A review of BIM (Building Information Modeling) implementation in Indonesia construction industry

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Abstract. Construction projects in Indonesia have been growing rapidly in the last three years. Therefore, construction management is very important to ensure completion of construction projects are within schedule and budget. Utilization of building information modeling (BIM) can increase the efficiency of a construction project. However, the implementation of BIM in Indonesia is still not known. This paper is intended to review the implementation of BIM in Indonesia through literature analysis. To find BIM articles in Indonesia, Firstly, searching was limited to English articles published in reputed journals or conferences. However the results were limited, then the search was expanded to the article using Indonesian languages that published in journal and conference. Based on the number of articles, the results showed that BIM research in Indonesia is still in a dearth. Furthermore, BIM study cases were conducted in a limited location and within a small population. Nevertheless, the literature shared the conclusion that BIM can increase project efficiency, but the implementation was hindered by high initial investment cost, inadequate human resources, small demand, and technology resistant. The research contributes to providing a current reported level of BIM implementation in Indonesia. In the future research to study of BIM implementation comprehensively in Indonesia is eminent.

1. Introduction
Construction projects in Indonesia have been growing rapidly since 2014. Particularly, the current government has set priority to develop Indonesia infrastructure. Consequently, investment in a construction project has been estimated to grow 5.2% per year [1]. Project management is one of the critical factors to assure a project can be finished on schedule. In Indonesia of the construction projects, 38% were late, 47% were on time, and 15% were faster than schedule [2]. The project owner is usually more focus on budget overrun than time delay because direct effect of a delayed project is less obvious. However, in an infrastructure project consequence of a delayed project is not only directly affecting the project cost, but the area of a construction site is also severely affected. In a major city, traffic congestion increase in the affected area eventually leads to huge economic loss. During the development of LRT project and elevated toll road in existing Cikampek toll road, the traveling time from Jakarta to Cikampek take 2 hours longer than usual. Consequently, the logistic cost increases significantly because of doubling traveling time. Therefore, adopting technology to make a project on schedule is eminent.

Building information modeling (BIM) has been widely known for having many benefits for the construction industry. Improvement of project cost control and conflict reduction are among the benefits associated with BIM [3]. Therefore, BIM has been widely adopted in many countries to
increase the productivity of construction projects. However, level of BIM utilization in construction industry varies among countries. While developed countries are among the early implementer of BIM, BIM implementation in developing countries still poses many challenges. Construction companies in Indonesia have used computer-aided design (CAD) to draw 2-D design and construction work. The 2-D drawing becomes the source of conflict during the construction phase as misinterpretation among designer and contractor frequently occurred. To solve the conflict, designer and contractor have to clarify and change the drawing. The process requires many meetings before all the misinterpretation were solved. If the problem cannot be managed, it could lead to delay and cost overrun. As the BIM has potential to reduce such integration problem, BIM implementation in Indonesia is promising. However, the high cost of BIM software, lack of skill of employee, and unclear benefits of BIM to the company are among the BIM implementation challenges in developing countries [4]. Therefore, studying about BIM research in Indonesia can provide information about the level of BIM implementation and challenges posed in Indonesia construction industry.

2. Methodology
Firstly, searching is focused on obtaining BIM related article from reputed peer-review academic publishers. Query using the keyword “BIM Indonesia” from ScienceDirect only resulted from one article. As the number of articles was very low, the searching had to be expanded using Google scholar with the similar keyword. Then the searching only produced another two articles that specifically address BIM implementation in Indonesia. As the literature about BIM implementation in Indonesia are very limited and hardly found. The search had to be expanded again to include peer review the Indonesian language articles using the keyword “implementasi BIM” and “penerapan BIM”. The search only returned four relevant articles in the Indonesian language. BIM articles from final project, thesis, and dissertation were omitted because the articles were not accessible and not open to the public. The collected articles then were analyzed using descriptive statistic.

3. Results and Discussion
The collected articles are presented in figure 1. Only seven articles associated with BIM were published until 2017. The first article about BIM in Indonesia was published in 2013 explaining BIM implementation experience in several construction projects in Indonesia [5]. Indonesia companies just started to use BIM in 2012. It shows that Indonesia is lack behind developed countries which have been using BIM since 2000. Only two articles have published between 2013 and 2015 can be interpreted that BIM has not been widely known Indonesia. However, five articles have been published in the last two years indicating that there is growing interest in BIM research in Indonesia.

![Figure 1. Number of publications per year](image-url)
Some articles published based on publication type is presented in figure 2. There are not many articles have been published in peer review international journal indicate that BIM research is not yet mature in Indonesia. Indonesian scholar only published three international articles since 2013. Therefore, Indonesian scholars must be encouraged to publish English articles to attract international readers.

![Figure 2. Number of articles based on publication type](image)

BIM research in Indonesia is summarized in table 1. Each article is categorized by BIM implementation framework dimension suggested by Jung and Jo [6]. The dimensions are technology, perspective, and construction management. Strong focus on technology is shown in 71.43% articles. The number can be understood that people are more interested to see the real benefit when using new technology in construction projects. Moreover, the studies are focusing on the benefit of BIM and the implementation challenges. The studies confirmed that BIM could improve construction project in Indonesia [5] in construction planning [7, 8], construction cost due to time efficiency and human resources efficiency [8–10], and project documentation [9]. However, successful implementation of BIM requires technological support [10]. But the implementation was hindered by companies’ internal factor such as lack of BIM skill worker and technology resistance, and external factor like low demand from clients [9]. Companies also need to have adequate capital to cover initial high licensing cost [9] and capable of handling incompatibility issue among BIM software [10].

While the academicians have more understanding than practitioners about BIM as integration software, practitioners only use BIM to obtain project information [11]. The situation was driven by low demand from clients. Therefore, the companies do not need to utilize all capabilities of BIM. Eventually, the companies do not require high BIM skilled users as BIM usages are for 3-D modeling and visualization [12].

Based on the companies’ utilization of BIM, the maturity level in Indonesia companies are still in level 0 and 1. [13]. The maturity level 0 is a pre-BIM stage, in this stage companies uses 2-D documentation to explain 3-D object. Furthermore, detail documents explaining the object such as specification, quantities, and cost estimation are separated from the documentation [14]. Indonesian companies still use 2-D documentation in their construction project. Maturity level 1 is object-based modeling stage, in this stage companies use BIM object for visualization. Currently, Indonesian companies only utilize BIM for modeling and visualization [12], and information [11].
| Theme                                                                 | Finding                                                                                     | Dimension  | Year   |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------|--------|
| Design and construction of prefabricated building [5].               | BIM has benefit to streamline construction projects in Indonesia                           | Technology | 2013   |
| Application of BIM for pre-construction [7].                        | BIM provides information about pre-construction planning, particularly construction logistic planning. | Technology | 2014   |
| Awareness and implementation of BIM among academicians and practitioners [12]. | 1. High awareness of BIM (70%) but the low implementation (38%).  
2. BIM’s main uses are 3-D modeling and visualization. | Perspective | 2016   |
| Perception of academicians and practitioners of BIM technology implementation in architecture [11]. | Practitioners perceive BIM as informative software while academicians perceive BIM as integration software. | Perspective | 2016   |
| Comparison between Project using BIM and project using a conventional method in term of time efficiency, cost, and human resources [8]. | Savings due to using BIM compared to conventional:  
1. Project planning time by 50%.  
2. Human resources by 26.66%.  
3. Personnel cost by 52.25%. | Technology | 2016   |
| Exploration of technological support for BIM implementation, benefits of BIM, challenges of BIM in construction project [10]. | 1. The need of technological support for BIM is eminent.  
2. BIM benefit is to reduce cost  
3. Incompatibility between different BIM software. | Technology | 2017   |
| Challenges of BIM implementation in small-medium enterprise architecture [9]. | 1. Main benefits of BIM are time efficiency, better communication and coordination, and improved project documentation.  
2. Main challenges are lack of skilled BIM user, low demand from a client, high investment cost, and resistance to technological change. | Technology | 2017   |
4. Conclusion
The first documented use of BIM in Indonesia construction industry was in 2012 [5]. Since then the progress of BIM is still slow. Low international journal articles show that BIM research is not yet mature in Indonesia. The perspective studies also show that BIM implementation in Indonesia is still in its infancy. Although stakeholders in Indonesia construction industry are aware of the benefit of BIM to their business, the penetration is still low. Several companies have promoted to elevate BIM usage in industry. However, the implementation is hampered by skill worker and technology resistance, and external factor like low demand from clients, high investment cost, and BIM software incompatibility. Particularly in small and medium companies (SMC) when the project is simple, the investment cost outweighs the benefit of BIM. Therefore, integrating BIM course into university curriculum could increase the availability of BIM skill worker. While licensing cost is free for educational purpose, SMC could ask for a special price through an agreement between association and Software Company to reduce investment cost.

In conclusion, the research contributes to providing a current reported level of BIM implementation in Indonesia. Therefore, in the future to provide a broad view of BIM implementation, research to study of BIM implementation in various construction sectors is eminent. Furthermore, to overcome the future shortage of BIM skill among construction worker, study about BIM in Indonesia higher education is a necessity.

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