

**INVESTIGATING THE POSSIBILITY OF
APPLYING BLOCKCHAIN TECHNOLOGY
FOR CONSTRUCTION PROJECTS
DURING THE FINANCIAL CRISIS IN SRI LANKA**

Dissanayakage Sajith Lakshan Perera

(209191H)

Master of Science in Construction Law and Dispute Resolution

Department of Building Economics
Faculty of Architecture

University of Moratuwa
Sri Lanka

August 2024

DECLARATION

I formally declare all of this to be my own work and, as far as I know, and believe it as, it does not contain previously written or written graduate material or diploma material, except where the acknowledgement is made in the text. This is not unconsented.

Further, I acknowledge the intellectual contribution of my research supervisor, Ch. QS. Indunil Seneviratne for the successful completion of this research dissertation. I affirm that I will not make any publication from this research without the name(s) of my research supervisor as contributing author unless otherwise I have obtained written consent from my research supervisor.

I shall also grant the completely non- exclusive right to reproduce my dissertation/ thesis in print, electronically or another medium, in whole or in part, to the University of Moratuwa. I retain the right to use this content in whole or part in future works such as articles or books.

.....

D.S.L Perera

03rd September 2024
.....

Date

I hereby acknowledge that Dissanayakage Sajith Lakshan Perera has followed the dissertation process set by the Department of Building Economics under my supervision. I confirm that the declaration made above by the student is true and correct.

.....

Ch. QS. Indunil Seneviratne

Dissertation Supervisor

.....

Date

DEDICATION

***To My Beloved Wife, Son, Daughter and Mother who have
being the utmost inspiration and light of my life.....***

ACKNOWLEDGEMENT

This research study is an outcome of much dedication and remarkable assistance given by many personnel and organizations, who contributed in ample ways to make this research a success. In fact, there were number of people behind me, who supported and guided me to the correct path and genuinely wished my success. I should say that the following words would not be enough to express my greatest gratitude for their tremendous help which was an enormous strength to me. Nevertheless, I take this opportunity to convey my gratitude to all of them.

First and foremost, I would like to forward my sincere gratitude to my supervisor, Ch. QS. Indunil Seneviratne, Senior Lecturer, Department of Building Economics, Faculty of Architecture, University of Moratuwa for his kind and insightful guidance without which this work would not have been possible. I take this opportunity to thank, Ch. QS. Prof. (Mrs.) Anuradha Waidyasekara, Head of the Department, Ch. QS Vijitha Disaratna, Post Graduate Coordinator & Prof. (Mrs.) Yasangika Sandanayake, former Post Graduate Coordinator of the Department of Building Economics as well as Post Graduate Division and Faculty of Post Graduate Studies for the support extended. Furthermore, I pay my heartiest gratitude to all non-academic staff members of the department of building economics for the valuable help given.

I must be thankful to all those who supported from the industry with their valuable insights in obtaining the data. Special thanks go to all the interviewees and industry experts who gave me an immense support and corporation to complete a successful data collection by sharing their valuable knowledge and experiences with me.

Last, but not least, but not least, I express my heartfelt gratitude to my family, my batch mates and all others who were with me during this study for giving their utmost support, genuine advice and continuously motivating me to carry out the work successfully.

ABSTRACT

The construction industry is crucial to the nation's economic development, makes substantial contribution to Gross Domestic Product. However, the ongoing economic crisis, reached to its climax in 2022, had a severe impact on Sri Lanka's construction sector due to significant currency depreciation and rising inflation. The increase in foreign debt and a decrease in tax revenues had led to the suspension of major infrastructure projects.

During the past, different countries adopted various strategies while managing the crisis. Blockchain is a technology which has the potential to revolutionize the structure of all accessible networks in the future. Construction companies are increasingly interested in utilizing blockchain to reduce project costs, improve planning, and minimize waste through modern construction technologies and innovative practices. Therefore, a thorough investigation is needed to explore the feasibility of applying blockchain technology for construction projects during Sri Lanka's financial crisis.

The study collected both qualitative and quantitative data, utilizing primary and secondary sources. Preliminary interviews were conducted to assess the relevance of information gathered from the literature review. Subsequently, a questionnaire survey was conducted among industry professionals in Sri Lanka, achieving a 46% response rate, to identify the applicability, barriers, and benefits of blockchain-based applications.

The research concluded that blockchain-based smart technologies could be applied to construction projects for smart contracts in payments and procurement, as well as during bidding and tender procedures. It also identified critical barriers to implementing blockchain technologies in Sri Lankan construction projects, containing financial resource constraints, lack of customer awareness, and insufficient stakeholder involvement. Advantages of blockchain technology were identified as fraud resistance, the ability to detect and correct misrepresentations or mistakes, improved information reliability, enhanced response times, and disintermediation.

Keywords: Blockchain; economic crisis; construction industry; Sri Lanka

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 ABBREVIATIONS.....	xi
LIST OF APPENDICS.....	xii
1.0 INTRODUCTION	13
1.1 Research Background	13
1.2 Problem Statement	14
1.3 Aim	16
1.4 Objectives	16
1.5 Research Methodology	17
1.6 Scope and Limitations.....	17
1.7 Chapter Breakdown	18
1.8 Summary	19
2.0 LITERATURE REVIEW	20
2.1 Introduction.....	20
2.2 Technology Behind Blockchain.....	21
2.2.1 Distributed Ledger Technology (DTL)	22
2.2.2 Block.....	23
2.3 Salient features of blockchain	24
2.3.1 Decentralization.....	25
2.3.2 Anonymity.....	25

2.3.3 Security	25
2.3.4 Immutability	26
2.3.5 Auditability	26
2.3.6 Transparency	27
2.3.7 Disintermediation	27
2.3.8 Trust.....	28
2.4 Construction Industry.....	28
2.4.1 Blockchain and Construction	29
2.5 Definition to Financial Crisis Situation	29
2.5.1 Financial Crisis in Sri Lanka	30
2.5.2 Impact of Financial Crisis on Construction Industry	31
2.6 Applications of Blockchain Technology in the Construction Industry.....	31
2.7 Specific Areas which Apply Blockchain technology within the Construction Industry.....	33
2.7.1 Supply Chain	33
2.7.2 Contract Administration	36
2.7.3 Payments /Accounts & Finance.....	38
2.8 Advantages and Barriers in Applying Blockchain for Construction.....	39
2.8.1 Advantages in Blockchain.....	39
2.8.2 Barriers in Applying Blockchain for Construction Applications	42
2.9 Summary	45
3.0 RESEARCH METHODOLOGY	46
3.1 Introduction.....	46
3.2 Research Design.....	46
3.3 Research Approach	46
3.4 Research Process.....	47

3.4.1 Literature Review	47
3.4.2 Preliminary Interviews	48
3.4.3 Questionnaire Survey	48
3.5 Techniques of Data Analysis	49
3.6 Summary	50
4.0 RESEARCH FINDINGS AND ANALYSIS	51
4.1 Introduction.....	51
4.2 Preliminary Interviews.....	51
4.2.1 Objectives of Preliminary Interviews.....	51
4.2.2 Interviewee Details of Preliminary Interviews.....	52
4.2.3 Finding and Analysis of Preliminary Interviews.....	52
4.2.3.1 Applications of Blockchain Technology within the Sri Lankan Construction Industry.....	53
4.2.3.2 Barriers in Applying Blockchain Technology in the Sri Lankan Construction Projects	57
4.2.3.3 Advantages of Applying Blockchain Technology in the Sri Lankan Construction Projects	61
4.2.3.4 Drawbacks of Applying Blockchain Technology for Sri Lankan Construction Projects	63
4.3 Questionnaire Survey	63
4.3.1 Objectives of the Questionnaire Survey	63
4.3.2 Respondent Profile	63
4.3.3 Personal Knowhow and Current Usage.....	67
4.3.4 Applications of Blockchain Technology within the Sri Lankan Construction Industry	68
4.3.5 Barriers in Applying Blockchain Technology in the Sri Lankan Construction Sites.....	69
4.3.6 Advantages in Applying Blockchain Technology in the Sri Lankan Construction Sites.....	72

4.4 Summary	73
5.0 CONCLUSIONS AND RECOMMENDATIONS.....	74
5.1 Introduction.....	74
5.2 Summary of Research Findings and Conclusions	74
5.2.1 Conclusions on objective 1 - Applications of Blockchain Technology in the Construction Industry	74
5.2.2 Conclusions on Objective 2 - Specific Areas to Apply Blockchain Technology within the Sri Lankan Construction Industry	75
5.2.3 Conclusions on Objective 3 - Barriers in Applying Blockchain Technology in Sri Lankan Construction Projects Operated during the Financial Crisis.....	76
5.2.4 Conclusions on Objective 4 - Expected Benefits by Applying Blockchain Technology for Construction Projects Operated during the Financial Crisis in Sri Lanka	77
5.3 Recommendations	78
5.4 Recommendations for Future Studies	79
5.5 Chapter Summary	79
REFERENCES	80
APPENDIX A - PRELIMINARY INTERVIEW GUIDELINE	90
APPENDIX B - QUESTIONNAIRE	91

LIST OF FIGURES

Figure 1: Distributed Ledger Network.....	22
Figure 2: Structure of a Block (Zheng et al., 2017)	23
Figure 3: Primary Construction Supply Chain Network (Nanayakkara et al., 2021)	33
Figure 4: Concept proposed by (Abeyratne & Monfared, 2016).....	34
Figure 5: General use case of data provenance proposed by Jyoti & Chauhan (2020)	35
Figure 6: Flowchart of the Research Process.....	47
Figure 7: Respondent Profile based on Profession	64
Figure 8: Respondent Profile based on Level of Education.....	64
Figure 9: Respondent Profile based on Years of Experience	65
Figure 10: Respondent Profile based on Sector	65
Figure 11: Respondent Profile based on types of construction.....	66
Figure 12: Respondent Profile based on number of projects	66
Figure 13: Respondent Profile based on personal knowhow	67
Figure 14: Respondent Profile based on current application	67

LIST OF TABLES

Table 1: Salient features of blockchain.....	24
Table 2: Blockchain applications under construction supply chain.....	35
Table 3: Blockchain applications under contract administration.....	37
Table 4: Blockchain applications under payments /accounts & finance	39
Table 5: Summary of literature findings on advantages in blockchain.....	40
Table 6: Summary of literature findings on barriers in blockchain	43
Table 7: Evaluation criteria for analysis of the outcomes.....	49
Table 8: Profile of Preliminary Interviewees	52
Table 9: Summary of blockchain applications within construction supply chain	53
Table 10: Summary of blockchain applications related to contract administration...	54
Table 11: Summary of blockchain applications related to payments, accounts & finance	55
Table 12: Summary of barriers in applying blockchain technology within construction	59
Table 13: Summary of advantages in applying blockchain technology within construction.....	61
Table 14: Summary of RII values - Applications of blockchain technology within the Sri Lankan construction Industry	68
Table 15: Summary of RII values - Barriers in applying blockchain technology	70
Table 16: Summary of RII values - Advantages in applying blockchain technology	72

LIST OF ABBREVIATIONS

Abbreviation	Description
BIM	Building information modeling
COVID-19	CORONAVIRUS Disease of 2019
DTL	Distributed Ledger Technology
GIS	Geographic Information Systems
IoT	Internet of Things
IT	Information Technology
QR	Quick-Response
RFID	Radio-Frequency Identification
RII	Relative Importance Index
USD	United States Dollars

LIST OF APPENDICS

Appendix	Description	Page
Appendix - A	Preliminary Interview Guideline	90
Appendix - B	Final Questionnaire	91