

CONFERENCE PAPER

NZAAR-CCS-18-51 CCS 2018

Investigating the Effectiveness of Adopting Building Information Modelling (BIM) for the Refurbishment of Complex Building Projects: Case of Auckland. A Preliminary Study

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PUBLISHED IN

The Fourth NZAAR International Event Series on Natural and Built Environment, Cities, Sustainability and Advanced Engineering
International Conference on Civil Engineering, Construction Management and Structural Design (CCS 2018)

Pages	70-75 of the volume
Held	27 January 2018, GTower Hotel, Kuala Lumpur, Malaysia
ISSN	2463-5979 (online) 2463-5960 (print)
Publisher	New Zealand Academy of Applied Research Ltd, Auckland

ABSTRACT

Refurbishment projects are believed to be risky, complex, and fraught with many uncertainties. Some of these projects have reported substantial project delays, significant costs that sometimes overrun twice the budget, poor stakeholder engagement, and dissatisfaction with the project outcome by the refurbishment stakeholders. The introduction of BIM technology into construction practice seemed to be the game changer within AEC. However, despite the promising BIM benefits for the entire AEC, the adoption of BIM for refurbishment projects seems to be challenging due to the highly fragmented nature of construction practice which invariably creates difficulty in the integration of diverse information throughout the project life cycle. In this paper, we investigate the effects and challenges of BIM adoption in refurbishment projects across New Zealand, adopting literature review and preliminary interview methodology to this end. The result of the study shows that the refurbishment projects are unique in nature and differ from the construction of new buildings. They are also highly driven by the project cost and time of project delivery.

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HOW TO CITE

Anthony Okakpu, Ali GhaffarianHoseini, John Tookey, Jarrod Haar and Amirhosein Ghaffarianhoseini (2018). Investigating the Effectiveness of Adopting Building Information Modelling (BIM) for the Refurbishment of Complex Building Projects: Case of Auckland. A Preliminary Study. In *The Fourth NZAAR International Event Series on Natural and Built Environment, Cities, Sustainability and Advanced Engineering*, Kuala Lumpur, Malaysia, 27 January 2018 (pp. 70-75). Auckland: New Zealand Academy of Applied Research. ISSN 2463-5979 (online), 2463-5960 (print).

INVESTIGATING THE EFFECTIVENESS OF ADOPTING BUILDING INFORMATION MODELLING(BIM) FOR THE REFURBISHMENT OF COMPLEX BUILDING PROJECTS: CASE OF AUCKLAND. A PRELIMINARY STUDY

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Abstract

Refurbishment projects are believed to be risky, complex, and fraught with many uncertainties. Some of these projects have reported substantial project delays, significant costs that sometimes overrun twice the budget, poor stakeholder engagement, and dissatisfaction with the project outcome by the refurbishment stakeholders. The introduction of BIM technology into construction practice seemed to be the game changer within AEC. However, despite the promising BIM benefits for the entire AEC, the adoption of BIM for refurbishment projects seems to be challenging due to the highly fragmented nature of construction practice which invariably creates difficulty in the integration of diverse information throughout the project life cycle. In this paper, we investigate the effects and challenges of BIM adoption in refurbishment projects across New Zealand, adopting literature review and preliminary interview methodology to this end. The result of the study shows that the refurbishment projects are unique in nature and differ from the construction of new buildings. They are also highly driven by the project cost and time of project delivery.

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1. Introduction

Building information modelling (BIM) is one of the significant recent developments in the construction industry, heralding the introduction of new processes, technologies and healthy interactions into practice [1]. BIM is widely advocated as a platform to enhance information communication and reduce the project duration and cost in the construction industry [2]. A strategic approach to BIM adoption requires the incorporation of people, process, and technologies on timely bases and leads to capacity building through managerial improvements [3]. Notwithstanding the benefits of BIM [4], its uptake and delivery have been recently reported to be slow for the refurbishment of existing building projects [5]. But some concerted effort is being made to make BIM a standard in the industry. For instance, the UK government, as part of enhancing adoption of BIM in the

public sector, have targeted minimizing life-cycle cost by 20% and 80% reduction in carbon by 2050 [6]. Similarly, BIM is now a mandatory requirement for governmental projects towards energy refurbishment in the Netherlands, while the government requirement for BIM implementation since 2007 has influenced its use for energy efficiency target in Denmark [7]. In New Zealand, a previous survey regarding BIM adoption affirmed that, within construction organizations, 38 % used BIM for most projects, 20 % used BIM for few projects, while 42 % of organizations did not respond: a reaction that shows a low level of engagement in projects models among project stakeholders [8]. Furthermore, a response from the same survey indicated that 71 % of respondents disagreed that “BIM is only for a new build projects, not for refurbishment projects”, 14 % was neutral while 14 % agreed to the

statement. With this result, it is expected that BIM will be highly demanded in refurbishment projects. However, little or none has been reported in the literature.

With the conventional approach, some of these refurbishment projects have reported substantial project delays as well as significant cost overruns, sometimes about twice the budget [9]. There is also poor stakeholder engagement [10] followed by the dissatisfaction of the project outcome by the refurbishment stakeholders [11]. The adoption of BIM for complex refurbishment projects seems to depend on the project stakeholders' decisions. In addition, the project stakeholders have diverse backgrounds and interests. They are not only independent of each other but also have intricate relationships and interactions [9]. These portray an inability of stakeholders to hold a common ground and maintain healthy collaborations which hinders the flow of information and knowledge sharing within the project participants. Thus, the need to re-consider the culture and collaborative environment of construction firms to enhance adoption of BIM becomes obvious. The need to investigate how construction environment influences technology adoption has already been highlighted [1]. In this study, we aim at investigating the environmental factors that influence refurbishment project stakeholders' decisions towards the adoption of new technology such as BIM in the New Zealand construction environment.

2. Literature Review

2.1 BIM potential for refurbishment project

One potential of BIM adoption is to improve the refurbishment work flows so as to mitigate cost overrun, critical decisions, and time by project stakeholders [5]. There are authors that have contributed towards BIM adoption study for the refurbishment project. Volk, Stengel [12] focused on the technical problems related to BIM

implementation. This includes updating and handling of the uncertainty of data information of BIM in existing buildings. Also, a study proposed a framework to understand tools and drivers that motivate BIM adoption for refurbishment projects [13, 14]. In addition, a study also focused on the clients as homeowners' preferences and how it influences BIM adoption for refurbishment projects [15]. Furthermore, there is an investigation for the essential barriers to BIM adoption for housing refurbishment [16]. The barriers were from two major sources. The first is the clients indicating lack of knowledge about refurbishment technologies, while the second is the construction professionals indicating lack of skills, and also fragmented practices. Therefore, there is a tendency that these stakeholders may underestimate the real BIM benefit for refurbishment projects.

2.2 Characteristics of refurbishment projects

The lack of existing building information differs refurbishment projects from new buildings [17]. The former are characterized by complicated cost-sharing [18] and lots of stakeholder interactions [19]. Majority of these projects are fraught with single or multi-level construction, special purpose user requirement, complicated nature, challenging in-site configuration, multiple organization participation, multiple stakeholders participating, and larger span [10, 20, 21]. Although complex projects can contain simple subsets of simple projects, they should not be reducible to them [22]. Hence, complex projects are not always based on their scale, but based on the issue of coordination or specialized expertise [23].

2.3 The need for BIM adoption for refurbishment projects

Although BIM benefits are well known, researchers and practitioners show less concern towards this venture [24]. This

attitude towards BIM adoption is attributed to the complicated stakeholder requirements added to the highly fragmented construction sector [15]. Hence, the sector is in great pressure to update existing buildings and correct structural faults, including poor insulation [3]. For example, in Europe, the construction sector recorded 40% of energy consumption as 40 % of Europe's existing buildings were more than 50 years old [25]. In addition, 35% of existing buildings in the UK predates 1945, and this is likely to remain in use over the next 30 years [20], causing high energy consumption and a high carbon footprint [3, 15]. According to a report by Building Research Association New Zealand (BRANZ), the refurbishment projects represented about one-third the total value of the new dwellings with about 33,000 renovation consents [26, 27]. In addition, there is a need to improve the performance of existing building to reduce the demand for new building. This will help to check the Auckland housing crisis, predicted to increase from the current 1.4 million to 2 million in the next 20 years [28]. This shows the urgent need for a strategic change in favor of adopting BIM for refurbishment of existing buildings.

3. Research Methods

This study employed a literature review followed by a face-to-face preliminary interview to investigate the effect and presence of environmental factors that impact on the day to day activities of stakeholders who have interest in refurbishment projects in Auckland. Accessing research participants was difficult. This is because, coming mainly from the background of conventional refurbishment practice, the expected participants tend to shy away from the study. Because the research participants are “hidden” (relatively new to BIM), a snowball technique was adapted to facilitate the extraction of data. Therefore, the method of the study is developed in 4 steps namely as shown in the figure below;

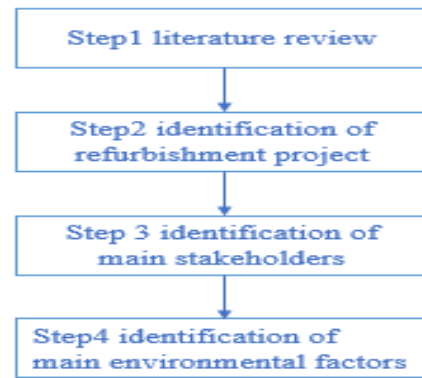


Fig 1: the research method

4. Analysis & Results

In this study, two previous refurbishment projects were identified due to the complexities encountered during the process of its execution in Auckland. Through these projects, the main stakeholders were identified and were approached to identify complexities and factors that could influence refurbishment projects, as well as how BIM adoption can be enhanced in New Zealand. Overall, the main stakeholders approached were 8 in number.

It was discovered that most refurbishment projects are driven by cost and time of project delivery as shown in figure 2. Table 1 shows the type of stakeholders that were involved in the two identified projects. Much of complexities were technical and structural complexities.

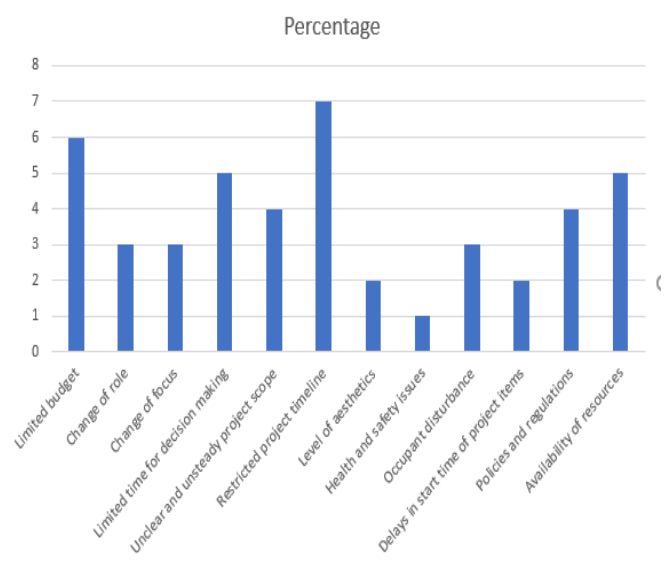


Fig 2: Environmental factors that impact on refurbishment project stakeholders

Table 1: refurbishment project stakeholders

No	Profession	Code
1	Project Managers	PM1, PM2
2	Main Contractor	MC
3	Sub-contractors	SB1, SB2
5	Managers	M1, M2, M2
6	Consultants	C1, C2
7	Architects	AR
8	Client representative	CR
9	Estimators	ES
10	Space Users	SU1,SU2,SU3,.....SUn
11	Value manager	VM

5. Discussion & Conclusion

The literature search and the preliminary findings revealed that refurbishment projects can be more challenging than new buildings in terms of IT adoption such as BIM. In general, most of the stakeholders in these projects mentioned that refurbishment projects are full of uncertainties. From figure 2, the respondents indicated that costs allocated to refurbishment projects are usually exceeded during the construction and there is limited time to execute these projects. Thus, there is an indication that there are less collaboration and information sharing within the refurbishment project subsector. In addition, these projects are subdivided into minor capital projects, yet, the collaboration and information problems have continued to exist. Therefore, these collaboration and information sharing should be a major driver for adoption of BIM. Hence, BIM adoption plan must be investigated through an interaction network of stakeholders to guide successful adoption of BIM for refurbishment projects in New Zealand.

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