

**MANAGEMENT OF FACTORS AFFECTING THE
QUALITY OF BUILDING PROJECTS
IN SRI LANKA**

Amunugama Abhayakoon Walawwe Rajaguru Rajanayaka
Janitha Methsiri Bandaranayaka Amunugama

(189590C)

MSc / PG Diploma in Project Management

Department of Building Economics

University of Moratuwa
Sri Lanka

August 2023

**MANAGEMENT OF FACTORS AFFECTING THE
QUALITY OF BUILDING PROJECTS
IN SRI LANKA**

Amunugama Abhayakoon Walawwe Rajaguru Rajanayaka
Janitha Methsiri Bandaranayaka Amunugama

(189590C)

Dissertation submitted in partial fulfilment of the requirements for the degree
Master of Science in Project Management

Department of Building Economics

University of Moratuwa
Sri Lanka

August 2023

DECLARATION

I declare that this research is my work to the best of my knowledge and it does not contain any materials of previously submitted dissertations prepared by researchers of other universities, institutes or higher education centres. Further, previously written and published materials are not included without providing relevant citations and references in the text.

Further, I admire and acknowledge the immense contribution of my research supervisor Dr. (Mrs.) P. Sridarran towards the successful completion of the research. I confirm that I will never publish any articles or any other publication based on this research without mentioning the name of the research supervisor as co-author of this research if I have not obtained any written consent to do so.

In addition, I hereby grant the non-exclusive right to the University of Moratuwa to reproduce and distribute this dissertation. The dissertation may reproduce in part or in whole using electronic or any other applicable medium. However, I retain the right of using the content of this research to produce articles, books or any other publication.

A.A.W.R.R.J.M.B. Amunugama

Date

The above-named undergraduate has carried out this research for the Dissertation under my supervision.

Dr. (Mrs.) P. Sridarran

Date

DEDICATION

I dedicate this piece of work to my family members for giving me great support and encouragement throughout the course of the study.....

ACKNOWLEDGEMENT

This research was covered with the dedication and ready assistance of plenty of persons who have contributed their support in numerous ways for the completion of this research successfully. Therefore, it is my pleasure to honour them.

I am grateful to Dr. (Mrs.) P. Sridarran, senior lecturer in the faculty of Architecture in particular for guiding me and helping in finalizing the research. Dr. (Mrs.) P. Sridarran was my patron who gave, advice, and encouragement throughout the preparation of the research report often teaching me how to formulate my report and devoting much of her valuable time and giving profound insights to me right throughout the research.

Further, I extend my sincere gratitude to Prof. (Mrs.) Yasangika Sandanayake and all the other academic staff members as well as all non-academic staff members of the Department of Building Economics for the utmost assistance given throughout the studies.

My special thanks should go to all the construction industry experts who provided their valuable support by sharing their knowledge, skills and experience for the collection of required data for my dissertation.

I must honour the Chairman and the General Manager of the Central Engineering Consultancy Bureau (CECB) for sponsoring me for this Master's programme.

Further, I would like to extend my sincere gratitude, especially to all my family members who sacrificed their time and energy on my behalf of me, as well as my batch mates and friends who wish me success throughout the learning process.

Thanking you.

A.A.W.R.R.J.M.B. Amunugama

15-08- 2023

Management of Factors Affecting Quality of Building Projects in Sri Lanka

ABSTRACT

The quality aspect in building construction has become a very much important role in building construction. This study was conducted to analyze the factors affecting the quality of building projects in Sri Lanka and to suggest best practices to be followed to enhance the level of satisfaction with the factors related to the quality of buildings. A thorough literature survey was conducted to determine how previous studies were focused on the relevant topic by various researchers. 35 factors were found from the literature survey that was identified as relevant in achieving the quality of building projects in Sri Lanka. A structured questionnaire was distributed among the industry professionals and information was gathered on the level of importance and the level of satisfaction of the present practices concerning the identified factors relevant to the quality of building construction projects.

Descriptive statistical tests were conducted to analyze the information obtained by the survey. Weighted mean analysis followed by the mean value analysis was conducted to eliminate unimportant data. Then the set of factors was narrowed down to 33 for both importance and satisfaction criteria. Cronbach's alpha test was carried out to validate and test the reliability of the data. Quadrant analysis was conducted to identify the most important factors that need urgent improvements. 15 factors were identified with a high level of importance, having a low level of satisfaction. Factor analysis as an inferential statistical test was conducted to narrow down the identified factors to the most relevant dimensions. Accordingly, the skills, knowledge and experience of the project team were identified as one dimension which represents the human dimension. Factors such as continuous improvement of the project team, training/ awareness of the project team, sharing knowledge among the project team, teamwork among the project team, proper communication among the project team and Labor skills and experience of workers govern the first dimension. The second dimension was the cost and quality management system of the project, which reflects the system dimension That governs the factors such as the cash flow of the project, variations/ accuracy of estimating, implementation of QA/QC systems (such as ISO Certification, TQM, QMS) QA/ QC systems for the contractor organizations, project constraints (low budget, limited time & inflexibility), scarcity of resources and project planning/ quality planning. Experts were interviewed to obtain best practices to be followed To enhance the level of satisfaction of the quality aspects related to the respective factors in the building construction projects. Ten experts having a minimum of 10 years of industry experience were interviewed. 45 best practices relevant to the factors under the dimension of "skills, knowledge and experience of the project team" and 30 best practices relevant to the factors under the dimension of "cost and quality management system of the project" were identified.

Identified factors need to be attained with high priority given achieving quality objectives of the building construction projects. Proposed best practices can be adopted by the design and construction professionals and the respective entities to enhance the quality aspects of building projects in Sri Lanka.

Keywords: *Quality, Building Construction, Factors, Improvement*

TABLE OF CONTENTS

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
TABLE OF CONTENTS	v
LIST OF FIGURES	ix
LIST OF TABLES	x
LIST OF ABBRIVIATIONS	xii
LIST OF APPENDICES	xiii
CHAPTER-1	1
1. INTRODUCTION	1
1.1. Research Background	1
1.2. Problem Statement	3
1.3. Aim of the research	4
1.4. Objectives of the research	4
1.5. Research Methodology	5
1.6. Literature Review	5
1.7. Questionnaire Survey	5
1.8. Expert Interviews	6
1.9. Scope and limitations	6
1.10. Chapter breakdown	6
CHAPTER-2	7
2. LITERATURE REVIEW	7
2.1. Introduction	7
2.2. What is Quality?	7
2.3. Key areas governing Quality in Building Construction Projects	8
2.4. Attributes of Quality in Building Constructions	10
2.4.1. Project-Related Factors	10

2.4.2.	Design-related factors.....	12
2.4.3.	Project Manager-Related Factors	13
2.4.4.	Project Management Team members related factors	13
2.4.5.	Contractor-related factors.....	14
2.4.6.	External Factors.....	17
2.5.	Discussion on literature review findings and its limitations	18
CHAPTER-3	27
3.	METHODOLOGY	27
3.1.	Introduction.....	27
3.2.	Research Design.....	27
3.3.	Research Approach	28
3.3.1	Available Research Approaches	28
3.3.2	Selected Research Approach for this Study	29
3.4.	Research Strategies	30
3.4.1.	Survey Strategy: Questionnaire Survey	30
3.4.2.	Survey Strategy: Expert Interviews.....	31
3.4.3.	Selected Research Strategy	31
3.5.	Data Analysis Techniques.....	36
3.5.1.	Descriptive statistical test- Weighted mean analysis	37
3.5.2.	Descriptive statistical test- Mean value analysis.....	37
3.5.3.	Descriptive statistical test- Reliability and validity test (Cronbach’s alpha test)	38
3.5.4.	Descriptive statistical test: Quadrant Analysis.....	39
3.5.5.	Inferential statistical test: Factor analysis	40
3.5.6.	Content Analysis [Qualitative Analysis – Expert Interviews]	40
3.6.	Research Process.....	41
3.7.	Summery	43
CHAPTER-4	44

4.	ANALYSIS AND RESEARCH FINDINGS	44
4.1.	Introduction.....	44
4.2.	Questionnaire evaluation.....	44
4.3.	Descriptive statistical test- Weighted mean analysis	44
4.4.	Descriptive statistics test - Mean value analysis.....	46
4.5.	Descriptive statistical test- Reliability and validity test (Cronbach's alpha test)	46
4.6.	Descriptive statistical test: Quadrant Analysis	47
4.7.	Inferential statistical test: Factor analysis	50
4.7.1.	Factor Analysis for the Identified Factors of Level of Importance..	51
4.7.2.	Factor Analysis for the Identified Factors of Level of Satisfaction .	55
4.7.3.	Identified Dimensions	59
4.8.	Content Analysis [Qualitative Analysis – Expert Interviews].....	61
4.8.1.	Objective of the Expert Interviews.....	61
4.8.2.	Profile of the Expert Interviewees.....	61
4.8.3.	Analysis of Findings of Expert Interviews.....	62
4.9.	Summary	67
	CHAPTER-5	69
5.	CONCLUSIONS AND RECOMMENDATIONS.....	69
5.1.	Introduction.....	69
5.2.	Conclusions.....	69
5.2.1.	Objective-1	70
5.2.2.	Objective 2	70
5.2.3.	Objective 3	70
5.2.4.	Objective 4	71
5.3.	Recommendations.....	72
5.4.	Impact of the research.....	72
5.5.	Limitations	72
5.6.	Areas for further research	73
	LIST OF REFERENCES	74

LIST OF BIBLIOGRAPHY	82
APPENDICES	86
APPENDIX A: Questioner survey.....	86
APPENDIX B: Expert interview guideline	96
APPENDIX C: Results of Mean value analysis of responses received for the level of Importance	101
APPENDIX D: Results of Mean value analysis of responses received for the level of Satisfaction.....	103
APPENDIX E: Input data for the Factor Analysis related to the Level of Importance	106
APPENDIX-F: Input data for the Factor Analysis related to the Level of Satisfaction	107
APPENDIX-G: Outcomes of the Manual Content Analysis	108

LIST OF FIGURES

	Page
Figure 3.1 Model of Important- satisfaction matrix	40
Figure 3.2 Research Process	42
Figure 4.1 Important – Satisfaction Matrix	49
Figure 4.2 Scree plot-1	52
Figure 4.3 Factor loadings-1 (axes D1 and D2: 40.78 %) after Varimax rotation	53
Figure 4.4 Variables-1 (axes D1 and D2: 40.78 %) after Varimax rotation	54
Figure 4.5 Scree plot-2	56
Figure 4.6 Factor loadings-2 (axes D1 and D2: 77.66 %) after Varimax rotation	57
Figure 4.7 Variables-2 (axes D1 and D2: 77.66 %) after Varimax rotation	58

LIST OF TABLES

	Page	
Table 2.1	Definitions of the term “Quality”	8
Table 2.2	Factors affecting quality in construction Projects as per the literature review	22
Table 3.1	Questions related to the level of importance of the selected factors	32
Table 3.2	Questions related to the level of satisfaction of the quality aspect related to the selected factors	34
Table 3.3	Scale for Cronbach’s Alpha coefficient	38
Table 4.1	Weighted mean values of responses under Section-1 (Questions related to level of importance)	45
Table 4.2	Weighted mean values of responses under Section-2 (Questions related to the level of satisfaction)	45
Table 4.3	Results of Cronbach's Alpha Test	47
Table 4.4	Input data for Quadrant Analysis	47
Table 4.5	Factors Identify as Priority for Improvement	50
Table 4.6	Eigenvalues-1	51
Table 4.7	Rotation matrix-1 after the Varimax rotation	52
Table 4.8	Percentage of variance-1 after Varimax rotation	52
Table 4.9	Factor pattern-1 after Varimax rotation	52
Table 4.10	Correlations between variables and factors-1 after Varimax rotation	53
Table 4.11	Factors Identified-1 for the Dimension-1 (D1)	55
Table 4.12	Factors Identified-1 for the Dimension-2 (D2)	55
Table 4.13	Eigenvalues-2	56
Table 4.14	Rotation matrix-2 after the Varimax rotation	56
Table 4.15	Percentage of variance-2 after Varimax rotation	56
Table 4.16	Factor pattern-2 after Varimax rotation	57
Table 4.17	Correlations between variables and factors-2 after Varimax rotation	58

Table 4.18	Factors Identified-2 for the Dimension-1 (D1)	59
Table 4.19	Factors Identified-2 for the Dimension-2 (D2)	59
Table 4.20	Identified Dimensions	60
Table 4.21	Details of the Expert Interviewees	61
Table 4.22	Findings of the Expert Interviews	63

LIST OF ABBRIVIATIONS

BIM	- Building Information Modelling
CMC	- Construction Management Consultants
CSF	- Critical Success Factors
DCIP	- Design-Construction Interface Problems
GDP	- Gross Domestic Product
HRM	- Human Resource Management
ISM	- Interpretive Structural Modelling
ISO	- International Organization for Standardization
NGT	- Nominal Group Technique
PM	- Project Management
PQMS	- Project Quality Management System
PRAF	- Percentage rank agreement factor
QA	- Quality Assurance
QC	- Quality control
QMS	- Quality Management System
RCC	- Reinforced Cement Concrete
RII	- Relative Important Index
SEM	- Structural Equation Modelling
SLR	- Sri Lanka Rupee
SPSS	- Statistical Package for the Social Science
TQM	- Total Quality Management
USD	- United State Dollar
WMM	- Weighted Mean Method

LIST OF APPENDICES

Appendix	Description	Page
Appendix- A	Questioner survey	85
Appendix- B	Expert interview guideline	95
Appendix- C	Results of the Mean value analysis for responses received for the level of Importance	101
Appendix- D	Results of the Mean value analysis of responses received for the level of satisfaction	103
Appendix- E	Input data for the Factor Analysis related to the Level of Importance	105
Appendix- F	Input data for the Factor Analysis related to the Level of Satisfaction	106
Appendix- G	Outcomes of the Manual Content Analysis	107