UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF BUILDING INFORMATION MODELING (BIM) ADOPTION ASSESSMENT TOOL FOR BIM-BASED PROJECTS IN MALAYSIA

WAN NUR SYAZWANI BINTI WAN MOHAMMAD

PhD

June 2022

ABSTRACT

Recently, the construction industry has been moving towards industrial revolution 4.0 which has transformed the construction industry into a competitive digital ecosystem by adopting BIM. BIM has emerged as a major accelerator in Engineering and Construction industry operations since it is used to improve visualization and productivity, the coordination of construction drawings and communication, planning, delivery, take-off and estimation, and off-site manufacturing. Thus, contractors have a vital role in adopting BIM for transferring data from drawing to reality. Despite potential benefits for contractors through the adoption of BIM, they are commonly regarded as slow adopters, lagging far behind when compared to other stakeholders. A preliminary study affirms that contractors are slow adopters and that the tools to assess and evaluate their BIM performance are absent. The failure to appreciate and comprehend existing BIM assessment models/tools from developed and developing countries have limited construction players' and contractors' benefits from BIM. For this reason, the research aims to develop a BIM Adoption Assessment Tool for BIM-based projects in Malaysia. Data was obtained from unstructured interviews with 4 participants and semi-structured interviews with 8 participants as a preliminary study. Then a questionnaire survey (114 respondents) and semi-structured interviews (12 respondents) with G7 BIM-based project contractors provided the main data. Consequently, four (4) essential elements of a BIM Adoption Assessment Framework for BIM-based projects were identified through the comparative results of both collections. These are: Eight (8) BIM Objectives (E1); Thirteen (13) Uses of BIM from planning/design to the construction phases (E2); Three (3) BIM adoption components (i.e., technology (11), organisation (14) and information culture (13) (E3); and four (4) project performance criteria (E4). Furthermore, these four (4) elements were considered in the development of a BIM Adoption Assessment Tool (BAAT) for BIM-based projects. The development of BAAT was established using a Microsoft Excel Spreadsheet and is suitable for project lifecycle phases (i.e., from planning/design to the construction phases). Six distinct levels of the BIM Maturity Index were identified: Level 0 (0.0%) - non-existent; Level 1 (>0.0% < or = 20.0%) - initial; Level 2 (>20.0% < or = 40.0%) -defined; Level 3 (>40.0% < or = 60.0%) - managed; Level 4 (>60.0% < or = 80.0%) -integrated and Level 5 (>80.0% < or = 100.0%) - optimised. The BAAT was validated by seven (7) expert panels and will benefit the BIM-based project teams in assessing their BIM performance. The BAAT acts as a baseline for BIM-based projects in achieving the project performance outcome (time, cost, quality, and safety).

ACKNOWLEDGEMENTS

Alhamdulillah, thanks to God for allowing me to finish my dissertation untitled "Development of BIM Adoption Assessment Tool For BIM-Based Projects in Malaysia". I owe many people and many things for the help and guidance throughout this research. Firstly, my deep appreciation is to my supervisor Ts Dr. Mohd Rofdzi Bin Abdullah, Prof Madya Ts Dr. Sallehan Ismail, and Professor Ts Dr. Roshana Takim for their kindness, advice, motivation, teaching, patience, friendship, and special gratitude is expressed to them. Thank you very much for believing in me to embark on the research field. My appreciation also goes to the Dean of the Faculty Architectural, Planning and Surveying, Rector UiTM Perak, and the Head of My Department for permitting me to pursue my Ph.D. Furthermore, a special thank also to UiTM Perak for giving a "Special Grant Incentive for Supervision in Perak" (GKIPP) Phase 1/2018 in sponsoring me throughout the data collection phase.

I would also like to express my deepest gratitude and appreciation to all the respondents of the surveys and interviews or contractors who have contributed their valuable views and opinions to this research journey. In addition, special dedication also goes to government bodies such as Construction Industry Development Board (CIDB) and Public Work Department (PWD) for giving such good information regarding BIM adoption in the Malaysian Construction Industry. I am also grateful to my colleagues, my officemate who provided useful advice, encouragement, and relationship with each other throughout this Ph.D. period. Furthermore, the gratitude also goes to the head of libraries and their staff for the willingness to help me in searching for journals, books, and references that I require. I am deeply grateful to my husband

my daughters

my father, father-in-law, my mother, mother-in-law, my siblings, sibling-in-law and my other relatives for their understanding, patience, tolerance, endless support, love, encouragement, and prayer. It was very valuable and priceless. Finally, this disertation is dedicated to those people whose I accidentally meet in seminars, conferences, and research events for their encouragement, criticism, ideas, suggestions, and support for this research. I would not be able to do it without all of you. Thank You and Alhamdulillah.

TABLE OF CONTENT

CHAPTER ONE
INTRODUCTION

1.1 Introduction

This chapter presents the content of the dissertation including the research background, statement of problems, research questions, and how the objectives are formulated. Subsequently, the scope, limitation, and significance of the research are discussed. The methodology is explained in the following section to guide the research in achieving the goal. The final section discusses the organisation of the dissertation and the chapter summary.

1.2 Background Of The Research

The construction industry is a dynamic and responsive sector that has a great impact on the development of social economics in the country (Khan *et al*., 2014). It is also noticeable as it produces great output and encourages economic growth through linkages with other sectors (Hung *et al*., 2019). Moreover, the construction industry makes remarkable contributions to sustainable economic development by fulfilling the development objectives by generating output, creating employment, and ability to generate income for the nation. According to Blanco *et al*., (2020), the construction industry is the largest in the world and contributes to 13% of global GDP. Despite the advantages of the construction industry playing a vital role in the economic development of the country, it is known to be very complex, competitive, and challenging. The Malaysian Construction Industry has underperformed for many years with low productivity, low quality and time, cost overruns (Mirawati et al., 2015: Sinesilassie et al., 2017), and the most hazardous industry (Abas et al., 2020). One probable reason for this predicament is the long-standing fragmentation of the construction industry arising from the involvement of multi-functional stakeholders (i.e., clients, designers, contractors, suppliers, and manufacturers) involved from inception until the completion phase of projects (Zakaria *et al*., 2012). Furthermore, the separation of the design and construction team, lack of communication among supply chains, lack of clients' attention, and an adversarial culture are the main factors affecting