construction industry is slowly departing from the traditional quantitative performance measurement to a mix of both quantitative and qualitative performance measurements. On the other hand, the Project Status Model (PSM) is presented as a powerful tool that analyses and illustrates the project success level from numerous of dimensions - both in qualitative and quantitative aspects. Moreover, it recommends a technique for visualizing key success criteria at each important stage throughout the life cycle of the project (Stewart, 2015).

As per Cox, Issa, Aherns, (2003), for most of the public development projects, number of stakeholders is usually large and diverse. Further, it is important to assimilate the viewpoint of all interest groups about the project's success. They determine that there is a substantial difference between the observations of construction stakeholders about Key Performance Indicators (KPI). Further, in present, due to complexity and stakeholders have distinct vested interests in a particular project which will be affected to the perception of success may also vary across various stakeholders (Bryde & Brown, 2005). Therefore, it is not surprising that different participants think differently while they analyze the performance of a project.

Additionally, Lim & Mohamed (1999), supportively argue that there are two possible viewpoints: macro-level success and micro-level success. Moreover, from another angle, Cookie - Davies (2002) points out the distinction between project success and project management success. Project success is measured against the successful level of the overall objectives of the project. Counter wise project management success is measured based on traditional iron triangle attributes. Further, as per Wateridge, 1998; Cookie - Davies (2002), it highlights the difference between the success criteria and success factors. Further, as per Pinto & Slevin, (1989), there are two main reasons for this combat or ambiguity regarding view of project success among the stakeholders.

1. It is still not clear how to measure project success because the parties who are involved in projects perceive project success or failure, differently.

2. Lists of success or failure factors vary in various studies due to the unique nature of projects.

From another perspective, Shenhar, Levy, & Dvir (1997) have noted that assessing success is reliant on time. That means, method of ascertaining the construction project's success will change from inspection to demolishing the structure after its life span. Shenhar & Dvir (2007) have suggested a model of success based on five groups

of success criteria and judged over different timescales. Criteria are: Project efficiency, Team satisfaction, Impact on the customer, Business success, Preparing for the future. Similarly, the above phenomenon has proven by Turner & Zolin (2012), it suggests that at the handing over point, the stakeholder's judgment in level of success is based on the traditional iron triangle. Though, in the months following the handing over the success is judged by the output performance as required and provides the desired benefit for the end user or the client. Ultimately, in the years following the project success is determined by whether the organization has achieved higher order strategic objectives that improves organizational performance through customer satisfaction and goodwill of the organization.

Further, as per Turner (2009) and Turner (2012), Project Managers assume that the projects and role of project management end when the project is delivered to the customer. Unfortunately, the Project Managers do not consider the wider and sustainable life cycle criteria which will affect the project once it is occupied. On the other hand, as per Chan & Chan (2004), even the same person's perception of success can change from project to project. Further, he has expressed that project success depends on project type, size, sophistication, project participants and experience of owners.

1.2 Research Problem

There are instances where the project is completed within the stipulated time period, within the given budget and match with pre agreed quality standards, the overall project success may be subpar and not up to the expectation or vice versa of it. Stewart (2015) illustrates several well-known examples where aspects in the iron triangle (i.e.: Time, Cost, Quality) fails to precisely represent the project's success.

Table 1.1: Example of Projects with Iron Triangle Deliverables and level of project success

Name of Project	Iron Triangle Deliverables			Project Success /Failure	
	Cost	Time	Quality	Short Term	Long Term
London Eye	Over	Over	Complete	Success	Success
First Generation Ford Taurus	On	Over	Complete	Fail	Success
Sydney Opera House	Over	Over	Complete	Fail	Success
Tacoma Narrows Bridge	On	On	Complete	Success	Fail
Titanic (the movie)	Over	Over	Incomplete	Fail	Success
Empire State Building	Below	Ahead	Complete	Fail	Success
Calgary Winter Olympics (1988)	On	On	Complete	Success	Success

Source: Stewart, 2015

In addition, as per Stewart (2015), Table 1.2 represents all the 16 probable scenarios that will occur, if one assumes that a project has only the 3 iron triangular deliverables (Time, Cost and Quality) and the verdict (an assessment/judgment of project outcomes).

Table 1.2: Decision table of four project assessment criteria (S = Success, F = Fail)

	Scenarios															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Time	S	S	S	F	S	F	F	F	S	S	S	F	S	F	F	F
Cost	S	S	F	S	F	S	F	F	S	S	F	S	F	S	F	F
Quality	S	F	S	S	F	F	S	F	S	F	S	S	F	F	S	F
Verdict	S	S	S	S	S	S	S	S	F	F	F	F	F	F	F	F

Source: Caccamese & Bragantini, 2013

When examining the above table, can easily identify that, Scenario 1 and 16 are the only two scenarios that represent project success judgment according to the iron triangle. Scenario 8 and 9 are the worst and dangerous selection of success criteria out of all the success factors. Due to traditional thinking of Project Managers in ICT projects focus only on triple constraints and categorized the project as a failure (really it is not so). Then, the project manager curtails the project or wastes money for unnecessary reworks. Hence, above Table 1.2 represents that iron triangle deliverables are not the absolute project success criteria that can be adopted in each project.

Further, it shows that the iron triangle does not represent the project success or failure at all the time. Moreover, for example, as per Clegg, Axtell, Damodaran, Farbey, Hull, and Lloyd-Jones (1997), Information and Communication Technology (ICT) projects failed in 80%. It happened because of the project success or failure was based on the iron triangle (Atkinson, 1999). Further, as per Sauer, Gemino and Reich, (2007), several other numerous factors encounter when evaluating ICT project success. Similarly, when considering construction projects, they also have copious success factors that are not considered in the traditional iron triangle; which are the only ones considered Time, Cost and Quality as the success criteria.

Hence, it is evident that the iron triangle criteria will not be sufficient to measure the project success and it has become a necessity to identify the different factors that will affect the success of a project.

1.3 Aim

The main aim of the research is to identify the Critical Success Factors (CSFs) of a construction project beyond the iron triangle with respect to building construction projects in Sri Lanka.

1.4 Objectives

Following are objectives of the research:

1. To identify the CSFs of a construction project beyond the iron triangle with respect to building construction projects in Sri Lanka.
2. To evaluate the relevancy and significance of CSFs on overall project success levels.
3. To identify the impact of the CSFs for each success level of construction projects in Sri Lanka.
4. To analyze the factors to suggest a taxonomy and framework related for effective implementation of the project deliverables throughout the project life span.

1.5 Hypothesis

In order to represent the project success level, the project deliverable framework must not be rigid to the iron triangle.

1.6 Methodology

To achieve the research objectives, both qualitative and quantitative methods were adopted. The methods adopted are as follows:

1. Literature Review:

   The literature survey was undertaken to identify the CSFs, types of project success. Further, it was discussed the CSFs of the construction project and how they affect from Key Performance Indicators of the different stakeholders related to project success or failure. Then, the review was further conducted to identify the effects of the CSFs for the project success or failure. Finally, it was discussed about how the project success varies according to stages of the project. Literature review was done by gathering information through Primary Sources, Secondary Sources and Referenced Guides.

2. Expert Questionnaire Survey

   The expert survey was conducted in two stages to identify the most CSFs for buildings and to recognize the criticality of the selected factors according to the project stakeholders and project success levels.

3. Main Questionnaire Survey

   A questionnaire survey was carried out to absorb the views of the professionals regarding the CSFs for building construction projects in Sri Lanka. A questionnaire survey was conducted among 50 responses who was working in 9 different professions related to constructions. When conducting the questionnaire, the professional's expertise and their enormous experience regarding the project success were assisted to derive the insight view of the CSFs related to the Sri Lankan construction project.

4. Case Studies

   Three case studies were conducted to validate the survey results and evaluate the changes in expectations and attitudes regarding the project success when time went on.

5. Data Analysis

   The collected data from the expert survey was analyzed by using Mean Rating (Stage-I) and Relative Importance Index (stage -II). Further, collected data of the main survey was analyzed by using Mean Rating. A framework was developed from the results of the Literature review findings, Questionnaire Surveys and Case studies. It was further supported through a matrix and a taxonomy.

1.7 Scope and Limitations

Numerous CSFs that will affect to the project success level. This study is narrowed down to key deliverables for multi- storied building projects and ignoring of the minor

ones. Since it is difficult to cover all the geographical area, the sample is limited to suburbs of Colombo district. Colombo district was selected as it is the prime district that building construction projects are carried out.

Further, the study is limited to specifically for the construction project management. Hence, the selected cluster of samples is limited to construction project professionals and researchers who have sound and in-depth knowledge in the construction industry. The questionnaire was answered by 50 professionals and some professionals did not answer the questionnaire due to several reasons which may affect final data analysis. Furthermore, when conducting the case studies several issues were encountered such as difficulty in contacting suitable respondents within each stakeholder category and respondents' unwillingness to share internal data. The approachable internal information related to the project was limited, due to confidential issues and some project information were not reported though it effects to project success. Therefore, case studies were conducted with limited information sources.

1.8 Chapter Breakdown

Proposed chapter breakdown for the dissertation is as follows:

- **Chapter 1 – Introduction**

  The Initial chapter covers the Background, Research Problem, Aim, Objectives, Hypothesis, Method Statement, Scope and Limitations of the research.

- **Chapter 2 – Literature Review**

  This chapter provides a comprehensive review of literatures on the CSFs and their effect on the final judgment of the project success level throughout the life cycle.

- **Chapter 3 - Research Methodology and Approach**

  The third chapter describes Research Design, Research Approaches, Strategies of Inquires, Research Methods, Data Collection and Data Reporting of the research.

- **Chapter 4 – Data Analysis and Research Findings**

  The penultimate chapter is allocated to analyze raw data collected from qualitative and quantitative research methods. Further, discussions were conducted based on the research findings to propose the most apt framework for the CSFs which represent the project success level for the multi storied buildings in Sri Lanka.

- **Chapter 5 – Conclusion, Recommendation and Suggestions For Further Researches**

  The final chapter concludes the research by highlighting the most effective project success factors for the ultimate verdict of the project success. It recommends a framework that will more precisely represent the CSFs beyond the iron triangle or not. The latter half of the chapter covers a list of suggestions for future researches.

CHAPTER 2 – LITERATURE REVIEW

2.1 Introduction

The initial chapter provides a brief introduction to the research subject area. Further, it discusses the research problem and ways of solving the research problem via establishing necessary aim for the study along with firm objectives to achieve it. This chapter tends to force on comprehensive background study, to obtain adequate knowledge about the subject area from previous researchers and pioneers of the project success area in project management. The first half of the chapter, provides information regarding numerous types of project success. The middle portion is allocated to reveal about the Critical Success Factors (CSFs), Key Performance Indicators (KPI) related to project success or failure. The penultimate quota of this chapter, is reserved for stages of a project; especially for a construction project. Finally, the chapter is allocated to establish a theoretical framework for the project's success and taxonomy for the overall project success.

2.2 History of Project Success

According to Muller and Jugdev (2012), the history of the project success and related literature can be categorized into four main eras considering the developments. During period 1 (the 1960s -1980s), the project success is highly focused within the project implementation to project handing over. The success of the project was based on iron triangle deliverables. Then, the project was either a success or a failure. Hence, project success is merely structural and straightforward.

Further, the second project success era was during the late 1980s and throughout the 1990s. In this epoch, the research prominently emphasized CSFs by enhancing the list through hypothetical narratives and single individual case studies. The negative point of this era was the lack of categorization structures or frameworks. Further, during this time zone, the researches described the success based on the tasked oriented view. Hence, the Project Managers measured the success in a single measure rather than

multiple measures throughout the life cycle of the project. They are not concerned about the collective effect of each success factor (Muller and Jugdev 2012).

Even though, in the middle stage of the 1990s, the researchers identified that success as subjective and objective dimensions. Further, they recognized success differs from time to time and person to person perspectives. During the penultimate period (from the late 1990s to the first decade of 2000), researchers found that there is a correlation among the project success factors and evaluated the relationship of the internal effects of each success factors to others (Muller and Jugdev, 2012).

As per Muller and Jugdev (2012), the final era runs from mid first decade of 2000 to date. Here, it is mainly concerned about the balancing of soft skills and hard skills of the Project Manager throughout the life cycle for a sustainable period to achieve business success and business ethics by fair trading practices which will be for the wellbeing of the society as a whole.

2.3 Types of Project Success

2.3.1 Macro Success and Micro Success

According to, Lim and Mohamed (1999), there are two possible viewpoints in project success. Namely, macro-level success and micro-level success (Figure 2.1). The micro level success is concerned about the iron triangle deliverables (i.e. Time, Cost, and Quality) along with the health and safety of the project. Further, in micro success, it is mainly concerned about the profitability and short-term gains such as: incentives, bonuses, promotions of the professional ladder. Generally, the micro viewpoint concerns the construction stakeholders such as consultants and contractors. They are concerned about project output only up to handing over the stage or until the defect liability and guarantee period of their commodity.

But, on the other hand, as per Lim and Mohamed (1999): the macro viewpoint considers that the project delivers long term operational and functionality from the project output.

Simply, in macro level success concerns the project outcome from the output throughout the life cycle of the project. It measures through the satisfaction gain during the operational period or product output. Usually the end users, clients and project beneficiaries are the ones looking at project success from the macro viewpoint. They are truly concerned that the project is delivered to the desired outcome, which will fulfill the requirements of the customer in a satisfactory level. (Carù, Cova and Pace, 2004). Further, it highlights the importance of customer requirements and meeting their needs. The desired level of success is correlated to the level of user satisfaction. Hence, if a project requires a high level of project success, the project output must deliver the project outcomes that must be able to fulfill the user satisfaction level (Lim and Mohamed 1999).

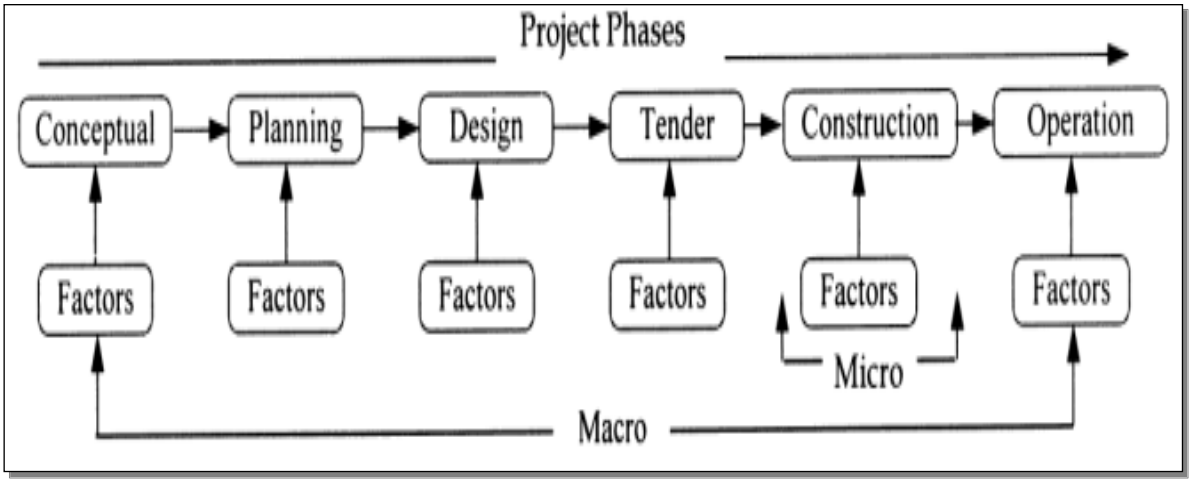


Figure 2.1 : Building Blocks of Project Life Cycle

(Source: Lim and Mohamed, 1999)

2.3.2 Levels of Project Success

Moreover, from another angle, Cookie - Davies (2002) has identified that, there is a distinction between project success and project management success. Further, Morris and Pinto, (2004) agreed with Cookie – Davies and extended the project success for three levels. Namely, they are: Project management success, Project success and Project portfolio success. Moreover, a continuous sequence in each adjacent levels (Project

management success and Project success levels; Project success and Project portfolio success levels) are not significantly different from each other. Though there is a significant difference in Project management success and Project portfolio success. Figure 2.2 represents the three levels of project success.

Figure 2.2: Three Levels of Project Success

(Source: Morris and Pinto, 2004)

As per Morris and Pinto, (2004), in the project management success level, it is concerned about, "Was the project done according to time, cost and quality standards?" According to Caccamese and Bragantini (2013), in this level project success is measured by using the cumulative earn value method of any project. Here, project output is measured by using the Cost Performance Index (CPI) and Schedule Performance Index (SPI);

Cost Performance Index (CPI) = Earn Value (EV)/ Actual Cost (AC)

According to Snijders, Wuttke, Zandhuis and Newton, (2013), Cost Performance Index (CPI), is a measure of the financial effectiveness and efficiency of the project until the handing over point. If the CPI value is more than 1, it indicates that the project is

performing well against the budget. If CPI value is equal to 1, it denotes that project performs according to the budget if not, the project exceeds the budget.

Schedule Performance Index = Earn Value (EV) / Planned Value (PV)

According to Snijders, Wuttke, Zandhuis and Newton, (2013), SPI indicates that project progress efficiency and it provides the schedule performance of a project. If SPI value is more than 1, the project is ahead of the planned schedule. Whereas, if SPI value is equal to 1, it symbolizes that the project is in par with the schedule, unless it denotes that the project is behind the planned schedule. Therefore, both indexes are considered only the project triple constraints –time, cost and quality. Time is measured by the Schedule Performance Index; cost is measured by Cost Performance Index and quality is measured by earn value at the handing over the stage of the project.

As per Morris and Pinto, (2004), the next level of success is Project success. Project success concerns "Was the correct project delivered to the user?" In this stage, it is mainly concerned whether the project output delivers relevant outcomes, which fulfills the needs of the users at a satisfactory level. It concerns that, the output of the project is in line with the meaning of the project. This is the period, that evaluates the project aims and objectives are achieved or not. In this stage success measures in terms of benefits for the stakeholders and whether project output has been delivered according to the organizations' practices and procedures.

Due to the fact, projects are Temporary Multiple Organizations (TMO), practically, most of the time, project success is judged at the time that deliverables are accepted by the client or at the handing over to the client. But, the real success of a project is often only understood after the benefits have been achieved, during the post handing over the stage. (Song and Letch, 2012). This is the most suitable period to judge whether the project deliverables are in line with end user needs.

According to Li, (2008), assessing the success of a project is not clear and it is referred to as "conditional causality", i.e. the relationship between project outputs and outcomes is not clear. The conditional causality means the cause is necessary but not sufficient to bring an effect of the work. As an example, Tacoma Narrows Bridge in the United Kingdom, was completed on time, within the budget, while fulfilling the initial quality requirements in July, 1940. It was the third longest suspension span bridge in the world when it was built. But unfortunately, after a smooth operation of 4 months it collapsed in November, 1940 (Stewart, 2015). This incident denotes that, though the project is delivered as per the project management success and short term project success, it was unable to fulfill the long term project success which was resulted unsuccessful in portfolio success also. That is why, as illustrated from figure 2.2, project success spans in a continuum in which project management success is complemented with project portfolio success. Hence, project management success and project portfolio success are two extremes in either poles.

As per Morris and Pinto, (2004), the final level of success is project portfolio success. In this stage, project portfolio success concerns: "Was the right project done, time after time?" Hence, it concerns not in one snap shot or one cross sectional time zone. The evaluation carries throughout the process periodically. Current stage success is measured in terms of aggregated performance of the portfolio components. The evaluation or assessment of this stage is not only limited to project output or project outcome; it goes beyond those boundaries. The project portfolio stage concerns the impact of the project, not only for the direct stakeholders and indirect stake holders, but also for the society as a whole. Similarly, Levine, (2005), has stated that, project portfolio success curve represents maximum benefit value that can be obtained by all the parties for all the invested capital throughout the life cycle of the project.

Besides, as mentioned above, according to Shenhar and Dvir (2007): level of project success can be categorized in to four levels as follows: Level 1- Project Management Success (until the handing over of the project or liability period of the manufacturer), Level 2 – Project Success, (within one year period from handing over the project), Level

3- Business Success (after 1 – 3 years from handing over the project), Level 4 - Further Potential Success (beyond 3 years after handing over the project).

Table 2.1 : Matrix for Project Focus versus Project Deliverables

		Project Deliverables	
		Project Output	**Project Outcome**
Project Focus	**External Focus**	**Level 2: Project Success** Quality of deliverables and stakeholder views	**Level 4: Future Potential Success** Business potential and wider impact to shareholders
	Internal Focus	**Level 1: Project Management Success** Internal Measures and Constraints	**Level 3: Business Success** Internal business value realized following project investment

Source: Dalcher, 2009

Table 2.2 : Matrix for Project Optimization versus Project Deliverables

		Project Deliverables	
		Short Term	**Long Term**
Optimize	**Effectiveness**	**Level 2: Project Success** Quality of deliverables and stakeholder views	**Level 4: Future Potential Success** Business potential and wider impact to shareholders
	Efficiency	**Level 1: Project Management Success** Internal Measures and Constraints	**Level 3: Business Success** Internal business value realized following project investment

Source: Dalcher, 2009

In Level 1 - project management success, is mainly concerned about internal measures such as iron triangle deliverables, health and safety of the project at the handing over the stage. The pivotal force is to concern only the internal forces and efficiency of the output of the project. Further, as per Toor and Ogunlana (2010), this is the main task of traditional project managers; but the most failure survey methods and criteria are using to assess. It results in most of the project failures are observed. In Level 2- Project Success, the assessment is based on the effectiveness of the project output and measured through the quality and satisfaction or acceptability of the stake holders (Shenhar and

Dvir, 2007). Moreover, concerns about the external forces, technical aspects of project output, assess whether project objectives are achieved or not. This is the most suitable and practicable period to access project success. Because after this stage, most of the parties are scattered.

According to Toor and Ogunlana (2010), Level 3- Business Success, assesses through the creation of internal value and delivery of internal values for the stakeholders. Assessment carries to evaluate that project has achieved its business objectives and efficiency of the project outcome. Generally, the above-mentioned strategic objectives examine through the maximization of financial strategies like, Sales, Profit gain and Return of Investment (ROI) from the project output. In this stage, it is concerned about the outcome and the values of project output. Level 4 - Future Potential Success: focuses to identify and optimize new business avenues to enhance the market share of the current business with welcoming the innovative and skillful young blood for the organization. Most of the decisions should not be short sighted; must be a strategically long-term approach. Hence, more concern about the long-term benefits such as: maximizes the market share, creating killer applications in ICT projects, self- enhancing positive feedback methods, sustainable future growth (Toor and Ogunlana, 2010). Here, the project effectiveness of the project outcome is concerned thoroughly.

According to Dalcher (2009), Level 1 and Level 2 success is about the micro view of the efficiency of a single product (project output). On the other hand, Level 3 and Level 4 success is focused on the macro view of the effectiveness of multiple products (project outcome). Further, Dalcher (2009), explained that quality is the main concern when the project moves beyond efficiency to effectiveness. The project success must be able to measure and evaluate satisfactory project quality levels to ensure the final product quality. To achieve the pre-specified product quality, there must be sufficient process quality. Moreover, Dalcher (2009), has emphasized that the overall project life cycle must have a Total Quality Management process to achieve both micro success and macro success of the project.

Hence, as per Dalcher and Brodie (2007), to achieve the desired project success, several different views of quality approaches must be adopted by the project managers and other stakeholders, according to the heterogeneous project attributes. They are as follows:

1. Quality of design - (type and grade of materials and tolerance and performance specifications)
2. Quality of conformance- (amount of adherence for the design during the manufacturing process)
3. Fitness for the purpose - (product can be used for the given purpose).
4. Maintaining quality becomes a process improvement.
5. Quality as product base quantity- (traditional view of quality related to the content of the product).
6. Quality as a user-based view- (quality is based on the values of the end users).
7. Quality as a specification- (product must adhere to technical specifications).
8. Quality as a value - based approach- (quality is equated to what the user needs at an acceptable price/ cost)
9. Quality as a transcendent property – (difficult to impose the assessment as it unmeasurable felling).
10. Quality as a continuous property – (modern view- quality as the evolving satisfaction level of the user).

2.4 Types of Project Results Appraisals

Another view of project success level, as per Turner and Zolin (2012), it is mentioned that the project results appraisal can be divided into above three stages as follows: Ex-ante assessment in project output level, Ex-post evaluation in project outcome, Ex-nunc monitoring in project impact. Hence, Ex- ante assessment is evaluating whether the project is delivered within the iron triangle constraints. Whereas, Ex- post evaluation is checking whether the desired outcomes fulfill the stakeholders' requirements and benefits. Further, Ex-nunc monitoring examines, the project deliverables impact as a whole of society – whether it is benefited or not.

Further, Fahri et.al.(2015), explained that, the benefits may be identified as financial benefits and non-financial benefits. Financial benefits are the ways of minimizing the cost and optimizing the profit. Non-financial benefits are the operational benefits and intangible benefits (Liu et al., 2003). In depth analysis, clearly distinguish that financial benefits are mostly quantifiable or can easily convert to a numerical value, which can be only utilized to check the efficiency of the project output. On the other hand, non-financial benefits are qualitative measures and difficult to convert into numerical representation, which can be applied to evaluate the both efficiency and effectiveness of the project.

Poon and Wagner, (2001), explained that, Ex- Post Project Evaluation (EPPE) is based on Ex -post evaluation and Ex- nunc monitoring. Therefore, EPPE, can effectively identify both quantitative and qualitative measures of the project success. As per Archibald, Di Filippo and Di Filippo, (2012), at the EPPE stage, it must be considered both planned and unplanned benefits from a project, to evaluate the comprehensive project success. This is due to the fact, the outcome level or impact level may provide benefits that cannot be achieved, in the output level. As an example, the movie "Titanic" is one of the most expensive films ever produced along with over scheduling and reducing the scope. The cost of the film was USD 200 Million in the year 1997; it was delayed by one year from the expected time of commencing the screening and the producer reduced the film telecasting duration by one hour. Yet, it became the highest grossing movie ever, has produced which has earned an estimated USD 2.18 Billion and won 11 Oscar awards in 1998. (Stewart, 2015). Another example from the construction industry is Opera House in Sydney, Australia. The Sydney Opera House was delayed by 10 years from the initial completion date and cost was overrun by 15 times of initial budget. But, in the present, the world admires its architectural value and consider as one of the architectural master pieces that hosts 1500 performances and attracts millions of visitors each year. (Stewart, 2015). Hence, as per Bryde and Brown, (2005), the overall satisfaction of stakeholders should also be considered in performance evaluation criteria.

2.5 Types of Skills Required for a Project Manager to Make the Project Success

Steven (1996) stated that, the project manger's skills can be categorized as: Soft skills and Hard skills. The hard skills are: objective, tangible and measurable. On the other hand, soft skills are: subjective, intangible, less measurable (Chan et.al., 2002). Additionally, Chan et.al. (2002), elaborated that, objective measures of project manager are: Time, Cost, Health and Safety, Profitability; whereas, subjective measures of project management are: Quality, Technical Performance, Functionality, Productivity, Satisfaction and Environmental Sustainability.

The project manager is responsible to delineate, create and maintain the balance among interrelated project constraints of heterogeneous nature. (Kerzner, 2009). This nature of the constraints ultimately affects for the heterogeneous nature of the overall project. Therefore, as per Caccamese and Bragantini, (2013), the project managers must combine project management through the concept of soft skills and hard skills of them, to achieve the desired outcome from the project.

Further, he explains that, soft skills must concern about the motivational space, social space and analytic space of the project team. On the other hand, the hard skills of project managers are to manage the time, cost, quality, scope of the project. Therefore, soft skills are quantitative attributes (mono-dimensional); where as hard skills focus both quantitative and qualitative attributes (bi- dimensional) (Caccamese and Bragantini, 2013). Moreover, as per Caccamese and Bragantini (2013), in a project, there must be a considerable large space for motivational portion such as intellect, respect, recognition and esteem of an individual. On the other hand, there must be a large span of analytical or holistic space which is very crucial when it comes to in-depth analysis. Social space requires throughout the project at an even amount, which makes each individual a valuable person for the project. The social characteristics that should be developed by each individual with the guidance of the project manager are: honesty, punctuality, truthfulness, attendance for the meetings.

Further, Caccamese and Bragantini (2013), explains that Ex- Post Project Evaluation (EPPE) assists to identify the project performance in a strategic level, to determine the relationship of project output, project outcome, project impact, to evaluate the correspondence between the planned and actual outcomes. As an example: project manager can measure:

1. Motivational space by: planned versus actual quantity and type of motivational activity.
2. Social space by: planned versus actual quantity and type of meetings
3. Analytic space by: planned versus actual quantity and type of tasks

As a summary following Table 2.3, depicts the relationship or the influence of the soft skills for the hard skills of the project manager.

Table 2.3: Influence of the Soft Skills for Hard Skills of the Project Manager

		Soft Skills Of Project Manger		
		Motivational Space	**Social Space**	**Analytic Space**
Hard Skills Of Project Manger	**Scope**	X		
	Quality			X
	Time		X	
	Cost	X	X	X

Source: Caccamese and Bragantini, 2013

2.6 Project Success Criteria and Project Success Factors

Lim and Mohamed (1999), defined the word “criterion” as principle or standard by which anything is or can be judged. According to Oxford Dictionary (2019), the word “success” means the fact that you have achieved something that you want and have been trying to do or get. Further, in Oxford Dictionary (1990), success is a favorable outcome or the gaining of fame or prosperity. When considering all these definitions, can come to conclusion that success criteria are a set of principles or standards that have

established to measure, whether favorable outcomes are achieved or not, within the given specifications.

Further, as per (Wateridge, 1998; Cookie - Davies 2002) highlights the difference between the success criteria and success factors. Success factors are all the causes that contribute to achieving the success or failure of a project. Success criteria are the selected measures, among all the success factors, that are utilized to evaluate the success or failure of a certain project. As an example, as per Saaty (1980), 67 CSFs will affect for a simple project. The traditional project manager has selected only the triple constraint (time, cost, quality) and health and safety as their measures to evaluate the success level of a project. Hence, Satty's 67 CSFs can be considered as the success factors for a project. But the traditional project manager has selected only 4 measures as his project criteria to evaluate the judgment of the project success or failure. The traditional project manager has ignored many more critical factors and only considered a handful of success factors. If the selected criteria are not the critical factors to that specific project, results, or judgment from that evaluation is incorrect due to wrongful selection.

The outmoded project manager at all times, when evaluating the project success level, selects the above mentioned 4 measures (especially at least iron triangle deliverables) as the criteria though project characteristics vary from project to project. According to Savolainen et.al. (2012), 80% of the Information, Communication Technology (ICT) projects are judged as unsuccessful projects due to the project criteria limited to iron triangle aspects. As per PMI (2014), stated that organizations have loosened 11% to 13.5% of their investment in every USD 1 Billion. Further, as per Sessions (2009), reported that, ICT projects' failure costs per year is USD 6.2 Trillion worldwide. Project managers in ICT industry are not willing to accept the evaluation of the project in macro level success rather than traditional triple constraint project criteria. This is one of the pathetic situations in most of the projects (especially in ICT projects) which make unnecessary termination and re-work during the manufacturing stage and testing, debugging stage or initial operational stage. Mischaels (2007), estimated that, ICT

projects terminated and reworks of systems, spends USD 75 Billion in USA. Factors establishing the success criteria are called as the Key Performance Indicators (KPI). Hence, as a conclusion, selected KPI's for project success in ICT project is not the absolute CSF.

2.7 Identify the Critical Success Factors (CSF) Through Key Performance Indicators (KPI)

The project management subject area was described under two theoretical schools of project management. They are: Optimization School and Critical Success Factor School. In optimization school, concerns about the efficiency of the resources – mainly, human resource. Here, Work Breakdown Structures (WBS) and Network Planning Techniques (NPT) are introduced. The WBS is for the division of labour and NPT are for integrating tasks and interrelating the labour force. The Critical Success Factor School examines generic factors that affect the project success (Packendorf, 1995).

Satty's (1980) has identified 67 CSFs, which can be frequently used to evaluate for multi criteria decision making for complex projects like multi-storied building construction. Further, Chua et.al. (1999), has grouped them under four main project aspects as mentioned below in Table 2.4.

Table 2.4 : Critical Success Factors According To The Project Aspect

Project Aspect	Success-Related Factor
Project Characteristics	(1) Political risks; (2) Economic risks; (3) Impact on public; (4)Technical approval authorities; (5) Adequacy of funding; (6) Site limitation and location; (7) Constructability; (8) Pioneering status; (9)Project size
Contractual Arrangements	(10) Realistic obligations/clear objectives; (11) Risk identification and allocation; (12) Adequacy of plans and specifications; (13) Formal dispute resolution process; (14) Motivation/ incentives

Project Aspect	Success-Related Factor
Project Participants	(15) PM competency; (16) PM authority; (17) PM commitment and involvement; (18) Capability of client key personnel; (19) Competency of client proposed team; (20) Client team turnover rate; (21) Client top management support; (22) Client track record; (23) Client level of service; (24) Capability of contractor key personnel; (25) Competency of contractor proposed team; (26) Contractor team turnover rate; (27)Contractor top management support; (28) Contractor track record; (29) Contractor level of service; (30) Capability of consultant key personnel; (31) Competency of consultant proposed team; (32) Consultant team turnover rate; (33) Consultant top management support; (34) Consultant track record; (35) Consultant level of service; (36)Capability of subcontractors key personnel; (37) Competency of subcontractors proposed team; (38) Subcontractors team turnover rate; (39) Subcontractors top management support; (40) Subcontractors track record; (41) Subcontractors level of service; (42) Capability of suppliers key personnel; (43) Competency of suppliers proposed team; (44) Suppliers team turnover rate; (45) Suppliers top management support; (46) Suppliers track record; (47) Suppliers level of service
Interactive Processes	(48) Formal design communication; (49) Informal design communication; (50) Formal construction communication; (51)Informal construction communication; (52) Functional plans; (53) Design complete at construction start; (54) Constructability program; (55) Level of modularization; (56) Level of automation; (57) Level of skill labors required; (58) Report updates; (59) Budget updates; (60) Schedule updates; (61) Design control meetings; (62) Construction control meetings; (63) Site inspections; (64) Work organization chart; (65)Common goal; (66) Motivational factor; (67) Relationships

Source: Chua et.al., 1999

When examining the above Table 2.4, can be identified that, most of the factors are subjective and lesser number are objective. Satty (1980) and Satty and Vargas, (1991) have stated that, the Analytical Hierarchy Process (AHP) should be adopted to assess the judgment of experts regarding the subjective measures of project success. Further, explained that, this approach is appropriate for complex technological, economical and

socio-political decisions making of projects. Mainly, the success related factors are grouped according to related sub-categories and present them in a hierarchical model.
According to Chan (1996), Key Performance Indicators can be categorized as objective measures and subjective measures. Hence, as mentioned above in section 2.2.4., the project managers must utilize a set of KPI to evaluate the both hard skill performance and soft skill performance of a project. Evaluation is based on the effectiveness, efficiency and quality of both labor force and final output. Collin (2002), reported that the following consideration must be examined when developing a set of KPIs for a project:

(1) KPIs must focus on critical aspects of outputs or outcomes.
(2) A manageable handful of number of KPIs.
(3) The systematic use of KPIs to derive a conclusion
(4) Data collection must be made as simple.
(5) The sample size must be adequate to reduce the impact of project specific variables.
(6) For performance measurement to be effective, the measures must be accepted by the organization
(7) KPIs will be subject to change and refinement
(8) Simple Graphical representation of KPIs with easy to update and accessible.

2.7.1 Methods of Evaluating the Objective Measures of Key Performance Indicators

2.7.1.1 Time

Time measures the concept of efficiency, i.e. how efficiently the project has been delivered to the end-user. According to Chan (1997) and Naoum (1994), time can be measured according to Construction Time, Speed of the Construction and Time Variation. Further, the “Construction Time” is the actual duration in days spent to practical completion from the starting date of the project. Moreover, “Speed of Construction” is the completed gross floor area per day. Time variation is additional time spent to complete the project except for the original contract period and Extension

of Time (EOT) accepted by the client or the consultant on behalf of the client. Following Table 2.5, emphasis the set of time criteria with a relevant equation.

Table 2.5 : Time Criteria with Equations

Measures	Equation
Construction Time (Days)	Construction time =Practical completion date - Commencement date
Speed of the Construction (m^2/Day)	Speed of construction = Gross floor area / Construction time
Time Variation (%)	Time variation = (Construction time - Original contract period – EOT) / Revised contract period* 100 %

Source: Chan (1997) and Naoum (1994)

2.7.1.2. Cost

Cost is the total expenses spent to project directly or indirectly throughout the project. The cost can be measured in terms of Unit cost and Percentage of Net Variation over final cost (Percent NETVAR) (Yeong, 1994). Net Cost is the total expenses for a $1m^2$ of gross floor area. Whereas, Percent NETVAR is the ratio of net variation of final contract sum expressed in percentage terms. Following Table 2.6, shows the above-mentioned cost criteria with relevant equation.

Table 2.6 : Cost Criteria with Equations

Measures	Equation
Unit Cost (Rs. /m^2)	Unit cost = Final contract sum/Gross floor area
Percent NETVAR (%)	Per cent NETVAR = (Final contract sum - Original contract sum - Final rise and fall +Contingency allowance)/ Final Contract Sum *100

Source: Yeong, 1994

2.7.1.3 Value and Profit

According to Alarcon and Ashley (1996), value is defined that as the amount of benefits that gain or should be gain by the user to satisfy his needs in universal logic. The most frequently utilized measurement for the financial achievement of an organization is Net Present Value (NPV). Following equation is applied to calculate the cumulative net present value of a project:

Net Present Value = Total Net Cash Flow / (1+ Discounted Rate)^{n}

n- Number of years

2.7.1.4 Health and Safety

As per (Bubshait and Almohawis, 1994), the health and safety of a project is a number of precautionary measures taken to avoid accidents from hazards which has an ill-effect for project occupants. This can be measured by evaluating the number and type (gravity) of the accidents. It can be evaluated from the following Accident rate (Construct for excellence, 2001). The answer is a ratio for 1,000 labor hours or a number of laborers. The flowing equation can be practiced to calculate the accident rate.

$$\textbf{Accident rate} = \frac{\textbf{Total no reportable construction site accidents}}{\textbf{Total no of workers employed}} * \textbf{1000}$$

$$\textbf{Accident rate} = \frac{\textbf{Total no reportable construction site accidents}}{\textbf{Total no man-hours worked}} * \textbf{1000}$$

2.7.1.5 Environmental Impact

Chan and Chan (2004), stated that environmental impact can be measured for a project by checking whether the project has obtained any relevant environmentally friendly certificate or standards such as ISO 14000 or Environmental Impact Assessment Score (EIA) or any other grading relevant to environmental impact.

2.7.2. Methods of Evaluating the Subjective Measures of Key Performance Indicators

Some of the objective measures are varying according to stakeholder's vision. Hence, Dvir et.al. (2003) have introduced seven – liket scale measures to convert the various views to a rationale. Following are the 7 liket scales:

Table 2.7 : Seven Point Likert Scale for Objective Measures of the Project

Criterion	7 point Likert Scale						
Time	>60% Than Estimate	45% - 59% Than Estimate	30%-44% Than Estimate	15% - 29% Than Estimate	1% -14% Than Estimate	On Estimate	Less than Estimate
Budget	>60% Than Estimate	45% - 59% Than Estimate	30%-44% Than Estimate	15% - 29% Than Estimate	1% -14% Than Estimate	On Estimate	Less than Estimate
Quality	>60% requirement missed	45% - 59% requirement missed	30% - 44% requirement missed	15% - 29% requirement missed	1%-14% requirement missed	Requirement met	Requirement exceeds

Source: Dvir et.al. (2003)

Muller and Jugdev (2012) stated that, project success remains to be "in the eyes of the beholder". That means, the project success is always being a subjective judgment from different perspectives. As per Muller and Turner (2007), non-quantifiable or subjective measures must have evaluated by using the following seven - liket scales for Project Team Assessment and Client Assessment. Further, Shenhar and Dvir (2007), stated that the Overall Success Assessment also can be evaluated by using seven – liket scale. The Following are the liket scales introduced by the previous researchers.

Table 2.8 : Seven Point Likert Scale for Subjective Measures of the Project

Criterion	7 point Likert Scale						
Project Team Expectation	>60% not fulfilled	45%-59% not fulfilled	30%-44% not fulfilled	15%-29% not fulfilled	1%-14% not fulfilled	Fulfilled	Fulfillment exceeds
Contractor Expectation	>60% not fulfilled	45%-59% not fulfilled	30%-44% not fulfilled	15%-29% not fulfilled	1%-14% not fulfilled	Fulfilled	Fulfillment exceeds
General Public Expectation	>60% not fulfilled	45%-59% not fulfilled	30%-44% not fulfilled	15%-29% not fulfilled	1%-14% not fulfilled	Fulfilled	Fulfillment exceeds

Source: Muller and Turner (2007) and Shenhar and Dvir (2007)

Besides, there is a necessity to identify a mutual set of indicators to be used by construction executives and project managers in ascertaining the construction performance (Cox et al., 2003). Those indicators will make a rational basis for every stakeholder and they reduce the ambiguities in views of the success level of the project.

As a conclusion, there is a practical difficulty to derive a specific set of project success criteria for each and every project due to, every project has a unique set of attributes and limitation factors. This results that constructing a generalized taxonomy of KPIs is impracticable. (Cox et al., 2003). There are two main reasons for this combat or ambiguity regarding the view of project success among the stake holders. As per Pinto and Slevin, (1989):

1. There is a grey area in how to measure project success because the parties who are involved in projects perceive project success or failure differently according to their views and there is a combination effect to the final judgment of the project success. Belassi and Tukel (1996) have mentioned that, the same project that is judged as a success by a project manager and team members might be a verdict as a failure by the client. Further, they grouped the factors into four areas:

Factors related to the project, Factors related to the project team, Factors related to the organization, Factors related to the external environment.

2. Success or failure factors vary in various studies due to the unique nature of projects. Most of the factors that affect certain projects may not be applicable for another – i.e. it is rare to find the same mutual set of factors that prominently affect to the success level of the project because of heterogeneous attributes of a project.

In addition, that Pinto and Slevin, (1989) stated that, one would first be able to identify the group or cluster of common factors. Then, he must further determine factors of each cluster and the combined effects of these factors in ultimately leading to project success or failure. Moreover, by categorizing the construction works into main clusters, one can construct a frame work that may appeal or respond beyond the framework of the iron triangle. As per Toor and Ogunlana, (2010) stated that, the current researchers attempted to achieve the following objectives in project success area:

1. To capture the perception of various stakeholders
2. To investigate if the perception of KPIs differs across:
    a. various construction stakeholders,
    b. firms working independently and in joint ventures
    c. various levels of professionals' overall experience and experience as project managers.

Hence, as a conclusion, to derive a project success, one must evaluate the project success in all the different viewpoints of stake holders with the utilization of proper taxonomy of Key Performance Indicators for the specific project.

2.8 Stages of a Project

As per PMBOK Guide (2013) mentioned only 4 stages of a project. They are as flows; Startup Stage, Organize Stage, Implement Stage, Closeout Stage. On the other hand, Premius (2010) identified five stages. Namely they are: Analysis stage, Programming stage, Elaboration Stage, Implementation Stage, Operational stage. It emphasis that

PMBOK Guide (2013) is concerned about the project and its success level beyond the handing over the stage of the project to the end user. Even though, Premius (2010) concerns only about the project success up to handing over the stage. As conclusion, PMBOK (2013) is concerning about the project success (or macro level success); whereas, Premius (2010) is only forcing its success to project management success (or micro level success). Hence, it evidences that project success must go beyond the project delivering stage to end-user. As per Archibald, Di Filippo and Di Filippo (2012, p. 29), the conducting of an assessment in Project Post Evaluation Phase (PPEP) is difficult due to practical challenges such as most of the parties are scattered after the practical completion of the project. Further, PPEP needs considerable flexible time and patience of the evaluator, depending on heterogeneous characteristics of the project attributes.

In addition to that, Turner and Zolin (2012), suggested that, at the project delivery stage, it is concerned only the success of project output as planned. But, a few months later of project handing over, CSF is changing to assess the performance of the project output. Finally, in the following years of project handing over, it is more concerned about the sustainable organizational goal achievement as a unit or society as a whole.

2.9 Assess the Success on Time

Shenhar, Levy, and Dvir (1997) have noted that the success of the stakeholders will change from inspection to demolishing of the structure after its life span. Researchers have identified that, at the point of handing over the project to the client and after a considerable time of functioning the project is the two milestone phases that the evaluation must take place. Further, Shenhar et.al (1997) have pointed out that, the resource constraints will have a little impact in the long run. Moreover, it is irrelevant after about one year of the project handing over. In contrast, after project completion the prominent factor is the impact on the customer and end-user; where the client is more concerned about customer satisfaction.

A similar kind of view is presented by Shenhar and Dvir (2007): There are five stages in a project. Namely, they are: Project efficiency, Team satisfaction, Impact on the

customer, Business success and preparing for the future. Table 2.9 represents it in a nutshell manner.

Table 2.9: The Five Dimensions of the Project Success

Success Dimensions	Measures	Time
Project efficiency	Meeting schedule goal, Meeting budget goal	Handing over point
Team satisfaction	Team morale, Skill development, Team member growth, Team member retention	Handing over point
Impact on the customer	Meeting functional and technical performance, Fulfilling customer needs, Solving a customer's problem, Customer satisfaction	After few months following the handing over point
Business success	Commercial success, Creating a large market share	1-3 years after handing over the project
Preparing for the future	Creating a new market, Creating a new product line, Developing a new technology-	3-5 Years after handing over the project

Source: Muller and Turner (2007) and Shenhar and Dvir (2007)

Further, as per Turner (2009), Project Managers and his project team believe that the roles and responsibilities of the project team are completed when the project is delivered to the customer. Further, most of the organizations reward structure is based on project handing over date. That will encourage the Project Manager to narrow down his conceptual thinking only by balancing the 3 factors in the traditional iron triangle. All the organization reward system must excel up to a period of sustainable profitability and functionality of the project; rather than providing rewards or blames for the stakeholders at the handing over stage.

On the other hand, as per Chan and Chan (2004), stated that, the same person's judgment was changed based on the CSFs that will use to evaluate from project to project. Further, he has expressed that the project success depends on project type, size and sophistication, project participants and experience of owners. Hence, he has suggested that, a proper systematic review of the existing literature is needed to develop a

framework for measuring construction success both quantitatively and qualitatively. Adding to that, as per Atkinson (1999) has suggested that, in future the three criteria of the iron triangle will become an alternative definition due to the advancement of various other definitions in several other related branches of project management.

2.10 Summary

This Chapter comprehensively evaluates the key research areas of the project's success. According to the literature synthesis of the previous researchers, the success of a project must be evaluated from the commencing of the project to a sustainable period (at least 5 years after handing over) based on the perspective of all the stakeholders. There is a demanding requirement in the construction industry (especially in Sri Lanka) for a new framework to represent the project success more accurately, by using CSFs relevant to the type of project, rather than adopting the traditional iron triangle for assessing all the projects. For introducing a new frame work, must establish proper taxonomy of KPI's of all the stakeholders along with a matrix for the project success.

CHAPTER 3 – RESEARCH METHODOLOGY AND APPROACH

3.1 Introduction

A clear and firm research methodology is the backbone of a successful research outcome. The process of research methodology assists to achieve the research objectives in a systematic way. Ultimately, it lays the foundation to succeed in the aim of the study. This chapter attempts to render a methodical approach to conduct the research. The initial half of the chapter excels in the approaches that will be adopted to identify the key CSFs and its relativeness for project success. The middle part of the chapter covers the research techniques that may adopt during the study for data collection and data analysis. In the end, the latter half of chapter prospers to develop a framework based on the results of data analysis. Moreover, this chapter explains how the research contributors were selected and how research survey parameters were designed.

3.2 Research Methodology

According to Kagioglou et.al. (2000), there are 3 major steps in the research methodology process. They have identified as follows: Identification of Research Philosophies, Identification of Research Approaches and Identification of Research Techniques. Research techniques for data collection should be selected according to the research approach, which should be based on research philosophy. Figure 3.1 represent the hierarchy of Nested Research Methodology.

Figure 3.1: Nested Research Methodology

Source: Kagioglou et.al. 2000

Further Saunders, M., Lewis, P. & Thornhill, A. (2012), have introduced overall research philosophy in a nutshell by using research onion. Figure 3.2 depicts the research onion as follows:

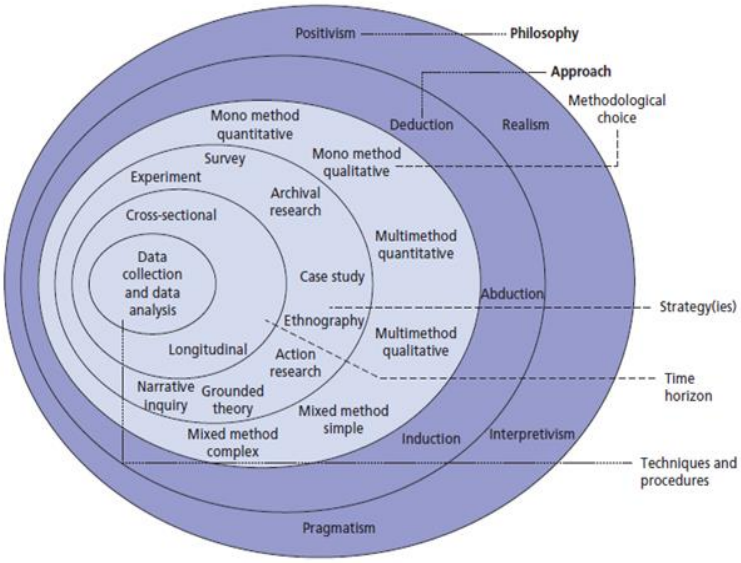


Figure 3.2: Research Philosophy in The 'Research Onion'

Source: Saunders, M., Lewis, P. & Thornhill, A., 2012

3.2.1 Research Philosophy

According to Saunders et.al. (2012), research philosophy can be categorized into: Positivism, Realism, Interpretivism and Pragmatism. In this study, the Positivism research philosophy has been selected because, it adheres to identify the factual knowledge gain through quantifiable observation. The data collection and data analysis have been undertaken objectively. Further, as per Collins, (2010), positivism should arise through the observer's view which is gained from knowledge acquired from human experiences. All these experiences and views are subjective; hence, research philosophy will be more towards post –positivism (Trochim, 2006). Further, Serrador and Tuner (2014), mentioned that, project success is not quantifiable; the personal judgment of project success is subjective. Hence, post positivism philosophy will lay the path to the reality of construction research with an insightful eye.

3.2.2 Research Approach

According to Saunders et.al. (2012), the research approach can be categorized into three approach methods. Such as: Induction Approach, Deduction Approach and Abduction Approach. According to Gabrial (2013), the deductive approach is aimed at testing theory while an inductive, it is more concerned with the inspiration of an innovative theory from the researched data. Further, a deductive approach usually begins with a hypothesis, on the other hand, an inductive approach will usually use research questions to narrow the scope. For deductive approaches the emphasis is generally on connection to the prevailing theory, while for inductive approaches the aim is attentive on exploring new concepts or looking at previously researched phenomena from a different perspective. Inductive approaches are generally associated with qualitative research, whilst deductive approaches are more commonly associated with quantitative research.

In this study, both inductive and deductive approach is utilized where appropriate. Through the literature review, the wide concept of overall project success was deducted to be represented by the CSFs. Using the results of the surveys and case studies conducted, an inductive approach is used to construct a framework for the CSFs for multi storied buildings in Sri Lanka. Therefore, this research used both inductive and deductive methods to achieve its goals.

Theories have been derived from the observations made. That means the observations are based on general law for the particular instance or practical scenario. The objective of identifying CSFs for the building construction projects in Sri Lanka was achieved through reviewing the works of previous researchers while considering the applicability to the Sri Lankan context.

Another two objectives are to assess the relationship and impact of the CSFs for project success. The final decision regarding those objectives was derived through the results of questionnaire surveyors and case studies.

3.2.3 Methodological Choice

Moreover, Creswell (2013) recommended that the research approach can be categorized as a quantitative research approach, qualitative research approach and mixed approach. Quantitative research uses deductive logic, in which researchers start with a hypothesis and then collect data to determine whether data to support that hypothesis. The quantitative research method permits the researcher to get the facts in a meaningful and broad manner rather than an abstract way (Bryman and Bell, 2007).

Further, Matthews & Ross (2010) have explained that quantitative research methods are applied for data that can be represented in a structured numerical way. Generally, quantitative data is collected when the researcher has adopted the positivism, and collected data can be scientifically analyzed. Adding to that, this method is adopted to quantify variables such as attitudes, opinions, behaviors and generalize results from a larger sample population.

On the other hand, as per Aliaga and Gunderson (2002), qualitative research is more focused on obtaining culturally specific information about the values, opinions, behaviors, beliefs, emotions, and relationships of individuals' social contexts of the selected sample. It provides a complex textual description of how people experience a given research issue. Bryman and Bell (2007) stated that qualitative research is a strategy that depicts how the relationship between theory and practical scenarios. It results to innovate new theories and to identify how theories were generated. As a research strategy qualitative research is inductive, constructive, and interpretive, but qualitative researchers always don't subscribe to all three of these methods.

Moreover, according to Saunders et.al. (2012), the methodological choice is varied depending on the number of methods that may be adopted by the researchers. They can be broadly divided into the mono method and multi method. So that, all together, there are six methodological choices as follows: Mono Method Quantitative, Mono

Method Qualitative, Multi-Method Quantitative, Multi-Method Qualitative, Mixed Method Simple and Mixed Method Complex.

To achieve the research objectives of this study, as mentioned in Chapter -1, mixed type research design was used. Quantitative analysis was conducted by statistical or numerical analysis procedures and qualitative analysis was executed by collecting data through interaction with individuals. A quantitative research method was adopted to check whether the selected hypothesis is accurate or not. That means quantitative research methods such as conducting an expert survey with experienced professionals and a questionnaire survey with a variety of construction stake holders, were assisted to prove that, project success can't be represented by the iron triangle. Qualitative research methods like case studies were the platform to design the conceptual frame work beyond the iron triangle for project success. Furthermore, adopted methodological choice was identified as Mixed Method Complex because, both qualitative and quantitative methods were adopted.

3.2.4 Research Strategies

According to Yin (2009), there are five types of research strategies. Namely, they are: Survey, Archival Analysis, Case Study, Experiment and History. Further, Saunders et.al. (2012), has agreed for the above types of strategies and have introduced another four strategies. They are as follows: Ethnography, Action Research, Grounded Theory and Narrative Inquiry. Among all, for this research, survey and case study approaches were selected. Primarily, the survey approach was used to gather expeditious knowledge and experience regarding the project success framework. Secondly, the case study approach was used to gain more insights on project success which aid to achieve the objective of developing the taxonomy and framework beyond the iron triangle. As mentioned in methodological choice, both quantitative and qualitative strategies were used for this research as follows:

3.2.4.1 Conduct expert questionnaire survey

An expert survey was conducted among experienced senior construction professionals in the industry, before the main questionnaire survey. It was carried out in two stages. The first stage of the expert survey was carried out to identify the key CSFs from the 67 project success – related factors mentioned in Chapter -2 as per Chua et.al. (1999) the 67-project success introduced by Chua et.al. (1999), was used due to consisting of a large variety of factors so that the expertise can select the most suitable factors for Sri Lankan context. The expert questionnaire guideline was prepared based on the literature findings. At this stage, all the 67 CSFs were listed and guidance has provided to the respondents to reduce the list to approximately one third of the original list (around 20 to 30). This measure was taken to ensure a higher response rate in the main survey. (Please See Appendix - IV: Sample for Expert Questionnaire Survey – Stage – I). All the expert questionnaires were sent to respondents via Google forms. The selected sample size of the first stage of the expert questionnaire survey was 8 but only 6 participants provided their feedback.

The secondary stage of the expert survey was conducted to identify how the criticality of the success factors changed according to the benefits to each stake holder types and project success levels (and its corresponding project deliverables). Six types of stake holders were considered are: (1) Project team (PT), (2) Contractor (CO), (3) Client or investor (CL/IN), (4) End-user or customer (EU/CU), (5) General public (GP) (6) Politicians (PO). The six project success levels and their corresponding project deliverables summarized in the below table. (Please See Appendix - V: Sample for Expert Questionnaire Survey – Stage – II). The sample size of the second stage of the expert survey was similar to the respondents of the initial stage of the expert survey.

Table 3.1: Project Success Levels and Its Corresponding Project Deliverables

Project Success Level	Description	Project Deliverables
Level -I	From Project Start To Project Handing Over	Efficiency of Project Output
Level -II	From Project Handing Over To 1 Year After Project Handing Over	Effectiveness of Project Output
Level -III	From 1 Year After Project Handing Over To 2-3 Year After Project Handing Over	Efficiency of Project Outcome
Level -IV	From 1 Year After Project Handing Over To 2-3 Year After Project Handing Over	Effectiveness of Project Outcome
Level -V	From 2-3 Year After Project Handing Over To 4-5 Year After Project Handing Over	Effectiveness of Project Impact
Level -VI	From 2-3 Year After Project Handing Over To 4-5 Year After Project Handing Over	Efficiency of Project Impact

The experts were requested to rank the criticality of the above-mentioned success factors using the five points likert scale as shown below (See Table 3.2).

Table 3.2: Five Point Likert Scale for Overall Project Success Rating According to Stakeholders

Success Criteria	Least Important for project success	Less Important for project success	Important for project success	Most Important for project success	Most Significant Important for project success
Scale	**1**	**2**	**3**	**4**	**5**

3.2.4.2 Conduct main questionnaire survey.

The 'Questionnaire Survey' was carried out to evaluate the relationship and effect of the CSFs to overall project success. Then, it evaluates the changes in priorities of critical factors according to the time element and stakeholder type. The questionnaire was structured according to the information gathered through a review of literatures and the results (21 most CSFs) of the expert questionnaire survey. Additionally, demographical questions were asked to get the background of the respondents.

Main Questionnaire surveys were conducted through "Google Forms" one of the most common and popular online survey methods in the country. The main survey was conducted among constructional professionals who represented the main three commercial development provinces of the country. (i.e. Western Province, Southern Province and Central Province).

The most critical 21 factors were listed and provided guidelines to select all the relevant effective stages that affect the factors for the project success. (Please See Appendix - VII: Sample of Main Questionnaire Survey). The main questionnaire survey was distributed among 80 respondents only 52 respondents returned their feedbacks. (The response rate was 65 percent). Out of that, 2 respondents hadn't respondent according to given instructions. Therefore, for the final data analysis, it was evaluated by ignoring that extreme feedbacks which can ill effect the final results.

3.2.4.3 Case Study

Three case studies were undertaken to evaluate whether the iron triangle deliverables are the most critical factors for project success or the new framework is more appropriate to represent the project success of building construction projects in Sri Lanka. This case studies assist to show the validity of the framework for the current Sri Lankan building construction projects. The selected three cases studies are situated in suburbs (i.e. Nawala, Jawatta and Mahragama) close to Colombo metropolitan area. The main selection of these case studies was done because most of the buildings are

being constructed in these areas at present and data collection is fast and convenient due to lack of time limit.

The case study parameters were prepared based on the literature findings, main survey and expert survey results. The case studies were undertaken based on 8 main categories. They are as follows: Project Background, Project Finance, Project Schedule, Health and Safety, Environmental Impact, Quality, and Stakeholder Satisfaction. (Please See Appendix - IX: Sample of the Case Study). The semi-structured interviews were conducted to collect qualitative measures such as: stakeholder satisfaction and quality satisfaction. The information about the quantitative measures such as performance of the project based on the time, cost, health and safety were accumulated through available documentation records. The evaluation has done in two stages (at the handing over the stage, after few months handing over the stage) to have a proper understanding of the satisfaction changes with the time. It was decided to carry out the case study in two stages to compare the project management success and project success. As discussed in literature review, the case study can be extended to two more stages which evaluate the success in (1) period between one to three initial functioning years and (2) period between three to five initial functioning years of the buildings. (Shenhar and Dvir,2007). However, due to time constraints associated with the research period, the additional two stages were not viable.

As per Serrador & Turner (2014), the respondent will provide their judgment of success mainly in three categories. They are as follows:

1. Overall project success rating
2. Project success according to stakeholders: Project team, Contractor, Client or Investor, End-user or Customer, General Public, Politicians.
3. Performance against three deliverables in the iron triangle.

Hence, based on the above principle, case studies for 3 projects were conducted in following deliverables: Time, Cost, Value and Profit, Health and Safety,

Environmental Impact, Quality, Functionality, User Expectation, Participant Expectation and Overall Project Performance (Chan & Chan, 2004).

As mentioned in chapter -2, according to Shenhar & Dvir (2007), Muller & Turner (2007), overall project success rating according to stakeholders was measured by using a five-point likert scale (See Table 3.3). Additionally, Chan & Chan (2004), have recognized seven likert scale and which was adopted for this survey. (See Table 3.4 and 3.5).

Table 3.3: Seven Point Likert Scale for Overall Project Success Rating According to Stake Holders

Success Criteria	Very Dissatisfied	Dissatisfied	Slightly Dissatisfied	Neither Dissatisfied nor Satisfied	Slightly Satisfied	Satisfied	Very Satisfied
Overall Project Success	1	2	3	4	5	6	7

Table 3.4: Seven Point Likert Scale for Performance against Deliverables in Iron Triangle (Time and Budget)

Success Criteria	>60% Than Estimate	45% - 59% Than Estimate	30%-44% Than Estimate	15% - 29% Than Estimate	1% -14% Than Estimate	On Estimate	Less than Estimate
Time / Budget	1	2	3	4	5	6	7

Table 3.5: Seven Point Likert Scale for Performance against Deliverables in Iron Triangle (Quality)

Success Criteria	>60% requirement missed	45% - 59% requirement missed	30% - 44% requirement missed	15% - 29% requirement missed	1%-14% requirement missed	Requirement met	Requirement exceeds
Quality	1	2	3	4	5	6	7

When measuring time effect on the project success, Chan (1997) & Naoum (1994) has identified that three parameters were important. They are: Construction Time, Speed of Constriction and Time variation. When relating to the effect of the cost for the project success level, Chan & Chan (2004) mentioned that, unit cost and percentage of net variation over final cost are the most suitable indicators. Further, the effect for the project success from the Value and Profit of a project can be reflected through Net Present Value (NPV).

The effect of the health and safety measures for the overall project success can be calculated by the annual accident rates at the construction site. (Construction Industry Review Committee, 2001) The environmental performance can be evaluated in numerous ways but the most common and recognized method be by evaluating the International Organization for Standardization (ISO) 14000 series certificate which is issued for environmental management. As per Chan & Chan (2004), Environmental Impact Assessment (EIA) score can be used as a measurable tool.

As mentioned in chapter - 2, according to Dvir et.al. (2003), Functionality, User Expectation, Participant Expectation of the selected project for the case study, will be evaluated by using 7 likert scale. The following Tables: 3.6, 3.7, 3.8 depict the likert scales that will be implanted for the questionnaire for case studies.

Table 3.6: Seven Point Likert Scale for Functionality of the Project

Success Criteria	>60% not fulfilled	45%-59% not fulfilled	30%-44% not fulfilled	15%-29% not fulfilled	1%-14% not fulfilled	Fulfilled	Fulfillment exceeds
Functionality	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Table 3.7: Seven Point Likert Scale for User Expectation of the Project

Success Criteria	>60% not fulfilled	45%-59% not fulfilled	30%-44% not fulfilled	15%-29% not fulfilled	1%-14% not fulfilled	Fulfilled	Fulfillment exceeds
Client Expectation	1	2	3	4	5	6	7
End User Expectation	1	2	3	4	5	6	7

Table 3.8: Seven Point Likert Scale for Participant Expectation of the Project

Success Criteria	>60% not fulfilled	45%-59% not fulfilled	30%-44% not fulfilled	15%-29% not fulfilled	1%-14% not fulfilled	Fulfilled	Fulfillment exceeds
Project Team Expectation	1	2	3	4	5	6	7
Contractor Expectation	1	2	3	4	5	6	7
General Public Expectation	1	2	3	4	5	6	7
Politicians Expectation	1	2	3	4	5	6	7

3.2.5. Research Sampling Method

As per Showkat (2017), Sampling is a methodology or process that will be undertaken to select entities or individuals for study from a large population. The selected sample should be representative of the total population in all aspects. Further, Showkat (2017), has explained that there are two major sampling methods called as: Probability Sampling and Non Probability Sampling.

Further, in probability sampling, each sample has an equal probability of being chosen; correspondingly, has a known non-zero probability of selection. Some probability sampling methods are as follows: Simple Random Sampling, Stratified Random Sampling, Systematic Random Sampling, Cluster Sampling, Multi-stage Systematic Sampling (Showkat 2017)

On the other hand, as per Showkat (2017), non- probability sampling applies for non-randomized methods to draw the sample; it involves a verdict or a judgment. Instead of randomization, participants were selected because they were easy to access with the required and adequate knowledge. Through the non-probability method result may be biased to some extent, but these types of studies will assist to generate valuable insight depth of a particular phenomenon. Further, this sampling method was used to study existing theoretical insights or innovative development. This method of sampling is considered as less expensive, less complicated and easy to apply as compared to its counterpart. Some non-probability methods of sampling are as follows: Convenience Sampling, Purposive Sampling, Quota Sampling, Snowball sampling.

Non- probability sampling method was suitable for this research because this method is not giving equal chance to each member in the population being a part of the subset. Hence, the sample frame for this questionnaire survey was stakeholders of the construction industry in Sri Lanka. This targeted population had various types of construction backgrounds and disciplines such as contractors, consultants, clients, researchers, and indirect stake holders etc. Furthermore, a sample of the questionnaire survey was based on a convenience sampling method; on the other hand, the sample for the semi structured interviews for the case study was identified through snowball sampling method.

The selected sample for the main survey had a fair representation of the construction industry in all managerial levels and covering the direct stakeholders and indirect stakeholders. Rather than going for a large sample, it is better to select an unbiased, experienced and knowledgeable set of construction professionals. Hence, the sample size was limited to 50 professionals to ensure the quality of the responses which will affect the ultimate survey results. The expert survey was sent to 8 professionals of which 6 responded. Participants for the sample had a fair amount of knowledge and adequate experience in the projects of the construction industry.

3.2.6 Time Horizon

According to Saunders et.al. (2012), research strategies can be implemented in two ways according to the time elements. They are as follows: Cross-sectional and Longitudinal. As per Encyclopedia.com, (2019), a cross-sectional study is an examination of a particular subject or factors that have existed in a specified population or sample at a particular time. On the other hand, a longitudinal study is an activity that is extended for a considerable period of time to study changes in the behavioral pattern of the sample. The monitoring process was done for an extended period of time by repeatedly monitoring the same subjects.

When considering this study, the feedback and data collection of the case study were evaluated at the delivery point of the project. Then, further study was taken place after few months of inaugural functioning of the project. Hence, the time horizon for this study is cross -sectional.

3.2.7 Research Techniques and Procedures

After completing the above-mentioned steps in methodology, specific research techniques and procedures are required to collect, analyze and interpret the gathered data. In order to do that, the mixed type concurrent triangulation strategy was adopted. As per Greene (2007), there are five purposes in mixed methods research: Triangulation seeks (validation of different methods), Complementarity seeks (illustration of the results from one method with another), Development seeks (to use the results from one method to assist develop another method: sampling, implementation, decision making), Initiation seeks (the discovery of new perspectives of frameworks), Expansion seeks (to extend the breadth and depth of inquiry by using different methods). Both quantitative and qualitative data were collected and analyzed separately.

Finally, data results were compared as follows:

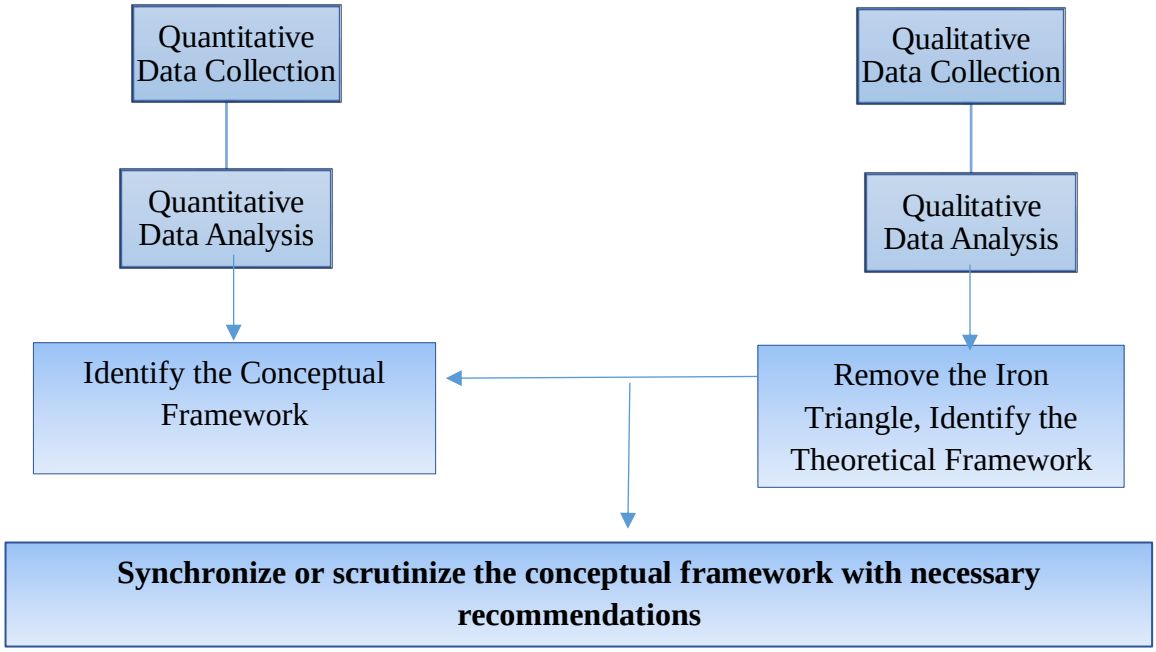


Figure 3.3 : Concurrent Triangulation Strategy

Source: Creswell et.al.,2003

According to Johnson et al. (2007), mixed methods research can have three different drives: Qualitative dominant (mixed methods research relies on a qualitative, constructivist-poststructuralist-critical view of the research process), Quantitative dominant (mixed methods research relies on a quantitative, the post positivist view of the research process, Center of the [qualitative-quantitative] continuum, equal status for both quantitative and qualitative research methods. Johnson and Onwuegbuzie (2004) have introduced four cell mixed method research design concept. (Illustrate in Figure 3.4).

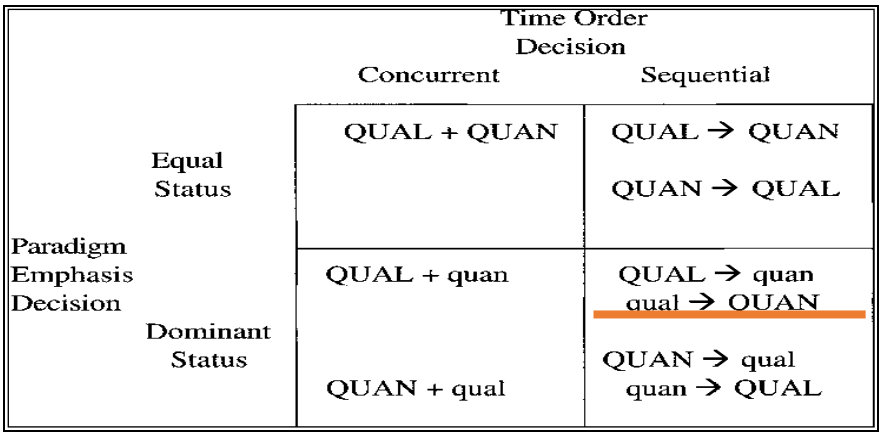


Figure 3.4 : Mixed Method Research Design Concept *(Source: Johnson & Onwuegbuzie, 2004*)

According to the research, the decision of quantitative and qualitative data was taken in sequential order; while the outcome of the quantitative data is prominent or higher priority rather than qualitative. One the other hand the sequential order of data analysis as flows: 1. Qualitative data; 2. Quantitative data. Hence, more priority will be allocated to conceptual frame work which will arise from quantitative data analysis.

3.2.7.1. - Data Collection

The main focus in data collection are: types of data, criteria for selection of CSFs for multi storied building projects in Sri Lanka, the practical procedure of data collection and unit of analysis. In this section, different types of collection of data are presented that enables to fulfill the purpose of the research study.

The research data was collected by using a combination of literature review, expert questionnaire survey, main questionnaire survey and case study. Data collection for the literature review was based mainly on books, journals and articles. Moreover, internet resources were used frequently to comprehend the data collected. All these sources were related to construction projects and concentrated on the effect of the CSFs on the end outcome. Data collection for case studies was done by gathering information related to the project through expert interviews of the key stakeholders.

Yin (2003) stated that, the holding of expert interviews is to strengthen and establish the research findings. Further, as per Punch, (2005), all the clarifications, elaborations and conclusions must be based on the views, options suggestions of the interviewee. The data should be collected from fair balance free flow and directed conversations.

Data collection will be designed as a semi-structured list of questions for expert and main questionnaire survey. Therefore, a list of fairly specified questions was prepared. Distribution and collection of the questionnaire were carried out via online method. Online based survey is selected, because of its' advantages such as; speed, economical, less paper work, easy to generate reports etc.

3.2.7.2. - Data Analysis

As per Kelly et.al. (2003) data analysis is summarizing collected data in a meaningful manner and present the results in logical sequence by using statistical equations. The analysis technique was selected based on the methodological choice. Further the following are the major steps that were carried during the data analysis process: Identify the issues, Determine the availability of suitable data, Decide the suitable method of represent questionnaire surveys, Adopt the appropriate methods for answering surveys, Evaluate and summarize the results and feed backs of the conducted surveys.

Accordingly, in order to analyze the collected data, Relative Important Index (RII) method and Mean Rating (MR) method were utilized according to the nature of the data. RII method was used to analyse the responses of likert scale and MR method was used to analyse data in binary form (two responses).

Relative Important Index (RII)

Relative Important Index was envisioned to identify the behaviors of all 67 factors. This method is implemented to identify the most CSFs from the expert questionnaire survey. According to Tam and Le, (2006), the prominent factors of each category,

relative importance of the success of criterion for the ultimate judgment of project success level and stakeholders were calculated by using the following formula.

$$\textbf{Relative Importance Index} = \frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

Where,

w – Weighting is given to each factor by the respondent (Range from 1-5)

A - The highest weight (i.e. 5 for the expert surveyor)

n_1 – Number of respondents for the least important factor category

n_2 – Number of respondents for less important factor category

n_3 – Number of respondents for important factor category

n_4 – Number of respondents for the most important factor category

n_5 – Number of respondents for the most significant important factor category

Relative Important Index (RII) ranges from 0 to 5

When analyzing the relative importance of the factors to project success, they were evaluated as per Table 3.9. Further, the second stage results of the expert survey were categorized into four categories.

Table 3.9: Relative Importance of Individual Stakeholder Satisfaction and Project Levels Satisfaction

RII Score	Importance of the Factors to Project Success
5.00>RII ≥3.75	Most Significant Factors
3.75 >RII ≥2.50	Significant Factors
2.50 >RII ≥1.25	Less Significant Factors
1.25 >RII ≥0.00	Not Significant Factors

Mean Rating (MR)/ Arithmetical Mean (AM)

The mean rating of each and every selected criterion in the main questionnaire survey was evaluated to identify the behavior of each and every factor compare to rest of the factors in the main survey. The following formula was adopted to calculate the mean ratio:

$$AM = \frac{1}{n}\sum_{i=1}^{n} a_i = \frac{a_1 + a_2 + \cdots + a_n}{n}$$

Where,

AM - Arithmetical Mean (Range from 1-5)

a_i – Frequency of responses (Range from 1-5)

n – Total number of respondents

High values of mean ratings show the importance and impact of the criteria for the overall project success and its contribution to the individual success of the identified stakeholder satisfaction. Therefore, the following classification was used in the research.

Table 3.10 : Critical Success Factors Contribution to Project Success

Mean Rating (MR)/ Arithmetical Mean (AM)	Contribution of Stakeholder Satisfaction
1.00>MR≥ 0.75	Most Relevant Factors
0.75> MR ≥0.50	Relevant Factors
0.50> MR ≥0.25	Less Relevant Factors
0.25> MR ≥0.00	Not Relevant Factors

Developing a Matrix for Project Success

Three types of matrices were developed in this study to support the framework. Namely: (1) Theoretical Matrix, (2) Analytical Matrices and (3) Final Matrices.

The **theoretical matrix** was developed based on the literature review which is presented in Appendix II – Theoretical matrix for Project Success for Building Construction in Sri Lanka. The backbone of the new theoretical matrix (2x3 matrix) was the 2 by 2 matrix which was introduced by other Dalcher (2009). It was further developed into a 2 by 3 matrix from other literature discussed in chapter 2 such as Muller and Turner (2002) and Morris and Pinto (2004). The new theoretical matrix introduced according to Forces Vs. Project Deliverables (2x3 matrix) and Performance

Vs. Project Deliverables (2x3 matrix). These CSFs were identified based on the literature findings.

The **analytical matrices** consist of 6 mini matrices which are presented in Appendix X – Analytical matrices for Project Success levels for Building Construction in Sri Lanka. These matrices are categorized according to the project success level which was developed based on the results of the Expert survey stage – II (Significance of the factors) and results of the Main survey (Relevance of the factors).

There are two **final matrices** for project success which are presented in Appendix XI – Final matrices for Project Success for Building Construction in Sri Lanka. One matrix is drafted based on the project force and project deliverables; whereas the other matrix was based on the performance (efficacy) and time scale. Project force have two sub sets; namely, Internal force and External force. Project deliverables are categorized as Project output, Project outcome and Project impact. Project performance is based on efficiency and effectiveness. Further, the time scale has divided into Short term, Intermediate Term and Long term.

The success factors which was in top 10 categories identified in the analytical matrices was used in compiling the final matrices. All other minor factors are not considered when preparing the final matrix for the project success. Further, CSFs are ranked according to the 10 categories in chronological order in maximum weightage in between the categories and within the categories. The factors are demarcated according to the categories by marking thick lines when category change within the level. The thick black lines demarcate the matrix level of each project success level. This matrix demonstrates the critical factors to concern during each project success level and evaluate at the milestones of level gates in project success for the stakeholders. With the help of the matrices developed this study propose a taxonomy and framework for project success.

3.3 RESEARCH DESIGN

Figure 3.5 depicts flow of research from start to end in a nutshell manner.

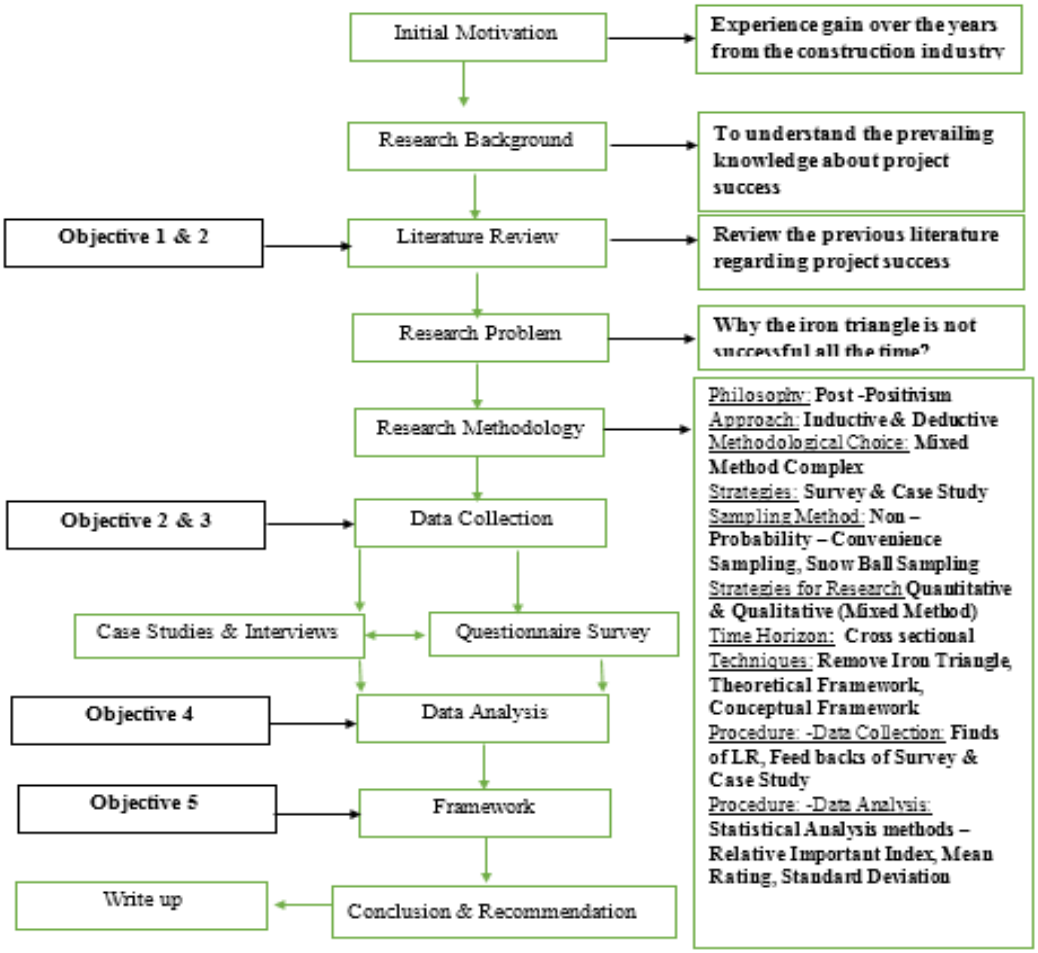


Figure 3.5 : Research Design

3.4 Summary

This chapter discusses the ways that the research was conducted to accumulate the required data from the selected sample. At the initial stage, discusses mainly the research philosophy, approach, methodological choice and sampling method that had implemented in this research. Further, in the middle half, this report elaborates investigation strategies, strategies of inquire and time horizon for the inquiry. The final stage of this chapter had allocated to explain research techniques that the study had

implanted, data collection and data analysis by using statical analysis methods such as: Relative Important Index (RII), Mean Rating (MR) for this study.

Here, the selected research choice is Mixed Method complex and research strategy is Mixed Strategy, where both Qualitative Strategies and Quantitative Strategies were adopted to acquire wide and in-depth knowledge regarding the CSFs beyond the iron triangle. Qualitative strategies were assisted to remove iron triangle from the place of precious representation of CSFs while establishing the theoretical background for a new framework. Quantitative strategies were utilized to establish a new conceptual framework for the CSFs.

CHAPTER 4 – DATA COLLECTION AND ANALYSIS

4.1 Introduction

The research methodology adapted in this study has been explained in chapter 3. Data have been collected, analyzed and presented in this chapter according to methods explained in the previous chapter. The purpose of this chapter, is to interpret the research findings and analysis of collected data. This chapter provides a clear idea about: (1) the relevancy and significance of CSFs on overall project success levels, (2) the impact of the CSFs for each success level and (3) analysis of CSFs to create a taxonomy related to the project deliverables throughout project life span, which is appropriate for the Sri Lankan construction industry.

The first section of this chapter covers the data analysis based on the expert survey which was distributed among well experienced professionals in the construction industry. The second part of the analysis chapter discusses about collected data from the main questionnaire survey among diversified professions who are working as direct or indirect stakeholders in the Sri Lankan construction industry. The questionnaires of expert survey (which was conducted using well experienced professionals) and main survey (conducted among the types of stake holders) were based on information collected through literature. The latter part of the chapter, discusses about three different kind of case studies related construction industry to validate the research findings with real world examples. The statistical analysis methods such as RII and MR along with five and seven degrees of likert scale methods were used in this study in a similar manner used in previous researches discussed in Chapter 3. At the end, this chapter introduces a project deliverable framework with respect to building construction projects in Sri Lanka, a relevant supportive taxonomy and matrixes for project optimizations.

4.2. Expert Survey

4.2.1 Profile of the Respondents for Expert Survey

Following table 4.1 depicts the summarized profile of the respondents based on their designation or the profession along with their experience in the field of construction and experience in management level.

Table 4.1: Profile of the Expert surveyor interviewees

Respondent	Designation/ Profession	Experience in Construction Industry	Experience as a Manager
Respondent A	Senior Quantity Surveyor	15-20	10-15
Respondent B	Quantity Surveyor	5-10	Less than 5
Respondent C	Civil Engineer and Academia	15-20	10-15
Respondent D	Environmental Engineer and Academia	10-15	5-10
Respondent E	Project Manager and Academia	10-15	5-10
Respondent F	Legal Advisor and Academia	15-20	10-15

4.2.2 Findings of the Expert Survey

First Stage of Expert Survey

Though it was requested to reduce the list to 20 to 30 factors, the respondents of the expert survey have selected 23 to 38 most CSFs out of 67. Table 4.2 shows the number of selected factors of each respondent.

Table 4.2: Number of Critical Success Factors of Each Respondent

Respondent	Number of Selected Most CSF by Respondent
Respondent A (R – A)	23
Respondent B (R – B)	34
Respondent C (R – C)	32
Respondent D (R – D)	28
Respondent E (R – E)	33
Respondent F (R – F)	38

Then, 21 critical factors were selected by considering the most frequently responded critical factors, which have at least 5 response out of 6. Table 4.3 depicts the 21 most responded critical factors with their correspondent responses and relevant mean ratings.

Table 4.3: Response for the Most Critical Success Factors

No.	Critical Success Factors for Project Success	R -A	R -B	R -C	R -D	R -E	R -F	Mean Rating
1	Political risks	x	x	x	-	x	x	0.83
2	Economic risks	x	x	x	x	x	x	1.00
3	Adequacy of funding	x	x	x	x	x	x	1.00
4	Site limitation and location	x	x	x	x	-	x	0.83
5	Constructability	x	x	x	x	x	-	0.83
6	Project size	x	x	x	x	x	x	1.00
7	Risk identification and allocation	-	x	x	x	x	x	0.83
8	Adequacy of plans and specifications	x	x	x	x	x	-	0.83
9	Project Managers' competency	x	x	x	x	x	x	1.00
10	Project Managers' authority	x	x	x	x	x	x	1.00
11	Project Managers commitment and involvement	x	x	x	x	x	x	1.00
12	Capability of contractor key personnel	x	x	x	x	x	x	1.00
13	Capability of consultant key personnel	x	x	x	-	x	x	0.83
14	Formal construction communication	-	x	x	x	x	x	0.83
15	Level of skill labors required	x	x	x	x	-	x	0.83
16	Report updates	x	x	-	x	x	x	0.83
17	Budget updates	x	x	-	x	x	x	0.83
18	Schedule updates	x	x	x	x	x	x	1.00
19	Design control meetings	x	x	x	x	-	x	0.83
20	Construction control meetings	-	x	x	x	x	x	0.83
21	Relationships	x	x	x	-	x	x	0.83

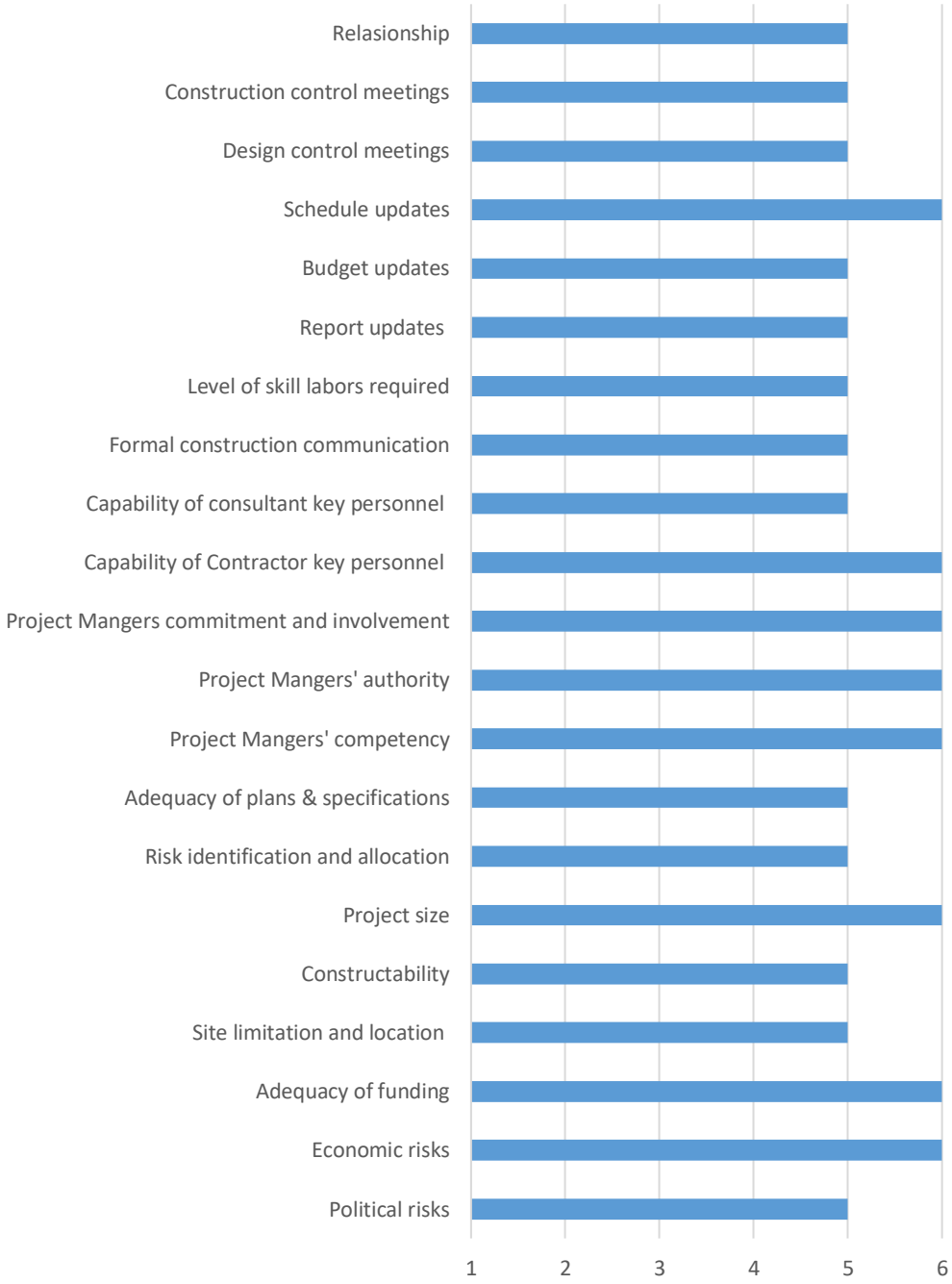


Figure 4.1 : Response for the Most Critical Success Factors

According to the responses of the participants, can come into conclusion that all of them believed that economical risk and funding ability for the project are critically important for the project success or failure. This result depicts that, lack of financial

ability is a critical factor for a project failure. On the other hand, a developing country like Sri Lanka always has a financial crisis and loan deficit. Hence, inflation rate increases at all the time and project cannot be completed within the estimated budgets. It happens due to following reasons: Lengthy construction project period, Depreciation of the rupee, High inflation rate, Economical instability of the country.

Moreover, a country like Sri Lanka, lacks resources which requires to complete mass scale project. Hence, all the Expert survey respondents agreed that, project size is one of the governing factors for project success or failure. Even though, Sri Lankan medium scale construction projects completion is at a considerable successful level; large scale projects are a failure at most of the time in both micro level project success and macro level project success (or at least one of the mentioned levels). This kind of failure is happening due to lack of resources and lack of technological advancement in construction industry.

Another highlighted point by all the Expert survey participants is the project manager's contribution and influence have a high impact on the project success level. It proves by all the respondents that the following project management related factors are critical: Project Mangers' competency, Project Mangers' authority, Project Mangers commitment and involvement. Other than that, contractor's competency level regarding project also makes a huge impact for the project success. It shows that, all the recipients, believe that the majority of the micro level success depends on the skill levels and competency levels of the project management team and construction team. Further, the selected sample depicts that traditional belief of the direct and indirect stakeholders of Sri Lankan construction industry regarding the project success is mostly based on competency of project team and contractor team.

Furthermore, the initial expert survey results emphasis that, availability of following factors is correspondingly assisted to enhance probability of project success: Collaborative relationship of construction stakeholders, Utilize the updated information as project inputs, Availability level of project information and risk

mitigation methods. When considering a project, if there is ample goodwill of each and every stakeholder for the rest of the stakeholders, that provides a fine communication lines among stakeholders. It increases awareness level of every stakeholder regarding the updated information. Generally, updated information is the input for the construction project. It assists to deliver the updated and upgraded output as the final deliverable. Moreover, updated information helps for the Project Manager to identify and foreseen the project risk types and methods of mitigating the negative risks and enhance the positive risks. Ultimately, proper project risk management process increases project success level of all the stakeholders while accumulating the satisfaction level of them.

Second Stage of Expert Survey

The responses obtained from the second stage of the expert survey has weighted according to the provided likert scale for the 21 most CSFs. Table 4.4 depicts the Relative Important Index obtained by summarizing the stakeholders' satisfaction.

Table 4.4 : Relative Important Index according to the Stakeholders' Satisfaction

No.	Critical Success Factors for Project Success	Importance of CSF for Stakeholders					
		PT	**CO**	**CL**	**EU**	**GP**	**PO**
1	Political risks	1.42	1.28	3.44	3.25	3.39	3.36
2	Economic risks	1.42	1.44	3.31	3.06	2.44	2.97
3	Adequacy of funding	1.42	1.44	1.92	2.86	1.75	1.75
4	Site limitation and location	1.11	1.22	2.47	2.36	2.28	2.61
5	Constructability	1.25	1.00	1.25	0.19	-	0.36
6	Project size	1.14	1.19	1.97	3.17	2.83	2.83
7	Risk identification and allocation	1.19	1.58	2.08	2.81	1.92	1.89
8	Adequacy of plans and specifications	1.19	1.06	1.17	1.72	-	-
9	Project Managers' competency	1.17	1.19	1.22	1.11	-	-
10	Project Managers' authority	1.06	1.14	1.19	0.25	-	-
11	Project Managers commitment and involvement	1.22	1.19	1.25	0.28	-	-
12	Capability of contractor key personnel	1.28	1.33	1.06	0.25	-	-
13	Capability of consultant key personnel	1.33	1.28	1.47	0.19	-	-
14	Formal construction communication	1.31	1.22	1.03	-	-	0.22

No.	Critical Success Factors for Project Success	Importance of CSF for Stakeholders					
		PT	CO	CL	EU	GP	PO
15	Level of skill labors required	1.14	1.42	1.11	0.86	-	0.06
16	Report updates	1.33	1.17	1.64	0.22	-	0.08
17	Budget updates	1.36	1.19	1.75	0.22	-	0.08
18	Schedule updates	1.36	1.17	1.36	0.19	-	0.08
19	Design control meetings	1.19	1.06	1.03	-	-	-
20	Construction control meetings	0.94	1.03	0.89	-	-	0.08
21	Relationships	1.53	1.56	1.69	2.81	1.22	1.22

The table clearly represents that the project team is concerned about all the critical factors in less significant manner or ignored manner compared to rest of the stakeholders. The main reason is project team concerns about the factors until the project handing over stage to client (i.e. only for end of Level –I). But, the majority of the stakeholders evaluate the project success beyond project handing over stage. The project team provides priority on factors such as: Relationship of stakeholders, Political risks, Economical risks and Iron triangle deliverables. Further, the consultant team focuses on the capabilities of the main stakeholders, constructability of the project and willing to have good rapport through strong formal construction communication. Hence, these results emphasis that the project team is more concern about the project management success rather than project success or project portfolio success.

When considering the contractor's perspective regarding the project success it is closely similar to project team. They are more concerned regarding Risk identification and risk allocation, Level of skill labor requirement than project team. Further, they are less concern about Constructability, Formal construction communication and Updates regarding iron triangle deliverables than the project team. Also, the contract team gives less attention about the CSFs compared to other stakeholders.

On the other hand, the client measures success from different CSFs. For the client the significant factors are Political risk and Economical risk. They are concerned about Site limitation and location, Risk identification and allocation, Project size, Adequacy

of funding, Updates regarding iron triangle deliverables and Relationship more than other main two parties in construction industry. Furthermore, it clearly reflects that the client is more attentive regarding the capabilities of the consultants rather than project team members. That shows the traditional client of Sri Lankan construction industry relies more on the capabilities and experience of the consultant. Further, the above point can be strengthened by that, the client is the most considered stakeholder party regarding project managers' competition, commitment and involvement of the project out of all the stakeholders. On the other hand, from the results of expert survey depicts that, the client provides less weightage for Capability of contractor key personnel, Formal construction communication, Level of skill labors required and Construction control meetings. It clearly emphasizes that the client is less confident regarding the capabilities and advices of the contractor compared to project team.

The end-user considers highest number of CSFs as significant factors. That is because of the end-user is the person who's a part of the project and project output for a sustainable period of time (most of the time it is total life cycle of the project or project outcome). The significant factors of end-user are: Political risks, Project size, Economic risks, Adequacy of funding, Risk identification and allocation, Relationships. Throughout the life cycle of the project, the end-user has two prominent risk from external environment and financial risk from internal project environment. Hence, the end-user significantly forces on risk management process during their attachment with the project outputs and project impacts. Additionally, the end-user is the party that focusses regarding the relationships of the stakeholders. That is due to the fact that, firm relationship with all the connected parties, is fruitful for overall project success in the perspective of the end-user of the multi-storied building. Further, the end-user considers about the Site limitations and location, as built drawings and specification when they purchase the project output (i.e. multi-storied building). Another highlighted fact is that; the end-user is not concerned about most of the remaining CSFs. All those factors effect until the project handing over stage. That reflects end-user concern about the project success or project portfolio success rather than project management success.

When considering the project success view of the general public, their CSFs are: Political Risk and Project Size of the multi-storied building projects. This is due to general public of developing country like Sri Lanka acts according to their political view point rather than social impact or sustainable development as a society. Further, they have less significance regarding the factors such as: Economical risk for the project, Site limitation and location of the project, Adequacy of funding and Risk identification and allocation. The reason behind is the general public has no definite idea about the economy of the country and economic factors that affect the project success specially in funding and financial management of the project. The general public is not concerned about the project management success; while, concerned about the project success and project portfolio.

The politicians' perspective of the project success is limited to Political risks, Economic risks, Site limitation and location, Project size. The politicians are concerned about the above-mentioned factors in the view of their political propaganda, political agenda and political advancement. Moreover, the politicians have less significance in Adequacy of funding and Risk identification and allocation. Most of the considered factors are not considered by the politicians as project success. Hence, a country like Sri Lanka, most of the projects which defines as a successful project is based on the political propaganda, political agenda of the prevailing governing party.

The below table 4.5 depicts the calculated RII of project level satisfaction as per the respondents in the second stage of expert survey.

Table 4.5: Relative Important Index according to the Project Levels Satisfaction

No.	Critical Success Factors for Project Success	Importance of CSF for Project Levels					
		L I	**L II**	**L III**	**L IV**	**L V**	**L VI**
1	Political risks	3.89	4.17	2.44	2.39	1.92	1.61
2	Economic risks	3.14	3.44	2.17	2.25	2.08	1.61
3	Adequacy of funding	3.19	3.47	1.42	1.25	0.94	0.81
4	Site limitation and location	3.08	3.31	2.00	1.56	1.11	0.78
5	Constructability	2.78	1.36	-	-	-	-

6	Project size	4.00	3.47	1.83	1.58	1.00	0.94
7	Risk identification and allocation	3.86	3.36	1.25	1.17	0.97	0.92
8	Adequacy of plans and specifications	2.64	1.81	0.22	0.22	0.14	0.11
9	Project Managers' competency	2.72	1.61	0.14	0.11	0.06	0.06
10	Project Managers' authority	2.44	1.19	-	-	-	-
11	Project Managers commitment and involvement	2.61	1.33	-	-	-	-
12	Capability of contractor key personnel	2.44	1.47	-	-	-	-
13	Capability of consultant key personnel	2.47	1.47	0.08	0.08	0.08	0.08
14	Formal construction communication	2.36	1.64	-	-	-	-
15	Level of skill labors required	2.56	1.64	0.17	0.17	0.17	0.17
16	Report updates	2.58	1.61	0.17	0.17	0.17	0.17
17	Budget updates	2.67	1.69	0.17	0.17	0.17	0.17
18	Schedule updates	2.56	1.69	-	-	-	-
19	Design control meetings	2.11	1.17	-	-	-	-
20	Construction control meetings	2.19	0.75	-	-	-	-
21	Relationships	3.31	2.89	1.19	1.08	0.75	0.69

By analyzing the Appendix VI- Expert Survey Results- Stage II and Table 4.5, they clearly represent that in Level -I of project success levels (project start to project handover stage), all the considered factors have significance to the project success. Hence, it shows that, the results of the expert survey in stage-1 are accurate and most relevant to project success of the multi storied buildings in Sri Lanka. The most CSFs of the level-I are: Political risks, Project size, Risk identification and allocation.

For a country like Sri Lanka, for any kind of multi-storied project has interference from politicians and their power. This political risk can be positive or negative factor for the project success. If the politicians have made optimistic interference for a construction project, it highly tends to become a successful project by fulfilling the satisfaction levels of all or majority of stakeholders of that project. On the other hand, if politicians view and interference for the project is pessimistic; most of the time, the final end results may become a failure due to the unsatisfactory level of the participants. Moreover, the politicians have power to spread their perspective regarding a project than any other stakeholders in the society. Hence, the influence done by politicians may change the final common judgment of the society. A country like Sri Lanka, must

concern about project size because the projects in Sri Lanka have less resources and experience to undertake large projects. Generally, in any kind of project, if the internal stakeholders can identify all the risks and method of mitigation at the initial stage, that assists to ultimate project success.

The collected data clearly represent that during the construction period, all the stakeholders must have a fine and strong relationship with other stakeholders which highly affect the project success. Hence, team building and work as a team for a one objective is a must to achieve the ultimate project success, though the project is a temporary multiple organization. Further, in level – I of project success, the more weightage is provided by all the stake holders to project management success factors such as: Adequacy of funding for the project, Economic risks in the country, Site limitation and constructability of the project, Utilizing of updated records for iron triangle constraints. Other significant areas that consider are: Project Mangers competence, commitment and involvement and Level of skill labors in contractor party. Though, the most of Project Managers in Sri Lanka force about the capabilities of workforce, meetings and communicational channels in the project, they contribute less weightage for ultimate project success.

In the project success level –II, most of the critical factors are less significant compared to level- I. But most highlighted factor is the significance of four factors (Political risks, Economic risks, Adequacy of funding, Site limitation and location) increase than previous level. The reasons are: the attraction of the external parties increase and financial capabilities of the client is limited to finalize payments for the parties. Whereas, the post construction relationship of project stake holders, project output size and risk attached project have significant influence for the project success.

The potential factors in project success level – III are how to encounter with political risk and economical risk, while fulfilling the business success of the project by reaping the profit and return on investment through trade and market the project output. Hence, for the trading and marketing following factors are critical: Site limitation and location, Project size, Risk on bearing the project output.

In the fourth level, where stakeholders concern about effectiveness of the project outcome, they are more concern about economic risk than previous level (i.e. efficiency of project outcome). On the other hand, political risk is less than project success level –III, because politicians are more concern about efficiency of the project outcome. In this level, there is a minor concern about: Site location, Project size, Adequacy of funding for project maintenance. All the other factors are not considered or ignored when evaluating project success at this level. In the project impact level (after 3-5 years from project handing-over stage), project success is mainly based on the political risk and economical risk. Here, basically considered the sustainable development of the project success and political success. In this level, the results clearly represent that, project success evaluates from the impact of project to the society as a whole which represents project portfolio success.

Another prominent finding that gains through the expert questionnaire survey is to evaluate the contribution of each criterion for the overall project success. Here, all the criteria are ranked according to the mean rating of the importance of the criterion for the overall project success. Table 4.6 depicts the mean rating results and overall ranking for 21 CSFs.

Table 4.6: Mean Rating according to the Overall Project Success Level

No.	Critical Success Factors for Project Success	Imporatnce of CSF for Overall Project Success	
		Mean Rating	Rank
1	Political risks	2.74	1
2	Economic risks	2.45	2
3	Adequacy of funding	1.85	6
4	Site limitation and location	1.97	4
5	Constructability	0.69	15
6	Project size	2.14	3
7	Risk identification and allocation	1.92	5
8	Adequacy of plans and specifications	0.86	8
9	Project Mangers' competency	0.78	12
10	Project Mangers' authority	0.61	19
11	Project Mangers commitment and involvement	0.66	17
12	Capability of contractor key personnel	0.65	18
13	Capability of consultant key personnel	0.71	13
14	Formal construction communication	0.67	16
15	Level of skill labors required	0.81	10
16	Report updates	0.81	10
17	Budget updates	0.84	9
18	Schedule updates	0.71	14
19	Design control meetings	0.55	20
20	Construction control meetings	0.49	21
21	Relationships	1.65	7

Political risks and Economical risks are the most impact factors for overall project success level, which both of the factors have close to 2.50 mean rating. The main reason is that, those two factors are significant from the project start to sustainable period (such as 5 years or more). In Sri Lankan context, due to lack of resources, lack of finical-ability and size of the project are the governing factors for a project success level than developed countries, who are having more resources and high technology. Due to the lack of prominent space, site limitations such as unavailability of utilizes, infrastructure and access modes are also governing factors for a project success or failure in Sri Lankan context.

Generally, risk identification, allocation for the risks, and risk mitigation method makes significant influence for the project. Hence, the project must establish proper risk management process which can be exceled throughout the life cycle of the project. Moreover, the relationship between stakeholders is a key factor not only for a specific project but also for professional lives of the stakeholders in construction industry. Hence, all the stakeholders must make sure a good rapport with everyone because that relationships are worth for a sustainable period of time, though the project is temporary multiple organization. All the above-mentioned factors have more than 1.5 mean rating in importance level in overall project success. All these factors influenced for the project success beyond the limits project management success and most of them exist until the project portfolio success.

From this research, another highlighting finding is that, all the critical factors of project management success, mean rating contribution or importance for the overall project success is less than 1. Out of those factors, adequacy of plans and specification information is more important than updates of the triple constraints. The budget, report and schedule updates are ranked in 9, 10, and 14 in the 21 critical factor list. Moreover, most of the clients seeking the Project Managers capabilities and Contractors capabilities in the pre –contract stage; while evaluating the performance through project managers' authority and commitment, workmanship of contractors during the construction period of a building. Even though, from this study, it reflects that those

parameters are least importance to final judgment of the project success. The least important factors of the list are controlled by the meetings which conduct only at the pre contract period and during the construction period. Hence, those results reflect that project manager must concern more about the soft skills of project management than hard skills of project management for a sustainable project success.

4.3 Main Questionnaire Survey

4.3.1 Profile of the Respondents for Main Survey

Following table 4.7 and figure 4.8 depict summarized profile of the respondents according to their profession. Further, from figure 4.4 and 4.5 represent their experience in construction industry and middle or top management respectively.

Table 4.7: Profile of the Main Questionnaire Survey

Profession	No. of Respondents
Directors	2
General Managers	3
Senior Academics	6
Project Managers	2
Architect	3
Civil Engineers	6
Quantity Surveyors	23
Academics	2
Legal Officer	1
Facility Manager	1
Project Coordinator	1

4.3.2 Findings of the Main Survey

Following table 4.8 reflects the summary of the responses of the respondents of main survey in mean rating value. Here, mean rating results present for all 21 critical factors relevant to each project success level.

The highlighted factor in the collected data is in level – I, all the 21 factors mean rating is 1.00. That means all 50 respondents agreed that all the 21 factors which were selected from the expert survey is absolutely critical factors and relevant for the project

success level. Hence, this dominant -point proves that the expert survey results are totally accurate. Further, in the second stage, Site limitation and location, Constructability, Design and Construction control meetings are less relevant, whereas all the other factors categorized as most relevant factors. The main reason for that is after the project handing over, above mentioned factors are no more apply in the future and impact that be gain from those are minimum. Further, those factors are only considered by the project team.

Table 4.8 – Mean Rating of the Critical Success Factors in Project Success Levels

No.	Critical Success Factors for Project Success	Main Survey Results					
		Level I	Level II	Level III	Level IV	Level V	Level VI
1	Political risks	1.00	0.96	0.80	0.80	0.74	0.74
2	Economic risks	1.00	0.98	0.86	0.82	0.74	0.46
3	Adequacy of funding	1.00	0.84	0.64	0.28	0.10	0.06
4	Site limitation and location	1.00	0.68	0.46	0.22	0.08	0.06
5	Constructability	1.00	0.72	0.28	0.10	0.06	0.02
6	Project size	1.00	0.78	0.64	0.38	0.34	0.20
7	Risk identification and allocation	1.00	0.94	0.62	0.34	0.20	0.10
8	Adequacy of plans and specifications	1.00	0.96	0.50	0.28	0.12	0.02
9	Project Managers' competency	1.00	0.96	0.46	0.20	0.10	0.04
10	Project Managers' authority	1.00	0.94	0.44	0.12	0.08	0.02
11	Project Managers commitment and involvement	1.00	0.94	0.44	0.22	0.06	0.02
12	Capability of contractor key personnel	1.00	0.90	0.26	0.18	0.08	0.06
13	Capability of consultant key personnel	1.00	0.76	0.26	0.18	0.10	0.04
14	Formal construction communication	1.00	0.96	0.42	0.22	0.12	0.08
15	Level of skill labors required	1.00	0.86	0.22	0.12	0.08	0.04
16	Report updates	1.00	0.96	0.70	0.34	0.22	0.18
17	Budget updates	1.00	0.94	0.44	0.18	0.04	-
18	Schedule updates	1.00	0.88	0.36	0.28	0.06	0.04
19	Design control meetings	1.00	0.64	0.16	0.10	0.04	0.02
20	Construction control meetings	1.00	0.72	0.16	0.12	0.06	0.02
21	Relationships	1.00	0.98	0.98	0.86	0.88	0.84

In the Stage –III, survey results emphasis that Political and Economic risks in the nation and relationship between the stake holders are most relevant factors for the project success. Additionally, the results show that there is no relevance for project success from the Design control meetings, Construction control meetings and Level skill labors, because after the defect liability period all those factors are not considered by the remaining stakeholders who are attached to the project. Further another significant aspect is, following factors can be categorized as less relevance: capabilities of contractor's and consultant's key personals, Project Manager's competency, authority, commitment and involvement. All the stakeholders (i.e. Project team and Contractor) were removed from the project, and that parties only consider above factors as critical. Further, iron triangle updates, site limitation, Adequacy of plans and specifications and constructability of the project, ignore after one year of functioning the multi-storied buildings. But the Client, End- user and General public are keen regarding the report updates of the project, project size and risk, adequacy of funding for maintenance of the project.

In the fourth stage, most relevant factors are similar as previous stage. All the other factors are either less relevant or not relevant for the final project success. At this level, more focused to the functional success of the project. Hence, there is minimum relevance in funds for maintenance, project size, risk factors and iron triangle attributes. In the fifth level, concern about the sustainable development of the success, where most critical success factor is good relationship between the stakeholders of the project. Further, in this level concern only about the economic factors and political factors that may affect for the project. At last level of the project success, relationship and political risk are remaining factors for the project success.

4.4 Case Studies

4.4.1 Details of the Case studies

The Case study was conducted by selecting three completed building construction projects in Sri Lanka. General information on the selected project is as follows:

Table 4.9 : Details of the selected case studies

Project	Suburbs	Success or Failure according to Iron Tringle Criteria		
		Cost	Time	Quality
Project 1	Nawala	Failure	Failure	Success
Project 2	Jawatta	Failure	Failure	Failure
Project 3	Maharagama	Success	Failure	Failure

Semi – structured interviews were conducted with the client party (or the investor), contractor party, consultant party, neighborhood and officials who are the indirect stakeholders of above-mentioned projects. Accordingly, responses from following stakeholders were collected for the three projects:

Table 4.10 : Details of the stakeholder types for each projects

Stakeholder Type	Project 1	Project 2	Project 3
Project Team	Collected	Collected	Collected
Contractor	Collected	Collected	Collected
Client	Collected	Collected	Collected
End user	Collected	Collected	Not Applicable
General Public[1]	Collected	Collected	Not Collected
Politicians[2]	Collected	Collected	Not Collected

[1] *Collected from neighbors*
[2] *Collected from officers of local authority since it was difficult to contact them in person*

4.4.2 Findings of the Case Studies

Following table 4.8 shows all the findings of the three projects in a nutshell manner. The final results are represented according to main parameters mentioned above with their sub elements. The project information given in the table 4.11 depicts the general information, initial evaluation of project management according to iron triangle and how the initial attitude has changed over the time. This case studies supports the findings of the previous two surveys.

Table 4.11: Findings of Case Study

No.	Description	Project 1	Project 2	Project 3
1	**Background**			
1.1	Nature of The Project	New Work	New Work	New Work
1.2	Type of The Project	Residential Apartment	Residential Apartment	Commercial Building
1.3	Procurement Method	Integrated	Separated	Separated
1.4	Payment Method	Lump sum	Lump sum	Measure and Pay
1.4	Gross Floor Area (m2)	10,000.00	2,260.00	1,710.00
2	**Project Finance**			
2.1	Original Contract Sum (Rs. Mn)	800	199	87.48
2.2	Final Contract Sum (Rs. Mn.)	821.989	204.885	77.481
2.3	Final rise and fall (Rs. Mn.)	0	0	(7.500)
2.4	Contingency allowance (Rs. Mn.)	0	0	8.748
2.5	Percent NETVAR	2.75%	2.96%	8.06%
2.6	Income From Selling (Rs. Mn.)	1179	424	Not Sold to end-user
2.7	Unit Cost (Rs./m2)	82,198.900	90,657.080	45,310.53
2.8	Profit(Rs. Mn.)	357.011	219.115	Not Apply
2.9	Net Present Value (NPV)			Not Apply
3	**Project Schedule**			
3.1	Original Contract Period (Days)	700	450	540
3.2	Project Commencing Date	2-Dec-14	7-Mar-17	10-Jan-17
3.3	Initial Project Completion Date	1-Nov-16	31-May-18	1-Jun-19
3.4	Total agreed E.O.T.	0	0	333
3.5	Adjusted Revised Contract Period	700	450	873
3.5	Actual Duration For Completion	2-Apr-19	31-Jul-19	20-Aug-19
3.6	Actual Contract Period (Days)	1583	876	953
3.6	% of Time Variance	126.14%	94.67%	9.16%
3.7	Speed of Construction (m^2/day)	6.32	2.58	1.79

4	**Health and Safety**			
4.1	No. Accidents	20	12	Minor accident are occurred
4.2	No. Labour Days Employed	158300	52560	10800
4.3	Accident Rates	0.13	0.23	Not Applicable
5	**Environmental Impact**			
5.1	Environmental Performance Certificates	Prepared According to CEA	Prepared According to CEA	Fulfill requirements of COC
6	**Quality**			
6.1	Quality Satisfaction	Requirement fulfilled	1%-14% requirement missed	1%-14% requirement missed
7	**Stakeholder Satisfaction**			
7.1	At the handing over stage			
7.1.1	Project Team Satisfaction	Requirement fulfilled	15% - 29% requirement not fulfilled	1%-14% requirement missed
7.1.2	Contractor Satisfaction	Requirement fulfilled	30% - 44% requirement not fulfilled	30% - 44% requirement not fulfilled
7.1.3	Client/ Investors Satisfaction	Requirement fulfilled	1%-14% requirement not fulfilled	1%-14% requirement missed
7.1.4	Customer/ End user Satisfaction	1%-14% requirement not fulfilled	1%-14% requirement not fulfilled	Not Applicable
7.1.5	General Public Satisfaction	1%-14% requirement not fulfilled	45% - 59% requirement not fulfilled	1%-14% requirement missed
7.1.6	Politicians Satisfaction	1%-14% requirement missed	1%-14% requirement missed	Requirements met
7.2	Few months after handing over			
7.2.1	Project Team Satisfaction	Requirement fulfilled	15% - 29% requirement not fulfilled	1%-14% requirement missed
7.2.2	Contractor Satisfaction	Requirement fulfilled	15% - 29% requirement not fulfilled	1%-14% requirement missed
7.2.3	Client/ Investors Satisfaction	Requirement fulfilled	1%-14% requirement not fulfilled	1%-14% requirement missed
7.2.4	Customer/ End user Satisfaction	Requirement fulfilled	1%-14% requirement not fulfilled	Not Applicable
7.2.5	General Public Satisfaction	1%-14% requirement not fulfilled	45% - 59% requirement not fulfilled	1%-14% requirement missed
7.2.6	Politicians Satisfaction	1%-14% requirement missed	1%-14% requirement missed	Requirements met

The project 1 and project 2 are residential apartments which they have same payment method but different procurement method. Project 3 is a commercial building which is completed under same procurement type as project 2, but payment method differs from other two projects. The gross floor area of project 1 is 10000m^2 whereas, other two have floor area around 2000m^2. Further, 5 floors of the project 2 and 3; but project 1 consists with 10 floors. When selecting those projects, the selection has been done by selecting different types of project which have similar and different kind of procurement methods, payment methods and different kind of floor area methods.

When considering project finance, project 1 and 2 have recorded a small Net Percentage Variance and project 3 has significant variation because the client has reduced the scope and budget; hence several variances were recorded. In here, first two projects profits are more because, that companies consider all the overheads as general overheads, due to that project specific overhead can't be evaluated correctly. According to the information received from the organization, overall profit should be between 12% to 18%. In the project 3, can't evaluate the profit, still the investors are seeking suitable buyer for that building. As a conclusion, regarding the cost all the projects exceed their initial budget. The project 3 scope is reduced and that is why its' amount is less than initial budget. But compare to the scope, they have completed; it has also exceeded the budget which depicts from net variation.

When considering the time, project 1 and 2 exceed the time in huge percentage and there were no agreements for Extension of Time (EOT). Hence, the investor had not considered about Liquidated Damages (LD) for the delay. On the other, project 3 has allocated EOT and deducted LD amounts for 60 days (2 months) at the end of the project. Though the time variance is small in project 3 compare to others, the client applied the LD for the slow progress. When comparing the three projects the least speed of the construction was in project 3. Hence client judgment is fair. Further, another point is that project planning is not accurately done by the first two projects. That can be the main reason for huge time variance in actual and estimated.

When considering the health and safety of the project, there were only minor injuries during the construction period. Hence, all the sites were satisfactorily achieved success in health and safety of the occupants during construction period (project management success period). When considering the environmental aspects project 1 and 2 have considered more deeply about environmental regulations but the other project has satisfied only the requirements to obtain the Certificate of Completion (COC).

Moreover, according to the judgment of the stake holders, project 1 quality requirements were fulfilled. The most of the end-users are highly satisfied regarding the quality standards but some stakeholder are still complaining about the long delay in delivering the project. Though they too are satisfied with quality standards and facilities of the project output. Besides, there are quality issues in other two project outputs from the end-users or the client.

When critically analyze the satisfaction levels of the stakeholders against other 2 project, stakeholders, project -1 stakeholders are at a far more satisfactory level. Additionally, in other two projects contractors are unsatisfied with the return. This is more common in Sri Lankan context where most of the time client and consultant are wrongfully utilizing their power and authority to maximize the benefits of them while minimizing benefits of the counterpart. Further, there is a dominant issue in the project -2, where all the general public around the site premises are dissatisfied and are showed their displeasure about the project, because the internal stakeholders have ignored their requirement and not fulfilled the infrastructure developments of the surrounding. This will negatively effect in future, because now the stakeholders are concerned only about the project management success and project success, but when time goes on project portfolio success will be a failure if the authorized persons will not take necessary actions to rectify the neighbor's needs and issues. Moreover, the results conclude that when time goes on stakeholders adopt to the facilities they have coped with interference and overcome them with their own abilities without complaining.

As a conclusion from the case study, we can identify the project success is not absolutely limited to iron triangle deliverables. Further, project quality is the most governing factor for project success. This is because, overall project success depends on the satisfaction level of the stake holders; where stakeholder satisfaction is purely based on the quality standards of the project output. Hence, though a project can't be delivered within the triple constraints (Time, Cost and initial Quality standards); if the project can be functioned in a way of Total Quality Management (TQM) throughout their lifecycle, overall project success can be achieved.

4.5 Analysis of Matrix for Project Success

Six analytical matrices were developed separately for each level, using the results of expert survey and the results of main survey. (Appendix X –Analytical Matrices for Project Success Level for building construction in Sri Lanka). In addition, the two final matrices were developed using the results of analytical matrices and it is presented in (Appendix XI –Final Matrices for Project Success for building construction in Sri Lanka).

The matrix categorized 4 sub categories according to significance and relevance of factor for the project success. The sub- categories are as flows: Most, Moderate, Less, Not. Hence, ultimately all the 21 factors were categorized under 16 sub categorizes (4x4 matrix). Out of that 16, 6 categories were ignored because either they were not or less relevant or not or less significant for the project success of that level. Further, other 10 categories were ranked based on both significance and relevance of the factor to the project success level. Table 4.9 depicts the categories which are ignored and ranking method for the considered factors.

Table 4.12: Analytical Matrix for Project Success Levels

			Significant Factors[3]			
			Most	Moderate	Less	Not
	Relevant Factors[4]	Most	**1**	**2**	**5**	**6**
		Moderate	**3**	**4**	**8**	**10**
		Less	**7**	**9**	**Ignored**	**Ignored**
		Not	**Ignored**	**Ignored**	**Ignored**	**Ignored**

The Appendix –X clear shows that, in level - I all the factors belong to either category 1, 2 or 5. All the factors in category one is less concern in project management success level. Most project management success level factors are categorized in the second category in the matrix. In Level-II, all 21 success factors are distributed clustering among 7 categories which depict the reducing of the criticality of the factors. On level –III, there are only 8 factors that can be influenced for the project success, on the other hand, their criticality falls on 5th, 6th, 8th and 10th categories. The highlighted factor is that all the iron triangle attributes and other factors that considered by project management team as critical during construction period is not considered after defect liability period (i.e. from level III). From Level - IV to Level –VI only Political risks, Economic risks and Relationship of stakeholders are governing factors for the project success. Though they fall on the category of 5, 6 and 8 in criticality. In level –VI economic factors can also fall in the ignored category because end users adopt to the ruling economy in long term period.

[3] Significant factors are the factors selected by the respondents of the expert survey as most significant factors among 21 CSFs selected. (At the second stage of expert survey). Pl. refer the table 3.8 for the categorization of these significant factors.

[4] Relevant Factors are the factors that the main survey respondents have selected as most relevant for each stage from the 21 CSFs selected. Pl. refer the table 3.9 for the categorization of these significant factors.

4.6 Project Success Framework and Taxonomy

The framework introduces a novel structure which broaden the project success beyond the iron triangle. The developed framework is presented in the Appendix – III.

The developed project success framework identified that the project success is purely based on the perspectives of the stakeholders. Further, the perspectives of the stakeholder are majorly based on the benefits, they are gaining through project outcome, project output or project impact. Additionally, these benefits are varying according to the needs, requirements and ambitions regarding the construction project and overall construction industry. All these needs and ambitions are based on the knowledge and experiences of the stakeholder. It proves the well renounced saying "Beauty is in the eye of the beholder" that means beauty doesn't exist on its own but is created by the observers. Similarly, success doesn't exist its own but it creates or not by the perspective of the stakeholder.

Moreover, through final matrix of the project success reflects that when the time goes on the importance of the factors varies. Hence, all the stakeholders must consider more about the most CSFs of a project while keeping a close eye to the factors that are critical for the current progressing project success level.

Further, this study once again proves that the well-known proverb of the American writer Ben Sweetland's "Success is a journey not a destination". Hence, this is the high time to the project manager and other stakeholders to think broader and novel manner regarding the project success rather than rigid to the iron triangle deliverables.

As the involvement of stakeholder groups reduce over time a taxonomy of the framework is introduced to illustrate the time dimension of the framework. The developed taxonomy and following Table 4.13 provide on what factors should be prioritized the most critical factors at each stage.

Table 4.13 Measurement of Success based on Literature & Survey Results

Project Success Level	Measurement of Success based on Literature	Measurement of Success based on Survey Results
Level -I	Iron Triangle Deliverables	All 21 CSF
Level -II	Profitability	All 21 CSF
Level - III	Value Delivery and Value Creation	Political risks, Economic risks, Relationships, Site limitation and location, Project size, Adequacy of funding, Risk identification and allocation, Report updates
Level - IV	Function ability	Political risks, Economic risks, Relationships
Level -V	Sustainability	Relationships, Economic risks, Political risks
Level - VI	Political Propagandas and Political Advancement	Relationships, Political risks

4.7 Summary

This chapter dramatizes the validation of the collected data with the literature findings, which pave the path way to investigate the significance and relevance of the CSFs for a sustainable project success beyond the traditional view of the iron triangle for the building construction projects in Sri Lanka. It is clear that project managers and other stakeholders must view success in wider dimensions by evaluating the success by utilizing the tools and techniques such as 21 CSFs, Taxonomy of Project Success and Hexagon of Project Success which was introduced by this study.

CHAPTER 5 – CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter concludes and provide recommendations using the findings presented in the previous chapter. Further, this chapter describes how the research objectives have been achieved through this research study. Ultimately, a brief description regarding the new directions of the research areas have been abstracted at the end of the chapter.

5.2 Conclusions

The literature review revealed that the project success can be effectively evaluated using 67 CSFs. The first stage of the expert survey assisted to narrow down the 67 CSFs to 21 factors that are the most significant factors in Sri Lankan context.[5] The identified top ranked factors are: (1) Political Risk, (2) Economic Risk, (3) Project Size, (4) Site Limitation and Location, and (5) Risk Identification and Allocation. These factors are more focused on project success and project portfolio success which goes beyond the project management success concept. The iron triangle deliverables were ranked at the middle half of the list. Further, most of the factors considered as critical by the Project Managers at the construction stage are least critical for overall project success.

In the second stage of expert survey, the 21 identified factors were presented to the respondents to evaluate the significance of each factor according to the success levels and stakeholders. Overall, criticality of most of the factors reduced with time. Political risk and Economic risk are the most significant factors throughout the whole life cycle of the project. Most of the other factors are important only for either project management success or project success levels.

When considering the critical factors in the perspective of the stakeholders, Client stakeholder group considers highest number of factors as significant. Contrast to that, project team and contractor team consider most of the factors are less significant or

[5] *Pl. refer the Appendix XII for the full list of 21 CSFs identified*.

ignored. In addition, general public and politicians consider the significance of the factors are in similar manner. The importance of the iron triangle deliverables is deliberated only by the Project Management team and the Client stakeholder group.

The results of the main survey also confirm that these identified factors are relevant to all levels of building projects in Sri Lanka. The case study results prove that overall project success differ from time to time, person to person according to their satisfaction levels and mostly not from project management success (iron triangle deliverables). Further, most of the stakeholders have a positive perspective regarding the ultimate project success and it increases over time. These results assist to prove that iron triangle is not the absolute indicator for the project success and it must excel beyond project management success through the satisfaction of the 6 types of stakeholders in construction industry. Another main point is majority of the factors are relevant up to the end of project success level – II. But the results clearly depict Political risk, Economic risk and Relationships of the stakeholder's remains important at all stages of a project.

In order to summarize and illustrate the findings of the literature review, surveys and case study a framework was introduced.[6] In addition a taxonomy and sets of matrices were developed to support the framework.[7] Framework provides a novel structure which views project success based on the perspectives of the six major stakeholder groups. It was understood that the project success would be a more border and subjective matter which depend on the perspectives of the stakeholder are majorly based on the needs and benefits that they gain through project outcome at different stages of the project.

The involvement of stakeholder groups reduce over time. A taxonomy of the framework is introduced to illustrate the time dimension of the framework. The

[6] *Pl. refer the Appendix III for the developed framework.*

[7] *Pl. refer the Appendix I for the taxonomy, Appendix II for Theoretical Matrix, Appendix X for Analytical matrices and Appendix XI for final Matrices.*

developed taxonomy and corresponding table 4.3 provide guidelines to prioritize the most critical factors at each stage. For example, all 21 factors remain important at the first and the second stage. The importance of the factors reduces at each stage as stakeholder groups reduces over time. Ultimately, at the final stage only Relationships and Political risk will only remain as CSFs as all stakeholder's interest reduces except to Politicians. The framework and related or supportive outcomes could be used as a guideline not only to conduct further research on project success; but also, an eye opener to evaluate the success in a wider perspective for Sri Lankan project managers, who are practising project management theories in their day to day life.

5.3 Recommendations

This section summarizes the major recommendations obtain through the analysis carried out. The following recommendations can be applied to building construction projects in Sri Lanka. Either direct or indirect, all the stakeholders should provide more attention to the following suggestions and adopt into their upcoming projects, which pave the pathway to widen the insights of the project success for a sustainable period of time. However, the initial steps must be taken by the main three parties of a construction project to utilize the below mention suggestions.

It is the high time for stakeholders of Sri Lankan construction industry to broaden the CSFs beyond the iron triangle. It is recommended to use the 21 CSFs which was narrowed down by the expert survey from the 67 CSFs identified through the literature review, to suit the Sri Lankan building construction project scenarios.

This study identifies important relationships among the CSFs and overall project success (refer Table 4.6). Since Political risks and Economic risks are beyond internal stakeholders' control and Project size, Site limitation and location are predetermined for a project it is recommended to carry out a proper macro risk analysis prior to the commencement of the project. In addition, as risk identification and allocation were also identified as significant factors impacting on overall project success level, it is advisable to have a proper risk management process in place for large scale building construction projects. The research identifies relationship among stakeholders as a

significant factor, it is recommended to agree and communicate a clear set of objectives and requirements for each stakeholder prior to the commencement of the project.

It was identified that the 21 CSFs impact project success at different levels with varying significance. Therefore, it is recommended to utilize the resources for the most significant CSFs identified for each level. (refer Appendix –XI). For example, at the Level-I, much priority should be given to CSFs such as Project size, Political risk, Risk identification and allocation than iron triangle deliverables or control meetings.

The developed taxonomy can be used as guideline to prioritize the most critical factors at each stage. These critical factors and project success matrix should be altered and modified, if required based on the characteristics of the project.

The constructed taxonomy for project success (Appendix I) suggest that the involvement of different stakeholders ceases after different levels. Therefore, stakeholders such as project management team and contractor team, traditionally whose involvement is limited to several levels of the project have more -short-sighted views compared to other stakeholders. Therefore, it is recommended to introduce a rewarding system according to the success level of the CSFs in all stages. Thereby, make every party to excel in their liabilities and responsibilities until the project portfolio success.

Project Manager's must depart from the traditional ways of forecasting the project time period and calculating the Liquidated Damage System. Further, introduce parameters to measuring the delays and the penalties method based on the speed of the construction. All the stakeholders must consider CSFs which related to the current stage; while keep a close eye to most of CSFs of the overall projects.

5.4 Limitations of Research

Following are the limitations identified during the research period and its findings:

- This research considered only the key CSFs and ignored the factors which are not relevant and significant at each stage of the project success level.

- The expert questionnaire sample was limited to 6 expertise in construction industry who have more than 10 years of experience in top or middle level management. However, most of the respondents were from the academic background, therefore it may have an impact on the results of the expert survey.
- Further, the main questionnaire sample was limited to 50 construction professionals in main 3 commercial construction cities in Sri Lanka (Colombo, Galle and Kandy). Widening the sample size and geographical area may help to improve the precision of the findings.
- The case studies were carried out for projects in suburbs in Colombo District and the approachable internal information was limited, due to the confidential issues of the companies.
- Due to difficulties in obtaining responses from certain stakeholder groups (e.g. Politicians), proxy stakeholder groups were interviewed to obtain the responses for the case study.
- The surveys and case studies were conducted by adopting both convent sampling and snowball sampling which may lead to some sampling bias.
- Due to the time constraints of the research the project success evaluation was limited until the end of Level II of project success levels (few months after the handing over).

5.5 Further Research Recommendations

While carrying out the research, following further research areas were identified where follow up scholars could focus in their future studies.

- A study of methods of improving the project success and project portfolio success for whole life cycle of the project.
- A study of evaluating the impact of CSFs in the project success and project portfolio success.
- A study of incorporating the changes of Key Performance Indicators of stakeholders and CSFs of project success based on time reliance.

REFERENCES LIST

Alarcon, L.F. and Ashley, D.B. (1996), Modeling project performance for decision making, *Journal of Construction Engineering and Management*, 1222 (3), pp. 265-273.

Aliaga, M. & Gunderson, B. (2002). Interactive statistics. New Jersey: Prentice Hall. Matthews, B. and Ross, L. (2010) Research Methods. Pearson Longman, London.

Archibald, R.D., Di Filippo, I. and Di Filippo, D. (2012). The six-phase comprehensive project life cycle model including the project incubation/feasibility phase and the post-project evaluation phase. *PM World Journal*, 1(5), pp. 1-40.

Atkinson, R. (1999), Project management: cost, time and quality, two best guesses and a phenomenon, is time to accept other success criteria, *International Journal of Project Management*, 17 (6), pp. 337-342.

Barnes, M. (1988), Construction project management, *International Journal Of Project Management*, 6 (2), pp. 69- 79. doi: 10.1016/0263-7863(88)90028-2

Bryde, D., and Brown, D. (2005). The Influence of a Project Performance Measurement System on the Success of a Contract for Maintaining Motorways and Trunk Roads. Project Management Journal, 35(4), pp. 57-65. doi: 10.1177/875697280403500407

Bryman, A. and Bell, E. (2007). Business research methods. Oxford University Press, USA.

Bubshait, A.A. and Almohawis, S.A. (1994), Evaluating the general conditions of a construction contract, *International Journal of Project Management*, 12 (3), pp. 133-135.

Caccamese, A., Bragantini, D. (2013). Beyond The Iron Triangle: Year Zero. *PM World Journal* 2(12).

Carù, A., Cova, B., and Pace, S. (2004). Project Succes. *European Management Journal*, 22(5), 532-545. doi: 10.1016/j.emj.2004.09.011

Chan, A., & Chan, A. (2004). Key performance indicators for measuring construction success. Benchmarking: An International Journal, 11(2), pp. 203-221. doi: 10.1108/14635770410532624

Chan, A.P.C. (1997), Measuring success for a construction project, The Australian Institute of Quantity Surveyors – Referred Journal, Vol. 1 No. 2, pp. 55-59.

Chua, D. K. H., Kog, Y. C., and Loh, P. K. (1999).Critical success factors for different project objectives .*Junior Construction Engineering. Management*. 125 (3), pp. 142–150.

Clegg, C., Axtell, C., Damodaran, L., Farbey, B., Hull, R., and Lloyd-Jones, R. et al. (1997). Information technology: a study of performance and the role of human and organizational factors. *Ergonomics, 40*(9), pp. 851-871.

Collin, J. (2002), *Measuring the success of building projects – improved project delivery initiatives*

Collins, H. (2010) "Creative Research: The Theory and Practice of Research for the Creative Industries" AVA Publications, p.38.

Construction Industry Review Committee (2001), "Construct for excellence", Report of the Construction Industry Review Committee, January 2001.

Cookie-Davies, T., (2002). The real success factors on projects. *International Journal of Project Management* 20 (3), 185–190. doi: 10.1016/s0263-7863(01)00067-9

Cox, R.F., Issa, R.R.A., Aherns, D., (2003). Management's perception of key performance indicators for construction. *Journal of Construction Engineering and Management* 129 (2), pp. 142–151.

Creswell, J. W. (2013). Qualitative Inquiry & Research Design: Choosing among Five Approaches (3rd ed.). Thousand Oaks, CA: SAGE

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson,W. E. (2003). Advance mixed methods research designs. In A.Tashakkori & C. Teddlie (Eds.), Handbook of mixed methods in social and behavioral research (pp. 209-240). Thousand Oaks, CA: Sage

Dalcher, D. (2009). Book Review: Project Reviews, Assurance and Governance. *Project Management Journal*, *40*(2), pp. 107-107. doi: 10.1002/pmj.20126

Dalcher, D. and Brodie, L.(2007). *Successful IT Projects,* Thomson Publishing, London

Dvir, D., Raz T. and Shenhar, A. (2003). An empirical analysis of the relationship between project planning and project success. *International Journal of Project Management,* 21 (2), pp. 89-95.

Encyclopedia.com. (2019). Cross-sectional Study | Encyclopedia.com. [online] Available at:https://www.encyclopedia.com/medicine/divisions-diagnostics-and procedures/medicine/cross-sectional-study [Accessed 1 Jan. 2019].

Fahri, J., Biesenthal, C., Pollack, J., and Sankaran, S. (2015). Understanding Megaproject Success beyond the Project Close-Out Stage. *Construction Economics And Building*, 15(3), pp. 48-58. doi: 10.5130/ajceb.v15i3.4611

Gabriel, D. (17th March,2013). Inductive and deductive approaches to research. Retrieved from http://deborahgabriel.com/2013/03/17/inductive-and-deductive-approaches-to-research/ [Accessed 27 Jun. 2019].

Gillham, B. (2008). Developing a Questionnaire. London: Bloomsbury Publishing.

Greene J.C. (2007), Mixed methods in social inquiry. San Francisco: Jossey-Bass.

Johnson, B.R., Christensen L.B., (2017). Educational research: Quantitative, qualitative, and mixed approaches. 6. Los Angeles: SAGE.

Johnson, R., & Onwuegbuzie, A. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. Educational Researcher, 33(7), 14-26. doi: 10.3102/0013189x033007014

Johnson, R., Onwuegbuzie, A., & Turner, L. (2007). Toward a Definition of Mixed Methods Research. Journal Of Mixed Methods Research, 1(2), pp. 112-133. doi: 10.1177/1558689806298224

Kagioglou, M., Cooper, R and Aouad, G., Hinks, J., Sexton, M.G. and Sheath, D.M., (1998), A generic guide to the design and construction process protocol, University of Salford, Salford

Keith F. Punch (2005). Introduction to Social Research–Quantitative & Qualitative Approaches. London: Sage

Kerzner, H. (2009). *Project management*. 8th ed. Hoboken, N.J.: J. Wiley & Sons.

Levine, H.K. (2005). *Project Portfolio Management.* (1st ed.).San Francisco, CA: Jossey-Bass

Li, J. (2008). Three Dimensions Structure Model Based on Project Evaluation. *2008 4th International Conference On Wireless Communications, Networking And Mobile Computing*. doi: 10.1109/wicom.2008.1840

Lim, C.S., Mohamed, M.Z., (1999). Criteria of project success: an exploratory re-examination. *International Journal of Project Management* 17 (4), pp. 243–248.

Liu, Y., Yu, F., Su, S.Y. and Lam, H. (2003). A cost–benefit evaluation server for decision support in e-business. *Decision Support Systems*, 36(1), pp. 81-97.

Michaels, P. (2007), Calculating the Cost of Failed Software Projects, Computer-Weekly. http://www.computerweekly.com/feature/Calculating-the-cost-of-failed-software-projects (Accessed 02/05/2016).

Morris, P., Pinto, J.K. (2004). *The Wiley Guide to Managing Projects*. Hoboken, NJ: John Wiley and Sons.

Müller, R., & Turner, J. (2007). Matching the project manager's leadership style to project type. International Journal Of Project Management, 25(1), pp. 21-32. doi: 10.1016/j.ijproman.2006.04.003

Müller, R., and Jugdev, K. (2012). Critical success factors in projects. *International Journal Of Managing Projects In Business*, 5(4), 757-775. doi: 10.1108/17538371211269040

Naoum, S. (1994). Critical Analysis of Time and Cost of Management and Traditional Contracts. *Journal Of Construction Engineering And Management*, *120*(4), pp. 687-705. doi: 10.1061/(asce)0733-9364(1994)120:4(687)

Packendorff, J. (1995). Inquiring into the temporary organization: New directions for project management research. *Scandinavian Journal Of Management*, *11*(4), pp. 319-333. doi: 10.1016/0956-5221(95)00018-q

Paradigm Whose Time Has Come by R. Burke Johnson, Anthony J. Onwuegbuzie Published 2008

Pinto, J., and Slevin, D. (1989). Critical Success Factors in RandD Projects. *Research-Technology Management*, *32*(1), 31-35.

PMI (2014), PMI's pulse of the profession: The high cost of low performance, Project Management Institute Inc.

Poon, P. and Wagner, C. (2001). Critical success factors revisited: success and failure cases of information systems for senior executives. *Decision Support Systems*, 30(4), pp. 393-418. doi: 10.1016/S0167-9236(00)00069-5

Priemus, H. 2010. Mega-projects: Dealing with Pitfalls. *European Planning Studies*, 18(7),1023-1039. doi:10.1080/09654311003744159

Project Management Institute 2013, *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*, Newtown Square, PA: PMI.

Roush, F. (1991). Thomas L. Saaty and Luis G. Vargas, Prediction, Projection, and Forecasting. Boston: Kluwer Academic Publishers, 1991. *Mathematical Social Sciences*, *22*(2), p. 185. doi: 10.1016/0165-4896(91)90014-i

Saaty, T. L. (1980). *The analytic hierarchy process: Planning, priority setting, resources allocation.* McGraw-Hill, London, England.

Sauer, C., Gemino, A. and Reich, B.H. (2007), The impact of size and volatility on IT project performance, *Communications of the ACM*, 50 (11), pp. 79-84.

Saunders, M., Lewis, P. & Thornhill, A. (2012) "Research Methods for Business Students" 6th edition, Pearson Education Limited

Savolainen, P., Ahonen, J. J. and Richardson, I. (2012), Software development project success and failure from the supplier's perspective: a systematic literature review, *International Journal of Project Management*, 30 (4), pp. 458-469. doi: 10.1016/j.ijproman.2011.07.002

Serrador, P., & Rodney Turner, J. (2014). The Relationship between Project Success and Project Efficiency. Procedia - Social And Behavioral Sciences, 119, pp. 75-84. doi: 10.1016/j.sbspro.2014.03.011

Shenhar, A. and Dvir, D. (2007), *Reinventing project management: the diamond approach to successful growth and innovation*, Harvard Business Press.

Shenhar, A.J., Levy, O. and Dvir, D. (1997). Mapping the dimensions of project success. *Project Management Journal*, 28, pp. 5-9.

Showkat, N. (2017) Probability and Non Probability Sampling. Asian Research Journal of Business Management, 4(4).

Snijders, P., Wuttke, T., Zandhuis, A., and Newton, S. (2013). *PMBOK Guide*. Zaltbommel: Van Haren Publishing.

Song, X.,Letch, N. (2012). Research on IT/IS Evaluation: A 25 Year Review. *Electronic Journal of Information Systems Evaluation*, 15(3), pp. 276-287.

Stewart, B., (2015), Beyond the Iron Triangle: Evaluating Aspects of Success and Failure using a Project Status Model, *Computing and Information Systems Journal* 19 (2), pp. 19-36.

Success | Definition of success in English by Oxford Dictionaries. (2019). Retrieved from https://en.oxforddictionaries.com/definition/success

Toor, S., and Ogunlana, S. (2010). Beyond the 'iron triangle': Stakeholder perception of key performance indicators (KPIs) for large-scale public sector development projects. *International Journal of Project Management*, 28(3), 228-236. doi: 10.1016/j.ijproman.2009.05.005

Trochim, W. (2006). Positivism and post-positivism. Research methods knowledge base.

Turner, J.R. (2009). The handbook of project-based management, 3rd edition, New York: McGraw-Hill.

Turner, R., and Zolin, R. (2012). Forecasting Success on Large Projects: Developing Reliable Scales to Predict Multiple Perspectives by Multiple Stakeholders over Multiple Time Frames. *Project Management Journal*, *43*(5), pp. 87-99. doi: 10.1002/pmj.21289

Wateridge, J. (1998), How can IS/IT projects be measured for success?, *International Journal of Project Management*, Vol. 16 No. 1, pp. 59-63. doi: 10.1016/s0263-7863(97)00022-7

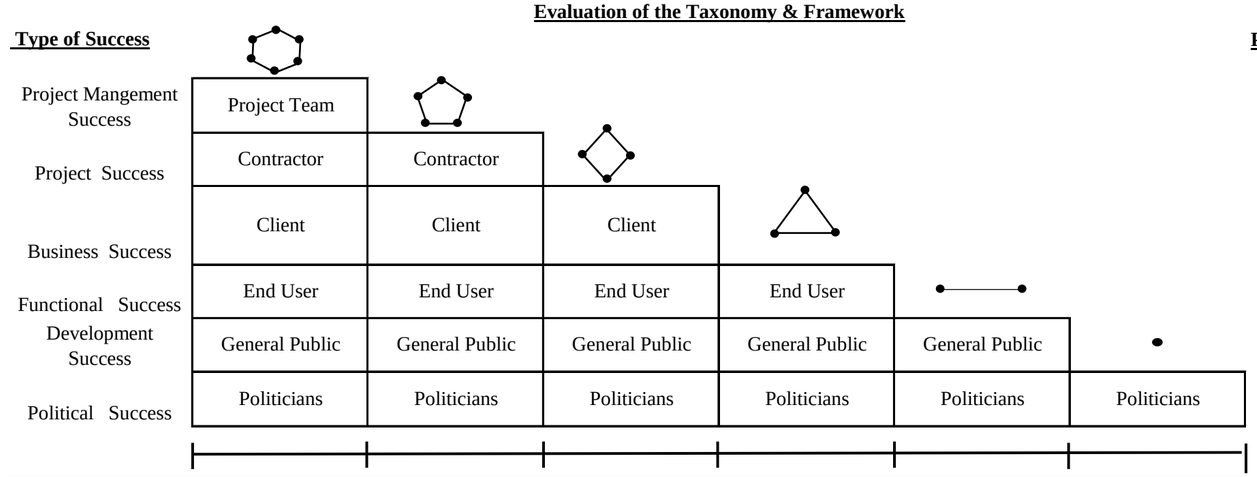
Yeong, C.M. (1994), Time and cost performance of building contracts in Australia and Malaysia, MSc thesis, University of South Australia, Australia, Adelaide.

Yin, R. K. (2009). Case study research: Design and methods (4th Ed.). Thousand Oaks, CA: Sage.

Appendix - I

Taxnomy of Project Success For Multi- Storied Building Constrcution in Sri Lanka

Evaluation of the Taxonomy & Framework



Project Success Level	Measurement of Success based on Literture	Measurement of Success based on Survey Results
Level -I	Iron Triangle Deliverables	All 21 CSF
Level -II	Profitability	All 21 CSF
Level -III	Value Delivery & Value Creation	Political risks, Economic risks, Relationships, Site limitation & location, Project size, Adequacy of funding, Risk identification & allocation, Report updates
Level -IV	Functionability	Political risks, Economic risks, Relationships
Level -V	Sustainability	Relationships, Economic risks, Political risks
Level -VI	Political Propagandas & Political Advancement	Relationships, Political risks

Project Success Level	Level -I	Level -II	Level -III	Level -IV	Level -V	Level -VI
Duration	From Project Start To Project Handing Over	From Project Handing Over To 1 Year After Project Handing Over	From 1 Year After Project Handing Over To 2-3 Year After Project Handing Over	From 1 Year After Project Handing Over To 2-3 Year After Project Handing Over	From 2-3 Year After Project Handing Over To 4-5 Year After Project Handing Over	From 2-3 Year After Project Handing Over To 4-5 Year After Project Handing Over
Project Deliveribles	Efficiency of Project Output	Effictivess of Project Output	Efficiency of Project Outcome	Effectiveness of Project Outcome	Effectiveness of Project Impact	Efficiency of Project Impact
Time Scale	Short Term		Intermidate Term		Long Term	
Type of Success	Project Mangement Success	Project Success	Project Mangement Success	Business Success	Functionality Success	Political Success
Forces	Internal Forces	External Forces	Internal Forces	External Forces	Internal Forces	External Forces

Appendix - II

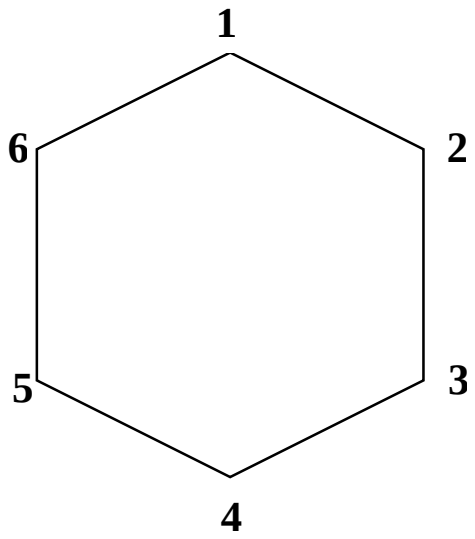
Theoretical Matrix of Project Success For Building Constrcution in Sri Lanka Based on Literature : Deliverables Vs. Force & Time Scale Vs. Efficacy

		Project Deliverables		
		Project Output	**Project Outcome**	**Project Impact**
Forces	**External Forces**	**LII: Project Success** Project Objectives Technical Aspects Financial Benefits Fitness for the purpose	**LIV: Functional Success** Usability Adoptability Performance Quality Improvement	**LVI: Political Success** Political Propaganda Political Agenda Political Power Quality for Political Advancement
	Internal Forces	**L I:Project Management Success** Time Cost Quality of Design Conformance Meeting the Specification Requirements Health & Safety	**LIII: Business Success** Achieve in Business Objectives Value Creation Value Delivery: Net Sales Income Net Profit	**LV: Sustainable Development Success** Modification Sustainability Total Quality Management Impacts for the society, economy, environment

		Time Scale		
		Short term	**Intermediate Term**	**Long Term**
Performance	**Effectiveness**	**LII: Project Success** Quality of Output Financial Benefits Initial Effect of Project Output	**LIV: Functional Success** Organization Strategical Objectives Investment Benefits Performance Quality Improvement	**LV: Sustainable Development Success** Modification Sustainability Total Quality Management Positive Impacts for the society, economy, environment
	Efficiency	**L I:Project Management Success** Time Cost Quality of Design Conformance Meeting the Specification Requirements Minimize idling/ wasting of resources	**LIII: Business Success** Achieve in Business Objectives Value Creation Value Delivery: Net Sales Income Net Profit	**LVI: Political Success** Political Propaganda Political Agenda Political Power Quality for Political Advancement

Appendix – III

A Framework for Project Deliverables For Building Construction in Sri Lanka: Hexagon of Project Success



Corner No	Stakeholder Benefits	Type of Success	Measurement of Success
1	Benefits for Project Team	Project Management Success	Iron Triangle Deliverables
2	Benefits for Contractor	Project Success	Profitability
3	Benefits for Client	Business Success	Value Delivery, Value Creation
4	Benefits for End User	Functional Success	Functionability,
5	Benefits for General Public	Sustainable Development Success	Sustainability
6	Benefits for Politicians	Political Success	Political Propagandas & Political Advancement

25th July, 2019.

P. Lakkhana Perera
No.148/3, Vihara Mawatha,
Kolonnawa, Sri Lanka.

Dear Sir/Madam,

Exprt Questionnaire Survey- Stage I

I am a Postgraduate student attached to University of Moratuwa, currently reading for M.Sc. in Project Management, as part of the study, I am conducting an individual research project on: **"A Framework of Project Deliverables Beyond the Iron Triangle for Multi Storied Building Projects in Sri Lanka",** to fulfill the mandatory requirement of M. Sc. in Project Management.

I would be grateful if you could follow the below mentioned link to complete the main questionnaire.

https://forms.gle/xnuoyBhfR5W2Gva87

The information gathered through the questionnaire will only be used to complete my final dissertation and all of your information will be treated confidentially by myself. Your early responses would be highly appreciated since I have to undergo with a tight -time schedule.

Thank you.

P. L. Perera
Student of M.Sc. Project Management
University of Moratuwa

Appendix -IV
Sample For Expert Questionnaire Survey - Stage I

Expert Survey Of Critical Success Factors for Multi Storied Building Projects in Sri Lanka

1. **Email address** *

2. **Profession**

3. **Designation**

4. **Experience in the construction industry**
   Mark only one oval.
   - ◯ Less than 10 years
   - ◯ 10-15 years
   - ◯ 15 - 20 years
   - ◯ 20 - 25 years
   - ◯ More than 25 years

5. **Experience as a middle-level manager or top level manager**
   Mark only one oval.
   - ◯ Less than 5 years
   - ◯ 5 - 10 years
   - ◯ 10 - 15 years
   - ◯ 15 - 20 years
   - ◯ More than 20 years

Expert Survey Of Critical Success Factors for Multi Storied Building Projects in Sri Lanka

The following 67 critical factors were identified by the Satty's (1980). Select (20-30 nos.) the most Critical Success Factors (CSF) for multi- storied building projects in Sri Lanka, according to the respondent’s views, considering whole life cycle of the project.

6. **What is the most critical success factors for multi-storied building projects in Sri Lanka**
Mark only one oval per row.

	Yes	No
Political risks		
Economic risks		
Impact on public		
Technical approval authorities		
Adequacy of funding		
Site limitation and location		
Constructability		
Pioneering status		
Project size		
Realistic obligations/clear objectives		
Risk identification and allocation		
Adequacy of plans and specifications		
Formal dispute resolution process		
Motivation/ incentives		
Project Mangers' competency		
Project Mangers' authority		
Project Mangers commitment and involvement		
Capability of client key personnel		
Competency of client proposed team		
Client team turnover rate;		
Client top management support;		
Client track record		
Client level of service		
Capability of contractor key personnel		
Competency of contractor proposed team		
Contractor team turnover rate		
Contractor top management support		
Contractor track record		
Contractor level of service		
Capability of consultant key personnel		
Competency of consultant proposed team		
Consultant team turnover rate		
Consultant top management support		
Consultant track record		
Consultant level of service		
Capability of subcontractors key personnel		
Competency of subcontractors proposed team		
Subcontractors team turnover rate		
Subcontractors top management support		
Subcontractors track record		
Subcontractors level of service		
Capability of suppliers key personnel		

	Yes	No
Competency of suppliers proposed team		
Suppliers team turnover rate		
Suppliers top management support		
Suppliers track record		
Suppliers level of service		
Formal design communication		
Informal design communication		
Formal construction communication		
Informal construction communication		
Functional plans		
Design complete at construction start		
Constructability program		
Level of modularization		
Level of automation		
Level of skill labors required		
Report updates		
Budget updates		
Schedule updates		
Design control meetings		
Construction control meetings		
Site inspections		
Work organization chart		
Common goal		
Motivational factor		
Relationships		

12th July, 2019.

P. Lakkhana Perera
No.148/3, Vihara Mawatha,
Kolonnawa, Sri Lanka.

Dear Sir/Madam,

Pilot Questionnaire Survey- Stage II

I am a Postgraduate student attached to University of Moratuwa, currently reading for M.Sc. in Project Management, as part of the study, I am conducting an individual research project on: **"A Framework of Project Deliverables Beyond the Iron Triangle for Multi Storied Building Projects in Sri Lanka",** to fulfill the mandatory requirement of M. Sc. in Project Management.

I would be grateful if you could complete the attached pilot questionnaire (includes 2nos. of A4 sheets – for instructions, basic information & 1no. of A3 sheets of the questionnaire). **The information gathered through the questionnaire will only be used to complete my final dissertation and all of your information will be treated confidentially by myself**. Your early response would be highly appreciated.

Thank you.

P. L. Perera

Instructions For The Participants Of The Questionnaire Surveyor – Pilot Survey – Stage II

Step -1

- Please refer the 1nos. A3 sheet which constraints 21 Critical Success Factors (CSF) for a project.
- In this study, the respondent (you) must identify the most Critical Success Factors (CSF) for multi-storied building projects in Sri Lanka, according to the respondent (your) views.
- The Columns -A1 to A6 are the interest stakeholder categories of a project :
  Project Team (PT), Contractor (CO), Client (CL), End User (EU), General Public (GP), Politician (PO)
- Make a cross (**X)** if relevant to the specific stakeholder; if not, keep relevant A, B, C columns as blanks. (The respondents (you) can select more than one stakeholder for success factor if necessary)

Step -2

- As per Shenhar, Levy, and Dvir (1997), has noted that assessing success is reliant on time.

Level	**Duration**	**Evaluation**
Level I	From project implementation to project handing over stage	Evaluate the **efficiency** of project output
Level II	From project handing -over stage to one year	Evaluate the **effectiveness** of the project output
Level III	1 to 2 years after Level II of the project	Evaluate the **efficiency** of the project outcome
Level IV	1 to 2 years after Level II of the project	Evaluate the **effectiveness** of project outcome
Level V	3 to 4 years after Level II of the project	Evaluate the **efficiency** of project impact
Level VI	3 to 4 years after Level II of the project	Evaluate the **effectiveness** of project impact

- If you fill any box in the Column A1 to A6 mentioned the stage/s (E.g.: I, II, III, IV, V, VI), then write the relevant project stage that must be assess for that criterion in relevant Column - B).

Step - 3

- As per Cox et.al. (2003), it is important to assimilate the viewpoint of all interest groups as they have diversified range of importance according to their Key Performance Indicators (KPI).
- Based on the literature following weightage of Critical Success Factors were identified:

Weightage	**Critical Success Factor**
1	Least Important Factors
2	Less Important Factors
3	Important Factors
4	Most Important Factors
5	Most Significant Important Factors

- If you fill any box in the Column A1 to A6 mentioned the weightage (E.g.: 1,2,.....,5) that the project must be allocated for that criterion in relevant Column – C.

Level	Duration	Evaluation
I	Project implementation to handing over	**Efficiency** of project **output**
II	Project handing -over to one year	**Effectiveness** of the project **output**
III	1 to 2 years after Level II of the project	**Efficiency** of the project **outcome**
IV	1 to 2 years after Level II of the project	**Effectiveness** of project **outcome**
V	3 to 4 years after Level II of the project	**Efficiency** of project **impact**
VI	3 to 4 years after Level II of the project	**Effectiveness** of project **impact**

- The Respondent can select any number of factors for one level & can select one factor for numerous levels

Basic Information:

- Profession:

  ……

  ……

  ……

- Designation:

  ……

  ……

  ……

- Experience in the Construction Industry:

Less than 10 years ( ) 10 – 15 years ( ) 15 -20 years ( ) 20 -25 years ( ) More than 25 years ( )

- Experience as a Middle Manager or Top Manger:

Less than 5 years ( ) 5 – 10 years ( ) 10 -15 years ( ) 15 -20 years ( ) More than 20 years ( )

Appendix - VI
Sample for Expert Survey Stage II

No.	Critical Success Factors for Project Success	CSF For Stakeholders (PT , CO, CL,EU,GP,PO), Level (I , II, III, IV,V, VI) Weightage (1-5),																
		A 1	B	C	A 2	B	C	A 3	B	C	A 4	B	C	A 5	B	C	A 6	B	C
		Project Team	Level	Weight -age	Contra - ctor	Level	Weight - age	Client	Level	Weight - age	End User	Level	Weight - age	Genral Public	Level	Weight - age	Politic - ian	Level	Weight - age
1	Political risks																		
2	Economic risks																		
3	Adequacy of funding																		
4	Site limitation and location																		
5	Constructability																		
6	Project size																		
7	Risk identification and allocation																		
8	Adequacy of plans and specifications																		
9	Project Mangers' competency																		
10	Project Mangers' authority																		
11	Project Mangers commitment and involvement																		
12	Capability of contractor key personnel																		
13	Capability of consultant key personnel																		
14	Formal construction communication																		
15	Level of skill labors required																		
16	Report updates																		
17	Budget updates																		
18	Schedule updates																		
19	Design control meetings																		
20	Construction control meetings																		
21	Relationships																		

Appendix - VI - Results of Expert Survey Stage - II

No.	Critical Success Factors for Project Success	Imporatnce of CSF for Stakeholders						Imporatnce of CSF for Project Levels					
		PT	CO	CL	EU	GP	PO	L I	L II	L III	L IV	L V	L VI
1	Political risks	1.42	1.28	3.44	3.25	3.39	3.36	3.89	4.17	2.44	2.39	1.92	1.61
2	Economic risks	1.42	1.44	3.31	3.06	2.44	2.97	3.14	3.44	2.17	2.25	2.08	1.61
3	Adequacy of funding	1.42	1.44	1.92	2.86	1.75	1.75	3.19	3.47	1.42	1.25	0.94	0.81
4	Site limitation and location	1.11	1.22	2.47	2.36	2.28	2.61	3.08	3.31	2.00	1.56	1.11	0.78
5	Constructability	1.25	1.00	1.25	0.19	-	0.36	2.78	1.36	-	-	-	-
6	Project size	1.14	1.19	1.97	3.17	2.83	2.83	4.00	3.47	1.83	1.58	1.00	0.94
7	Risk identification and allocation	1.19	1.58	2.08	2.81	1.92	1.89	3.86	3.36	1.25	1.17	0.97	0.92
8	Adequacy of plans and specifications	1.19	1.06	1.17	1.72	-	-	2.64	1.81	0.22	0.22	0.14	0.11
9	Project Mangers' competency	1.17	1.19	1.22	1.11	-	-	2.72	1.61	0.14	0.11	0.06	0.06
10	Project Mangers' authority	1.06	1.14	1.19	0.25	-	-	2.44	1.19	-	-	-	-
11	Project Mangers commitment and involvement	1.22	1.19	1.25	0.28	-	-	2.61	1.33	-	-	-	-
12	Capability of contractor key personnel	1.28	1.33	1.06	0.25	-	-	2.44	1.47	-	-	-	-
13	Capability of consultant key personnel	1.33	1.28	1.47	0.19	-	-	2.47	1.47	0.08	0.08	0.08	0.08
14	Formal construction communication	1.31	1.22	1.03	-	-	0.22	2.36	1.64	-	-	-	-
15	Level of skill labors required	1.14	1.42	1.11	0.86	-	0.06	2.56	1.64	0.17	0.17	0.17	0.17
16	Report updates	1.33	1.17	1.64	0.22	-	0.08	2.58	1.61	0.17	0.17	0.17	0.17
17	Budget updates	1.36	1.19	1.75	0.22	-	0.08	2.67	1.69	0.17	0.17	0.17	0.17
18	Schedule updates	1.36	1.17	1.36	0.19	-	0.08	2.56	1.69	-	-	-	-
19	Design control meetings	1.19	1.06	1.03	-	-	-	2.11	1.17	-	-	-	-
20	Construction control meetings	0.94	1.03	0.89	-	-	0.08	2.19	0.75	-	-	-	-
21	Relationships	1.53	1.56	1.69	2.81	1.22	1.22	3.31	2.89	1.19	1.08	0.75	0.69

Expert Survey
Most Significant Factors
Significant Factors
Less Significant Factors
Not Significant Factors

P. Lakkhana Perera
No.148/3, Vihara Mawatha,
Kolonnawa, Sri Lanka.
15th August, 2019.

Dear Sir/Madam,

Main Questionnaire Survey.

I am a post graduate student in University of Moratuwa. I' m currently engaging in my individual research, "**A Framework of Project Deliverables Beyond the Iron Triangle for Multi Storied Building Projects in Sri Lanka",** to fulfill the mandatory requirement of M. Sc. in Project Management.

I would be grateful if you could follow the below mentioned link to complete the main questionnaire.

https://forms.gle/xREA7H3uUbchgE2X8

The information gathered through the questionnaire will only be used to complete my final dissertation and all of your information will be treated confidentially by myself. Your early responses would be highly appreciated since I have to undergo with a tight -time schedule.

Thank you

P. L. Perera
Student of M.Sc. Project Management
University of Moratuwa

Main Survey Of Critical Success Factors for a Multi Storied Building Projects in Sri Lanka

Basic Information

1. **Email address** *

2. **Profession**

3. **Designation**

4. **Experience in the construction industry**
   Mark only one oval.
   - Less than 10 years
   - 10 - 15 years
   - 15 - 20 years
   - 20 - 25 years
   - More than 25 years

5. **Experience as a middle-level manager or top level manager**
   Mark only one oval.
   - Less than 5 years
   - 5 - 10 years
   - 10 - 15 years
   - 15 - 20 years
   - More than 20 years

Main Survey for Critical Success Factors for a Multi Storied Building Projects in Sri Lanka

Guidelines for Respondents

The respondent must select the most Critical Success Factors (CSF) for multi-storied building projects in Sri Lanka from the following 21 Critical Success Factors, which is abstracted from the pilot survey.

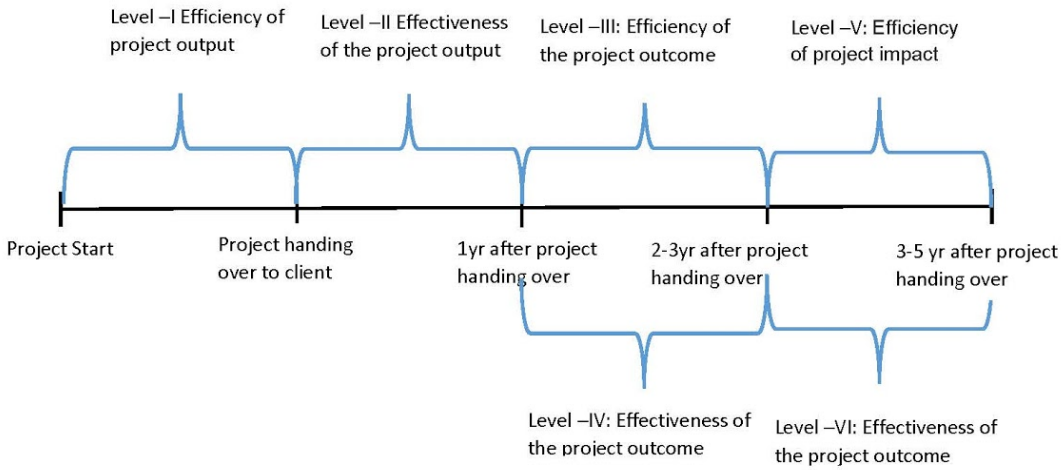
As per Shenhar, Levy et.al.(1997): following levels are identified to evaluate the project success or failure:

Level	Duration	Evaluation
I	Project implementation to handing over	Efficiency of project output
II	Project handing -over to 1-year	Effectiveness of the project output
III	1 to 2 years after Level II of the project	Efficiency of the project outcome
IV	1 to 2 years after Level II of the project	Effectiveness of project outcome
V	3 to 4 years after Level II of the project	Efficiency of project impact
VI	3 to 4 years after Level II of the project	Effectiveness of project impact

The respondent can select any number of factors for one level & can select one factor for numerous levels.

The respondent must select all the effective stages of Critical Success Factors.

Stages of Project Success



6. **What are the most influenced levels of Critical Success Factors for a Multi Storied Building Project in Sri Lanka?**
Tick all that apply.

	Level I	Level II	Level III	Level IV	Level V	Level VI
Political risks	☐	☐	☐	☐	☐	☐
Economic risks	☐	☐	☐	☐	☐	☐
Adequacy of funding	☐	☐	☐	☐	☐	☐
Site limitation and location	☐	☐	☐	☐	☐	☐
Construct-ability	☐	☐	☐	☐	☐	☐
Project size	☐	☐	☐	☐	☐	☐
Risk identification and allocation	☐	☐	☐	☐	☐	☐
Adequacy of plans and specifications	☐	☐	☐	☐	☐	☐
Project Mangers' competency	☐	☐	☐	☐	☐	☐
Project Mangers' authority	☐	☐	☐	☐	☐	☐
Project Mangers commitment and involvement	☐	☐	☐	☐	☐	☐
Capability of contractor key personnel	☐	☐	☐	☐	☐	☐
Capability of consultant key personnel	☐	☐	☐	☐	☐	☐
Formal construction communication	☐	☐	☐	☐	☐	☐
Level of skill labors required	☐	☐	☐	☐	☐	☐
Report updates	☐	☐	☐	☐	☐	☐
Budget updates	☐	☐	☐	☐	☐	☐
Schedule updates	☐	☐	☐	☐	☐	☐
Design control meetings	☐	☐	☐	☐	☐	☐
Construction control meetings	☐	☐	☐	☐	☐	☐
Relationships	☐	☐	☐	☐	☐	☐

☐ Send me a copy of my responses.

Appendix - VIII

Results of Expert Survey & Main Survey For Project Success Level

No.		Critical Success Factors for Project Success	Main Survey Results						Expert Survey Results					
			Level I	Level II	Level III	Level IV	Level V	Level VI	Level I	Level II	Level III	Level IV	Level V	Level VI
1	1	Political risks	1.00	0.96	0.80	0.80	0.74	0.74	3.89	4.17	2.44	2.39	1.92	1.61
2	2	Economic risks	1.00	0.98	0.86	0.82	0.74	0.46	3.14	3.44	2.17	2.25	2.08	1.61
3	3	Adequacy of funding	1.00	0.84	0.64	0.28	0.10	0.06	3.19	3.47	1.42	1.25	0.94	0.81
4	4	Site limitation and location	1.00	0.68	0.46	0.22	0.08	0.06	3.08	3.31	2.00	1.56	1.11	0.78
5	5	Constructability	1.00	0.72	0.28	0.10	0.06	0.02	2.78	1.36	-	-	-	-
6	6	Project size	1.00	0.78	0.64	0.38	0.34	0.20	4.00	3.47	1.83	1.58	1.00	0.94
7	7	Risk identification and allocation	1.00	0.94	0.62	0.34	0.20	0.10	3.86	3.36	1.25	1.17	0.97	0.92
8	8	Adequacy of plans and specifications	1.00	0.96	0.50	0.28	0.12	0.02	2.64	1.81	0.22	0.22	0.14	0.11
9	9	Project Mangers' competency	1.00	0.96	0.46	0.20	0.10	0.04	2.72	1.61	0.14	0.11	0.06	0.06
10	10	Project Mangers' authority	1.00	0.94	0.44	0.12	0.08	0.02	2.44	1.19	-	-	-	-
11	11	Project Mangers commitment and involvement	1.00	0.94	0.44	0.22	0.06	0.02	2.61	1.33	-	-	-	-
12	12	Capability of contractor key personnel	1.00	0.90	0.26	0.18	0.08	0.06	2.44	1.47	-	-	-	-
13	13	Capability of consultant key personnel	1.00	0.76	0.26	0.18	0.10	0.04	2.47	1.47	0.08	0.08	0.08	0.08
14	14	Formal construction communication	1.00	0.96	0.42	0.22	0.12	0.08	2.36	1.64	-	-	-	-
15	15	Level of skill labors required	1.00	0.86	0.22	0.12	0.08	0.04	2.56	1.64	0.17	0.17	0.17	0.17
16	16	Report updates	1.00	0.96	0.70	0.34	0.22	0.18	2.58	1.61	0.17	0.17	0.17	0.17
17	17	Budget updates	1.00	0.94	0.44	0.18	0.04	-	2.67	1.69	0.17	0.17	0.17	0.17
18	18	Schedule updates	1.00	0.88	0.36	0.28	0.06	0.04	2.56	1.69	-	-	-	-
19	19	Design control meetings	1.00	0.64	0.16	0.10	0.04	0.02	2.11	1.17	-	-	-	-
20	20	Construction control meetings	1.00	0.72	0.16	0.12	0.06	0.02	2.19	0.75	-	-	-	-
21	21	Relationships	1.00	0.98	0.98	0.86	0.88	0.84	3.31	2.89	1.19	1.08	0.75	0.69

	Main Survey
Most Relevent Factors	1<=MR>=.75
Relevent Factors	.75>MR>=.50
Less Relevent Factors	.50>MR>=.25
Not Relevent Factors	.25>MR>=0

	Expert Survey
Most Significant Factors	5.0>RII>=3.5
Significant Factors	3.5>RII>=2.0
Less Relevent Factors	2.0>RII>=1.0
Not Significant Factors	1.0>RII>=0.0

Appendix - IX
Sample for Case Study

No.	Description	Project 1	Project 2	Project 3
1.0	**Background**			
1.1	Nature of The Project			
1.2	Type of The Project			
1.3	Procurement Method			
1.4	Payment Method			
1.4	Gross Floor Area (m2)			
2.0	**Project Finance**			
2.1	Original Contract Sum (Rs.)			
2.2	Final Contract Sum (Rs.)			
2.3	Final rise and fall (Rs.)			
2.4	Contingency allowance (Rs.)			
2.5	Percent NETVAR			
2.6	Income From Selling			
2.7	Unit Cost (Rs./m2)			
2.8	Profit			
2.9	Net Prescent Value (NPV)			
3.0	**Project Schedule**			
3.1	Original Contract Period (Days)			
3.2	Project Commencing Date			
3.3	Initial Project Completion Date			
3.4	Total agreed E.O.T.			
3.5	Adjusted Revisied Contract Period			
3.5	Actual Duration For Completion			
3.6	Actual Contract Period (Days)			
3.6	% of Time Varience			
3.7	Speed of Construction (m^2/day)			
4.0	**Health & Safety**			
4.1	No. Accidents			
4.2	No. Labour Days Employed			
4.4	Accident Rates			
5.0	**Enviornmental Impact**			
5.1	Enviornmental Performance Certificates			
6.0	**Quality**			
6.1	Quality Satisfaction (ISO/SLS/other Certificate)			
7.0	**Stakeholder Satisfaction**			
7.1	At the handing over stage			
7.1.1	Project Team Satisfaction			
7.1.2	Contractor Satisfaction			
7.1.3	Client/ Investors Satisfaction			
7.1.4	Customer/ End user Satisfaction			
7.1.5	Genral Public Satisfaction			
7.1.6	Politications Satisfaction			
7.2	Few months after handing over stage			
7.2.1	Project Team Satisfaction			
7.2.2	Contractor Satisfaction			
7.2.3	Client/ Investors Satisfaction			
7.2.4	Customer/ End user Satisfaction			
7.2.5	General Public Satisfaction			
7.2.6	Politications Satisfaction			

Appendix - X

Analytical Matrices for Project Success Levels For Building Construction in Sri Lanka

Level -I

			Significant Factors			
			Most	Moderate	Less	Not
	Relevant Factors	Most	1,6,7	2,3,4,5,8,9, 11,15,16, 17,18,21	10,12,13,1 4,19,20	
		Moderate				
		Less				
		Not				

Level -II

			Significant Factors			
			Most	Moderate	Less	Not
	Relevant Factors	Most	1	2,3,6,7,21	8,9,11,12,1 3,14,15,16, 17,18	10
		Moderate		4		19,20
		Less		5		
		Not				

Level -III

			Significant Factors			
			Most	Moderate	Less	Not
	Relevant Factors	Most			1, 2	21
		Moderate			3,4,6,7	16
		Less				5,8, 9,10,11,12 ,13,14,17, 18
		Not				15,19,20

Level -IV

			Significant Factors			
			Most	Moderate	Less	Not
	Relevant Factors	Most			1, 2	21
		Moderate				
		Less			3,6	8,16,18,7
		Not			4,	5,9,10,11, 12,13,14,1 5,17,19, 20

Level -V

			Significant Factors			
			Most	Moderate	Less	Not
	Relevant Factors	Most				21
		Moderate			1,2	
		Less				6
		Not				3,4,5,7,8,9 ,10,11, 12,13, 14, 15, 16, 17,18, 19,20

Level -VI

			Significant Factors			
			Most	Moderate	Less	Not
	Relevant Factors	Most				21
		Moderate			1	
		Less			2	
		Not				3,4,5,6, 7,8,9,10,1 1, 12,13,14, 15,16,17, 18,20

1 Political risks
2 Economic risks
3 Adequacy of funding
4 Site limitation and location
5 Constructability
6 Project size
7 Risk identification and allocation
8 Adequacy of plans and specifications
9 Project Mangers' competency
10 Project Mangers' authority
11 Project Mangers commitment and involvement
12 Capability of contractor key personnel
13 Capability of consultant key personnel
14 Formal construction communication
15 Level of skill labors required
16 Report updates
17 Budget updates
18 Schedule updates
19 Design control meetings
20 Construction control meetings
21 Relationships

Appendix - XI

Final Matrices for Project Success For Building Constrcution in Sri Lanka

		Project Deliverables		
		Project Output	**Project Outcome**	**Project Impact**
Forces	External Forces	**LII: Project Success** Political risks	**LIV:Functional Success** Political risks	**LVI:Political Success** Relationships
		Adequacy of funding Economic risks Project size Risk identification & allocation Relationships	Economic risks Relationships	Political risks
		Site limitation and location		
		Adequacy of plans & specifications Budget updates Schedule updates Formal construction communication Level of skill labors required Report updates Project Mangers' competency Capability of contractor key personnel Capability of consultant key personnel Project Mangers commitment and involvement		
		Project Mangers' authority		
		Constructability		
		Design control meetings Construction control meetings		
	Internal Forces	**L I:Project Mangement Success** Project size Political risks Risk identification & allocation	**LIII:Bussiness Success** Political risks Economic risks Relationships	**LV:Sustainble Development Success** Relationships Economic risks Political risks
		Relationships Adequacy of funding Economic risks Site limitation and location	Site limitation and location Project size Adequacy of funding Risk identification and allocation	
		Constructability	Report updates	
		Project Mangers' competency Budget updates Adequacy of plans and specifications Project Mangers commitment and involvement Report updates Schedule updates Level of skill labors required		
		Capability of consultant key personnel Project Mangers' authority Capability of contractor key personnel Formal construction communication Construction control meetings Design control meetings		

Appendix - XI

Final Matrix for Project Success For Building Constrcution in Sri Lanka

		Time Scale		
		Short term	**Intermidate Term**	**Long Term**
Performance	**Effiectiveness**	**LII: Project Success** Political risks	**LIV:Functional Success** Political risks	**LV: Sustainable Development Success** Relationships
		Adequacy of funding Economic risks Project size Risk identification & allocation Relationships	Economic risks Relationships	Economic risks Political risks
		Site limitation and location		
		Adequacy of plans & specifications Budget updates Schedule updates Formal construction communication Level of skill labors required Report updates Project Mangers' competency Capability of contractor key personnel Capability of consultant key personnel Project Mangers commitment and involvement		
		Project Mangers' authority		
		Constructability		
		Design control meetings Construction control meetings		
	Efficiency	**L I:Project Mangement Success** Project size Political risks Risk identification & allocation	**LIII:Bussiness Success** Political risks Economic risks Relationships	**LVI:Political Success** Relationships Political risks
		Relationships Adequacy of funding Economic risks Site limitation and location	Site limitation and location Project size Adequacy of funding Risk identification and allocation	
		Constructability	Report updates	
		Project Mangers' competency Budget updates Adequacy of plans and specifications Project Mangers commitment and involvement Report updates Schedule updates Level of skill labors required		
		Capability of consultant key personnel Project Mangers' authority Capability of contractor key personnel Formal construction communication Construction control meetings Design control meetings		

Appendix - XII

List of Most Critical Factors For Building Constrcution in Sri Lanka

Rank	Critical Success Factors for Project Success
1	Political risks
2	Economic risks
3	Project size
4	Site limitation and location
5	Risk identification and allocation
6	Adequacy of funding
7	Relationships
8	Adequacy of plans and specifications
9	Budget updates
10	Report updates
10	Level of skill labors required
12	Project Mangers' competency
13	Capability of consultant key personnel
14	Schedule updates
15	Constructability
16	Formal construction communication
17	Project Mangers commitment and involvement
18	Capability of contractor key personnel
19	Project Mangers' authority
20	Design control meetings
21	Construction control meetings