# BIM READINESS IN SRI LANKAN ARCHITECTURAL ENGINEERING AND CONSTRUCTION (AEC) INDUSTRY.

Kanchana Anuruddha Galagedara

(148407F)

Theis submitted in partial fulfiment of the requirements for the degree Master of Science in Project Management

Department of Building Economics

University of Moratuwa

Sri Lanka

November 2018

# DECLARATION

"I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for 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.

Also I grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis in whole or in part in print electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books)"

Signature: Date:

The above candidate has carried out research for the Masters Dissertation under my supervision.

Name of the supervisor:

Signature of the supervisor: Date:

# ABSTRACT

Construction industry highly influences on improving the infrastructure industry of a country. Architectural Engineering and Construction (AEC) industry always focuses on reducing inefficiencies, enhance the productivity and increasing the communication. Construction industry is highly turbulent and complex in nature as number of suppliers, employees, materials and machinery work in a construction site. One of the major challenges in the construction industry is communication and coordination between different disciplines involved in the industry like authorities, local & foreign governments, financial authorities & institutes, engineers, architect, lawyers, quantity surveyors, contractors, suppliers, community and trades. Building Information Modeling (BIM) is currently the most common denomination for a new way of approaching the design, construction, and maintenance of buildings. According to the literature and industrial reports BIM implementation is in primary stage in Sri Lanka. The researcher aims to develop suitable framework to assess BIM readiness of construction organizations.

The researcher followed both interpretivism and positivism to conduct this research study. Because BIM is currently on a radical development arround the world and also is a novel idea to Sri Lankan industry. The researcher identified several factors such as importance of management, importance of process, importance of people and importance of technology which infleunces on level of BIM readiness. Both qualitative and quantitative data were used to understand the practice of BIM in Sri Lanka and collect employees' view.

The research result stated that all the factors such as importance of management, importance of process, importance of people and importance of technology highly infleunces on BIM implementation in Sri Lanka in different perspectives.

# DEDICATION

I dedicated this research to my loving wife and to my family members for their commitment and cooperation for the success of this thesis.

I dedicated this thesis to research supervisor, Ch.QS.(Mr.) Suranga Jayasena, pioneer Building Information Modeling researcher in Sri Lanka for his valuable guidance and valuable assistance towards the success of this thesis and also I dedicated this thesis to Programme Director, all of my lectures, programme coordinator and colleagues for their valuable support and guidelines.

And also I would like to dedicate this thesis for all professionals who had share their experience and knowledge regarding the Building Information Modelling in Sri Lanka and also for all professionals for their effort to delivering successful Building Information Modelling implementation in Sri Lanka.

# TABLE OF CONTENT

DECLARATION ..... ii

ABSTRACT ..... iii

DEDICATION ..... iv

TABLE OF CONTENT ..... v

LIST OF TABLES ..... viii

LIST OF FIGURES ..... ix

LIST OF ABBREVIATION ..... xi

1. INTRODUCTION ..... 1

1.1. Introduction ..... 1

1.2. Background of the Study ..... 1

1.3. Rationale ..... 6

1.4. Problem Statement ..... 6

1.5. Aims and Objectives of the Study ..... 9

1.6. Research Questions ..... 9

1.7. The significance of the Study ..... 10

1.8. Document Outline ..... 10

2. LITERATURE REVIEW ..... 12

2.1. Introduction ..... 12

2.2. Building Information Modeling (BIM) ..... 12

2.3. Technological Aspects and BIM in Sri Lanka ..... 16

2.4. Dimensions of Building Information Modeling (BIM) ..... 17

2.5. Building Information Modeling (BIM) Implementation Process ..... 18

2.6. BIM Readiness and BIM Realization. ..... 20

2.7. Technological Aspects and BIM in Sri Lanka ..... 23

2.8. Construction Lifecycle with BIM .....23
2.9. Readiness Concept .....25
2.10. Relevant Theories and Models of BIM Readiness .....28
2.10.1. Capability Maturity Model Integrated (CMMI) .....28
2.10.2. Structured Process Improvement for Construction Enterprises (SPICE) 29
2.10.3. General Practitioner Information System (GPIS) .....30
2.10.4. IS Competency Framework .....30
2.10.5. Building Information Maturity Index (BIMMi) .....31
2.11. Empirical Findings .....31
2.12. Factors Impact on BIM Readiness .....33
2.13. Conceptual Framework .....33
2.14. Chapter Summary .....34
3. RESEARCH METHODOLOGY .....35
3.1. Introduction .....35
3.2. Research Philosophy .....35
3.3. Research Method .....36
3.4. Research Approach .....37
3.5. Data Sources used in this Study .....37
3.6. Data Collection Method .....38
3.7. Population and Sample .....38
3.8. Sampling Techniques .....39
3.9. Data Analysis Methods of the Study .....39
3.10. Ethical Consideration .....40
3.11. Summary .....40
4. DATA PRESENTATION AND ANALYSIS .....41

4.1. Introduction ..... 41
4.2. Reliability and Validity of Quantitative data ..... 41
4.3. Reliability and Validity of Qualitative data ..... 44
4.4. Sample Profile ..... 45
4.4.1. Age ..... 45
4.4.2. Job Category ..... 46
4.4.3. Company Type ..... 47
4.4.4. Number of Employees in the Company ..... 48
4.4.5. Highest Education Level of the Employees ..... 48
4.4.6. Working Experience ..... 49
4.4.7. BIM Status ..... 50
4.5. Answers of the Participants ..... 51
4.5.1. Answers of the participants for quantitative survey questionnaire ..... 51
4.5.2. Answers of the participants for qualitative survey questionnaire ..... 69
4.5.3. Correlation analysis ..... 75
4.5.4. Regression analysis ..... 77
4.6. Summary ..... 78
5. CONCLUSION AND RECOMMENDATION ..... 80
5.1. Introduction ..... 80
5.2. Achievement of the Objectives ..... 80
5.3. Limitation of the Study ..... 83
5.4. Future Research ..... 83
5.5. Recommendation ..... 84
RREFERENCES ..... 85
APPENDIX 1 – QUESTIONNAIRE ..... 89

# LIST OF TABLES

Table 1-1: GDP of the countries and construction industry..... 2

Table 1-2: Value of Construction activities on 2015(As per the latest statistics) ..... 5

Table 4-1: Reliability test result of the study.....43

Table 4-2: Answers to the importance of management variable .....52

Table 4-3: Statistic - Importance of Management.....53

Table 4-4: Answers to the importance of process variable. .....55

Table 4-5: Statistic - Importance of Process.....57

Table 4-6: Answers to people variables .....59

Table 4-7: Statistics - The importance of people.....60

Table 4-8: Answers to the importance of technology.....62

Table 4-9: Statistics - Importance of Technology .....63

Table 4-10: answers for the level of readiness.....65

Table 4-11: Statistics - The level of Readiness.....67

Table 4-12: Sample profile.....69

Table 4-13: Correlation analysis result .....76

Table 4-14: Regression analysis result. .....78

# LIST OF FIGURES

Figure 2-1: Percentage of BIM users .....13

Figure 2-2: Building lifecycle according to the Building Information Modeling .....15

Figure 2-3: BIM Application in Project .....16

Figure 2-4: BIM with Cloud.....20

Figure 2-5: BIM Evolution.....22

Figure 2-6: Comparison between the traditional construction lifecycle and BIM related construction lifecycle.....24

Figure 2-7: Comparison between the bid-build system and BIM system .....25

Figure 2-8: Performance analysis chart.....26

Figure 2-9: Readiness assessment process .....27

Figure 2-10: SICE process improvement framework. .....30

Figure 2-11: Conceptual Framework .....34

Figure 4-1: Age of the participants .....46

Figure 4-2: Job Category .....46

Figure 4-3: Company type .....47

Figure 4-4: Number of Employees .....48

Figure 4-5: Educational qualification.....49

Figure 4-6: Working experience.....50

Figure 4-7: BIM Status .....51

Figure 4-8: Histogram of Importance of Management .....54

Figure 4-9: Histogram of the importance of process .....57

Figure 4-10: Histogram of the importance of people .....60

Figure 4-11: Histogram – Importance of technology .....63

Figure 4-12: Histogram for the level of readiness.....68

Figure 4-13: Suitable job scope for BIM system implementation.....72

Figure 5-1: BIM readiness Framework.....82

# LIST OF ABBREVIATION

| | | |
|---|---|---|
| GDP | - | Gross Domestic Product |
| AEC | - | Architectural Engineering and Construction |
| R & D | - | Research and Development |
| IT | - | Information Technology |
| BIM | - | Building Information Modelling |
| ICT | - | Information Communication and Technology |
| ICTAD | - | Institute of Construction Training & Development |
| LAN | - | Local Area Network |
| CMMI | - | Capability Maturity Model Integrated |
| SPICE | - | Structured process improvement for construction enterprises |
| GPS | - | General Practitioner Information System |
| BIMMi | - | Building Information Maturity Index |
| CAD | - | Computer Aided Design |
| 2D | - | Two Dimensional |
| CDE | - | Common Data Environment |
| ROI | - | Return Of Investment. |