A Critical Literature Review of BIM Cloud Score: Building Information Model and Modeling Performance Benchmarking

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Abstract

The quick acquisition of building information modeling (BIM) in the architecture, engineering, construction, and operations (AECO) industry in recent years has effected in large distinctions in the level of BIM application and adoption among organizations. AECO stakeholders, including designers, owners, and general contractors, don't have a benchmark method for them to perceive their own execution and know how to renovate themselves. A cloud-based BIM performance benchmarking application, BIM Cloud Score (BIMCS), has been offered to collect BIM execution (performance) data from BIM users over the nation in order to permit them to match their BIM performance with the effects gathered from their industry peers. This research aims to improve and authenticate a preliminary list of metrics that are appropriate for the proposed BIM benchmarking application. A survey was operated in the AECO industry and involved BIM architects (authors) and contractors (users) to authenticate the offered preliminary list of metrics. The replies from the survey were utilized for initializing the metric weights for the benchmarking method. In addition, an investigation of the differences in opinion between different groups of respondents indicated that out of 26 variables used, the perceived significance of 6 variables was statistically various between BIM authors and BIM users. This outcome shows that the surveyed architects and contractors were in contract with the significance level for most of the variables offered including model economy, model usefulness, and model productivity. Future adjustments of the metric weights might be required in the application based on the different intended purposes for the BIM models.

Keywords: *Building information modeling (BIM), Modeling cloud score, Performance evaluation, Benchmarking, Productivity Information technologies*

INTRODUCTION

The perceived benefits and resource savings attributed to building information modeling (BIM) during the building lifecycle have drawn growing interest and discussions in the architecture, engineering, construction and operations (AECO) industry. This is evidenced by a dramatic increase in the number of peer-reviewed publications with BIM in the keywords and abstract. Among one of the most-referenced research problems is the question of how to evaluate BIM deliverables at different stages of the project lifecycle, especially since many owners have started to require BIM at different levels.

BIM performance issues were to aware for all organizations, for that a variety of performance evaluation frameworks were designed to enhance technological maturity and capacity. BIM quality assurance and BIM assessment is an important area of study. A messy BIM model will eventually guide to a messy project. While many owners have begun requesting higher level of development (LOD) standards for their building information models, they lack the time and technical skillset

required to check model deliverables. As a result, architects and general contractors have little incentive to deliver a high LOD, since there is no measurable way to evaluate their work. Architects and general contractors may still be willing to deliver a high-LOD model based on protecting their reputation and their business interest, but they still do not have an effective evaluation and benchmarking tool to give them feedback about their BIM product and their modeling process. Thus, a quantitative method for BIM performance evaluation and control is both necessary and required.

REVIEW OF LITERATURE

The following are the previous research review based on BIM Cloud Score: Building Information Model (BIM) and Modeling Performance Benchmarking.

Bilal Succar et al. (2009) recognized a study and delivery framework, specific visual language and ontology tailored to inspect the BIM domain and provide actionable deliverables. The author has concisely introduced BIM Stages, BIM Lenses and BIM Fields. It also recognized Step Sets, Step Types- both requisites of BIM application- and discussed various framework deliverables. **[4]**

Rizal Sebastian et al. (2010) described about the applied study to create mechanism which use to benchmarking BIM performance. The author also derived unique characteristics like BIM Quick Scan combines qualitative and quantitative assessments and accommodates valuable expert judgement in such a coherent way, it possesses a sufficient degree of consistency, it covers the 'hard' and 'soft' aspects of BIM at corporate level, ICT infrastructure level and model/ modelling level etc.**[12]**

Hazar Dib et al. (2012) derived that BIM Maturity (BIMM), which mentions to the range to which the BIM is clearly "defined, managed, integrated, and optimized", is discontiguous across these companies/projects. The implementation of BIM is more than the update of the hardware or software infrastructure. It is an organized approach to the lifespan information connected to a building. **[8]**

Léon van Berlo et al. (2012) described that BIM QuickScan is providing insight in the level of BIM within a company and has proven to be a valid instrument to collect benchmark data on BIM usage. Although it is very hard from the data to draw firm conclusions, it has provided some new insights. He also added that BIM QuickScan is accepted by consultants and they are very happy with the concept of 'scanning' a company before advise them in follow up. **[10]**

Bilal Succar et al. (2013) addressed that BIM helps to recognize BIM objectives and goals through capabilities articulated as aptitude, measure the capability of individuals, institutions and teams using a general reference set, describe and meet project necessity through standardized capabilities articulated as aptitudes/necessities, Facilitate organizational and project workflows through capabilities – articulated as events/tasks, recognize pre-qualification criteria through capabilities – articulated as outcomes/deliverables, develop training and continuing professional development (CPD) modules – expressed as outcomes and many more. **[5]**

David Bryde et al. (2013) derived that this is a combined design approach and a dominant stakeholder engagement procedure, which also deliberates the operators' requirements throughout the design phase – which BIM can facilitate. But as was specified earlier in this section, using BIM to its full potential to bring on the sustainability schedule will only be reachable if the people using it adapt and adopt working practices to suit. **[7]**

Mehmet Yalcinkaya et al. (2013) defined the significant outcome of this investigation is associated to the potential of BIM to be utilized alongside many construction management requests. But there are variances between traditional and BIM application. So that, these conclusions recommend that the recent construction management form of information should be updated to reflect the modifications caused by BIM in the current construction management responsibilities and duties. **[11]**

Ammar Dakhil et al. (2014) described the latest framework which describes the connection between the BIM maturity level and the benefits connected to it. The results of this study are summarized as follows. The researchers have established a methodology for searching twenty-one BIM applications which support the construction project management procedure. All the available

current maturity methods were inspected in order to discover the best BIM maturity components which interrelated especially to the client. The researchers have recommended a framework which clarifies the relationship between the BIM maturity level and the benefits which are associated to it. Client organisations can use this framework to estimate their maturity and benefits. These results deliver the occasion for the client to modification the existing BIM execution plan. **[3]**

Jing Du et al. (2014) introduced a cloud-based BIM performance benchmarking application called BIMCS to automatically gather BIM performance data from a wide range of BIM users from all over the nation. Twenty authorized benchmarking metrics are used to calculate BIM application performance in view of the BIM model (the product) and BIM modeling (the production). **[9]**

Yunfeng Chen et al. (2014) described BIMM measurement was considered as per three views. The First perspective, the key dimensions and parts of BIMM measurement models were reliable with other maturity models and BIM-related standards. The second perspective, the four dimensions and their level in this research allied with the four most significant factors effecting BIMM advantages as stated in the Smart Market Report that presented by McGraw-Hill. The third perspective, identical factors were perceived as significant by both the USA and the non-USA BIM-related specialists. **[14]**

Brittany Giel et al. (2015) described that study of BIM illustrates more than one area for estimating the BIM capability of building owners and offers a modified framework for them to execute self-evaluations of their organizations on the basis of the key perceptions of 21 main BIM experts from several various circumstances. The BIMCAT serves to provide owners with direction in set up a baseline of where their organization stands and possible areas for upgradation. The results of this assessment may aid facility owners in expanding their technical knowledge, filtering their BIM necessities during design and construction, and finally improving the productivity of their post-construction actions. **[6]**

Aizul Nahar Harun et al. (2016) explained the various countries across the world have revealed great curiosity in the direction of BIM execution and their public sector plays a significant role in leading the market towards BIM implementation. Even though the implementation of BIM in those countries has evolved in many different pathways, the fundamental issues are that the government has given a full support and most of the BIM projects were started through government entities having mandates to impose the use of BIM for their initiatives. **[2]**

Susanna Vass et al. (2016) conducted an international survey to inspecting the advantage and business values of BIM and many of the advantages and business values found have been the identical or very similar. From a huge international survey on the perceived business value of BIM, two types of groups of advantages of BIM were discovered. The most significant category of advantages of BIM was project growth related and developed around minimizing and managing project managerial matters. The conclusions had both theoretical and practical implications. They made a contrast to previous studies on the benefits and business values of BIM and showed where the impact of BIM on the day to day management of the project was largest. **[13]**

Abdul-Majeed Mahamadu et al. (2017) revealed that there is a good degree of relationship between the BIM capability and success in general. While this study revealed that most of the BIM capability attributes are reliable predictors of success, thus, important for BIM qualification process, their contribution to success in practice may be to a lesser extent. **[1]**

Fig.1(a) and Fig.1(b) shows the factors affecting BIM performance benchmarking.

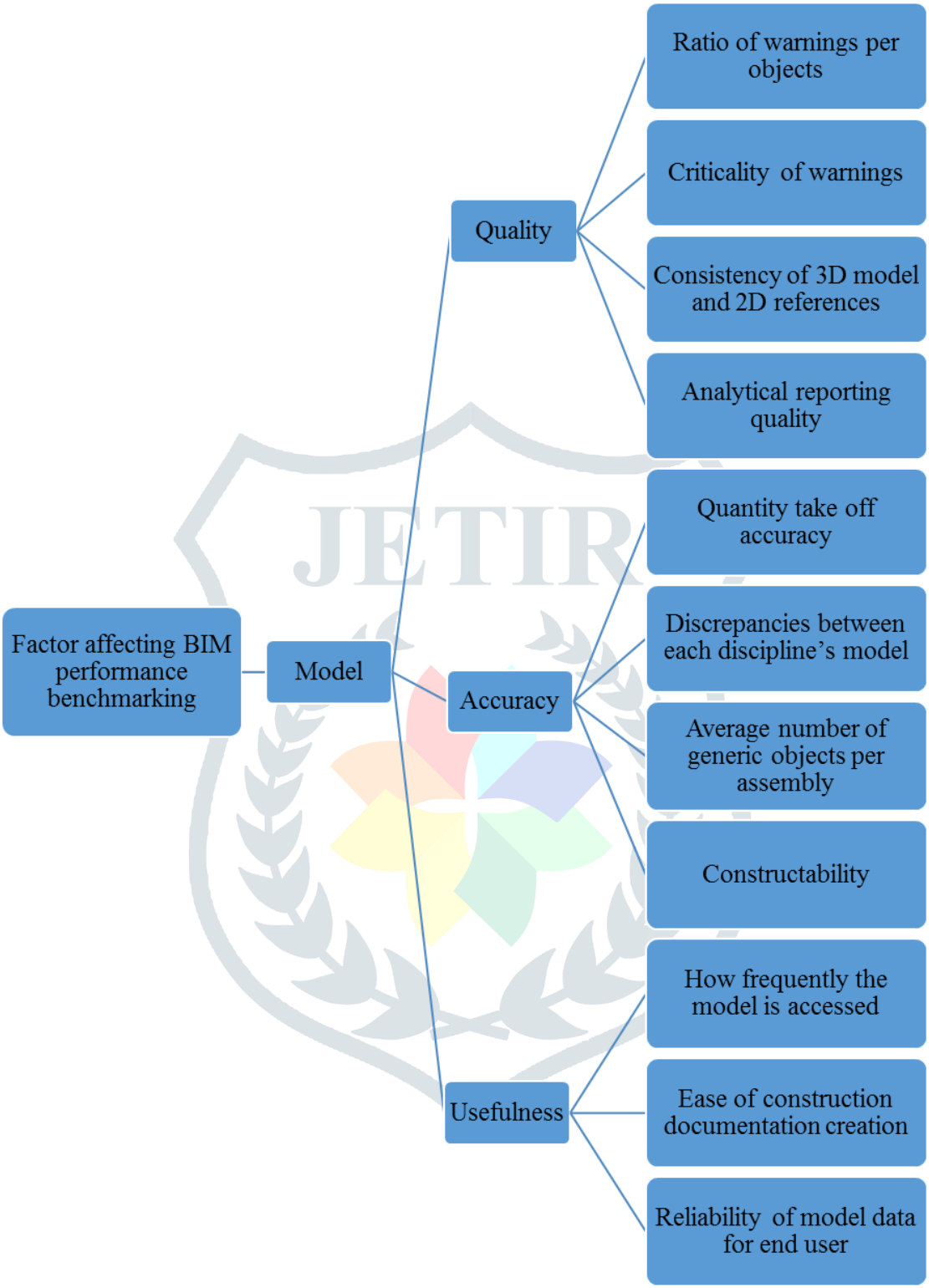

Fig. 1(a): *Integrated Framework for Factor Affecting BIM Performance Benchmarking*

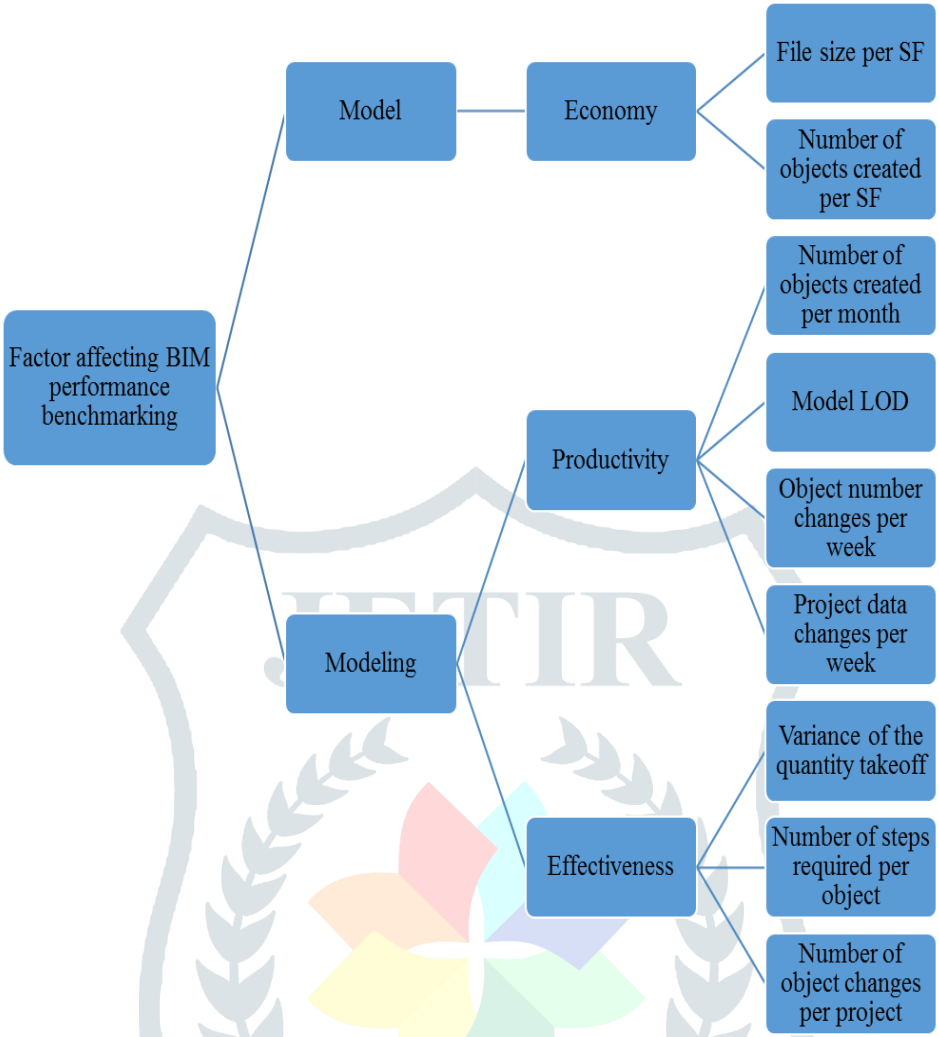

Fig. 1(b): *Integrated Framework for Factor Affecting BIM Performance Benchmarking*

CONCLUSIONS

The following major findings from research paper that identified are described below:

1. BIM performance to recognize gaps in their BIM model and modeling procedures and to decide upgrading directions.
2. The overall BIM performance can be measured based on two critical characteristics: BIM (process) and the building information model (product).
3. BIMCS use to automatically assemble BIM performance data through a wide range of BIM users all over the nation. And at last, a protocol for BIM performance may be established on the origin of this upgraded knowledge discovery process.
4. The BIMCAT serves to deliver owners with direction in mounting a baseline of where their organization stands and conceivable areas for development.
5. The importance of necessities and the suitable documentation are definitely required in the BIMCAT. It helps to develop a step for how to check the accuracy, completeness and quality of a building information model will good for owners.
6. BIM QuickScan is an instrument for benchmarking performance, aims to provide insight in the level of BIM within a company and has proven to be a valid instrument to collect benchmark data on BIM usage.
7. BIM QuickScan combines qualitative and quantitative assessments and accommodates valuable expert judgement in such a coherent way, it possesses a sufficient degree of consistency, it covers

the 'hard' and 'soft' aspects of BIM at corporate level, ICT infrastructure level and model/ modelling level etc.

8. All twenty one BIM applications clarify the connection between the BIM maturity level and the benefits which are related to it. Client organizations can use this whole framework to calculate their maturity and their advantages. These results provide the opportunity for the client to alteration the current BIM execution plan.

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