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Combining BIM and Strategic Management for Efficient Planning and Execution of Construction Projects

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ABSTRACT

Construction projects are faced with a range of challenges. These can be addressed significantly by combining Building Information Modeling (BIM) and strategic management (SM) right from planning to execution phases of construction projects. This study argues that these two problem-solving mechanisms can be leveraged in combination for the attainment of efficient planning and execution of construction projects. It draws evidence from secondary data, sourced from the internet and subjected to systematic review and thematic and content analyses. The descriptive analysis done proves BIM and SM to be indeed capable of ensuring efficient planning and execution of construction projects, when duly deployed and the constraints to their application tackled sufficiently. The study concludes that the combination of BIM and SM produces more results and guarantees efficient planning and execution of construction projects much more than when either of them is used alone. Organizations and institutions are charged to resort to combining these strategies as well as others in finding solutions to problems such as those confronting construction projects.

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Introduction

Construction projects usually face constraints such as poor planning, delay, cost overrun, stakeholders' clashing interests and attitude, inefficient risk and human management, poor performance, and the sustenance of traditional methods of operations over the digital ones [1-4]. With Building Information Modeling (BIM) and Strategic Management (SM), the aforementioned constraints, among others, can be tackled at a reasonable extent and reduced to the barest minimum. Consequently their combined application, efficient planning and execution of construction projects are bound to be attained. Studies confirm that BIM can function maximally and cause efficient service delivery in construction [4-9]. The National BIM Standard of United States (2018) states that BIM coordinates design sustainably and efficiently.

Similarly, Samimpay and Saghatforoush aver that for meaningful achievements in the construction industry, BIM has to be applied sustainably, as doing so would increase the contributions of the sector to socio-economic development [10]. Also, Liu et al. note that BIM guarantees efficient integration and delivery of projects [7]. This assertion suggests that the application of BIM can lead to efficiency in different projects, including construction projects. Also, studies affirm the viability of SM in the attainment of efficiency in various activities, including projects. Among them are Bagader and Sultan, Torzhevskaia, and Kanyora and Okello [11-13].

Again, the Cabinet Office indicates that BIM is a strategy for efficient construction [14]. As a strategy, combining it with SM to attain efficient planning and execution of construction projects would undoubtedly produce more results. This is because when combined, more results would be realized from BIM, as a technological strategy, and SM, as a management strategy. Therefore, the novelty of the present study is its proposition on the combination of two result-oriented mechanisms for the attainment of efficient planning and execution of construction projects. The study sets out to prove its stance that regardless of the challenges to the application of BIM and SM in different activities, they are capable of producing high results when duly deployed in construction projects. This is because they are problem-solving. All that is needed is for project managers and their teams to get exposed to and familiarized with the nitty-gritty of these two viable mechanisms in construction setting.

Building Information Modeling (BIM)

Building Information Modeling (BIM) refers to a computer-aided technology for managing construction project information, focusing on building information, models, production, communication and analysis. For Shahhosseini et al. BIM refers to a method of receiving information about construction projects in the design and pre-construction phases [15]. To Diaz, BIM refers to the means of changing the age-long approaches to building, designing and maintaining construction projects [16]. Diaz adds that BIM has a virtual process, with all encompassed and disciplined features. For the present study, these require SM for betterment [16].

Fridrich and Kubecka say that BIM can be described as software and an integrated method [17]. From the foregoing conceptual perspectives, some core conceptual elements of BIM are figured out and presented in the following table for emphasis and better understanding.

Table 1: Conceptual Elements of BIM

Perspectives	References
A 3D project model, which links planning, design, construction and operation	Kymmell [18]
Construction information channel from design to pre-construction	Shahhosseini et al. [15]
An object-oriented parametric modeling technique	Azhar et al. [19]
An integrated method and software capable of solving problems	Fridrich and Kubecka [17]
Computer-aided technology, with which information about construction projects is managed	Eastman et al. [20]
Key concepts: building, information, models, production, communication, and analysis	Eastman et al. [20]

Source: Author, 2024

The place of BIM in planning is captured by Kymmell, who describes it as a 3D project model that links design, planning, construction and operation [18]. This means that BIM plays a crucial role in the planning of construction projects. From effective planning, effective or successful execution obtains. It is to that end that the present study considers BIM as a tool for attaining efficiency in planning and execution of construction projects. BIM has the following major features:

Table 2: Central Features of BIM

Features	References
Quantity take-off	Farnsworth et al. [21]
Investigation	Liu et al. [22] Gomez-Romero et al. [23]
Constructability	Yang [24]

Source: Author, 2024

Having described BIM and highlighted its features, it is important to present some examples of BIM. The Table 3 below contains some major examples of BIM, with their core functions:

Table 3: Examples of BIM

BIM software examples	Functions
Enscape, Rhino	Visualization, alternative exploration of design
OpenStudio, Autodesk Insight, ClimateStudio	Modeling energy for efficient senario and design
Autodesk Revit, Rhino	Porvigin detailed performance analysis and structural integrity
Miro, Enscape	Visualization, iterative design and speedy proto-typing
SketchUp, Tally	Ensuring resource efficiency, and detailing model minimization of waste
WUFI, Tally	Assessing and regulating environmental impact
Autodesk Revit, Tally	Providing insights into cost, labor and material, which ground logical budgeting

Source: Author, 2024

Uses of BIM

Different studies highlight the uses of BIM, though all or seemingly alike. Accordingly, BIM can be used for design, planning, construction, operation, repair, maintenance, demolition and promote sustainability [25-28]. BIM helps stakeholders of projects to attain sustainable construction, as they capitalize on the perceived technical premises of the projects. It offers an avenue for rich information database and technology-driven analysis [29,30]. Kim et al. look at Modelica, while Gupta et al. treat PV*Sol. Kim et al., Kim and Yu, Ahn et al., Wong and Fan and Azhar et al. treat BIM-based energy simulation and 401 modeling during design [19,27,29,30,31].

In addition to the above, the place of BIM in waste management and CO_2 reduction in construction is affirmed by Liu et al. and Won and Cheng (2017) [32]. For this study, BIM can be used to:

- Create some essential components of construction, both onsite and offsite
- Fabricate precise shop drawings and design details
- Ensure exact specifications for assembly
- Reduce errors, which thereby paves ways for high level of efficiency
- Cause increase in quality and profit-making, for which costs are reduced and construction processes are optimized
- Improve planning, accuracy, and timely execution of projects
- Produce a centrally run up-to-date system of information management, for which issues are easily detected, prevented and resolved
- Increase the sustainability of construction projects.

The Role of BIM in Construction

BIM plays a critical role in design and manufacturing, logistic planning, assembly planning, construction control, and management and maintenance of projects [4]. That is to say that BIM is essential in construction projects because it improves operational efficiency, enhances and increases project sustainability, optimizes construction processes, streamlines design and manufacturing processes, ensures environment-friendly operations, and encourages collaboration among stakeholders. With the aforementioned in place, which follow the application of BIM, errors and rework are minimized, and planning, accuracy, and timely execution of projects are guaranteed and obtained.

BIM ensures effective planning because its usage allows for early design, analysis, predictions, and orientation, for which informed decisions are made. By reducing energy consumption, BIM reduces the matters arising from energy consumption and saves costs of building or construction projects. These help ensure the execution of construction projects. BIM impacts positively on the performance of solar panels, wind turbines, and other renewable energy technologies. By so doing, it reduces carbon emission. Thus, it contributes to ensuring green environment. Green building certifications and passive deign strategies are possible with BIM. These help attract tenants who are interested in energy-efficient and sustainable buildings. Facility managers are able to access real-time data on consumption and performance levels of energy. By allowing for the adjustment of HVAC settings, BIM helps in maintaining energy-intensive equipment. Consider the following table, which contains highlights of the role played by BIM in construction projects:

Table 4: Functions as well as Prospects of BIM

Prospects of BIM	Citations
BIM allows for better teamwork practice, co-operation and collaboration.	Diaz [16]
Propels performance, efficiency and productivity in construction	Arayici [33] Isikdag [34]
Facilitates sustainability and technological integration in construction Addressing sustainability concerns in construction procedures	Arayici [33] Isikdag [34] Chen et al. [35] Travaglini et al. [36]
Enhancing and increasing project performance, competency and service delivery	Hadi [4]
Easy facility management Reducing interoperability challenges Helps in addressing management and communication problems that confront remote construction projects	Samimpay and Saghatforoush [10] Jiju [37] Love et al. [38] Arayici et al. [39]
Facilitates productivity, project quality assurance, and faster service delivery	Jung and Joo [40]
Lowering costs, reducing wastages, and offering new opportunities for revenue and business	Hadi [4] Diaz [16]

Source: Author, 2024

Prospects of Applying BIM to Construction Activities

Different studies point out the prospects of BIM. Some of them are presented hereunder in Table 5, with some citations for scholarly backing.

Table 5: Prospects of BIM

Prospects	Scholarly Backing
Bringing to place technological innovations in construction sector	EL Mounla et al. [2] Arayici [33] Isikdag [34]
Ensuring the attainment of high level of efficiency, performance and productivity	Arayici [33] Isikdag [34]
Improving the socio-economic contributions of construction industry to the society	Samimpay and Saghatforoush [10]
Increase in quality assurance	Alotaibi et al. [41]
Reduction of resource wastage Enhancing the efficiency of energy	Liu et al. [32] Won and Cheng (2017)
Effective time management and saving time spent on construction projects	Wang and Chen [42]
With BIM, engineers, architects and contractors create a digital version of a building before its construction	Stanley and Thurnell [43]
Visualization and realization of project tasks and scopes	Salako [3] Bagader and Sultan 11]
Enhances resource management and safeguards workers' safety during construction	Manzoor and Othman [44]
Provision of insights to best strategies that optimize design, operations and performance, and efficient management of resources	Salako [3] Bagader and Sultan [11] Shareef and Altan [45]

Source: Author, 2024

Barriers to Integrating BIM into Construction

There are different factors that pose challenges to BIM adoption, integration and sustained use in construction sector. The challenges are broadly classified into four main categories by Dakhil and Alshawi viz: technical, skill acquisition and training, legal procedures, and economic challenges [46]. Just as they stress that upgrading construction to a BIM-driven one is usually constrained by the aforementioned challenges, this study argues that the integration of BIM into construction to make it BIM-driven is also constrained by the above categorized challenges, among others. For a scholarly example, Dalui et al. examine the barriers to BIM adoption and implementation in UK [47]. The results of their analysis reveal the major barriers to be the unwillingness of many professionals to key into the innovation, lack of enthusiasm for the potential opportunities of BIM, costs of software, environmental conditions, cost implications and frequency of maintenance, and cultural factors like belief or worldview about BIM as well as the like innovations in society. They suggest increase in awareness about BIM as the pathway to harnessing the potentials of BIM in the electricity generation sector and others.

Further, high costs of BIM scare many companies and individuals away from utilizing BIM [8,48]. These include costs of training and logistics. Kineber et al. hold that regardless of the cost implications of BIM, its adoption leads to high level of performance, sustainability and project success [49]. The present study upholds the Kineber's et al. position and goes further to propose its combination with SM, as a way of surmounting the noted challenges or disadvantages of BIM [49].

It is observed that many companies are yet to understand the benefits of using BIM [50]. Technical-know-how is another factor, because high level of training is required. The other barriers to integrating and using BIM in construction include:

- **Awareness:** The awareness level of individuals in this industry determines the extent to which BIM is integrated into construction. High level of awareness would make it clear to many that BIM can be integrated into construction for betterment. It would also make many realize the prospects of integrating BIM into construction. Awareness would also deal with negative perception of BIM, as the informed individual in the field changes their perception of and attitude towards BIM.
- **Applications Unfamiliarity:** It is quite obvious that individuals tend to be bent on using what they are familiar with and disregard the one or those they are not familiar with. As such, because many people are not familiar with BIM, they have little or no interest in it.
- **Belief:** One's belief could make them disregard or reject the adoption of BIM for construction. Attia et al. hold that managers' belief influences their adoption or non-adoption of BIM [51].

Regardless of the above identified barriers as well as any others, the benefits of BIM outweigh them. This assertion is also held by Hadi, who states that the barriers of BIM have been identified to be insignificant compared to the benefits [4]. In the same vein, this study argues that the challenges of BIM in construction are insignificant compared to its benefits and so any arguments against it adoption, integration, use and sustenance in construction are subjective, illogical and/or inconsequential. Thus, since the benefits of BIM in construction outweigh its shortcomings, it is imperative to integrate and use BIM in construction significantly at all times.

Strategic Management and BIM in Construction Projects

Alotaibi et al. discuss the importance of adopting BIM in the management of construction projects, with a view to enhancing legal and contractual management of projects [41]. They emphasize that adopting BIM for this purpose enhances collaboration among stakeholders involved in the projects, which thereby leads to a successful execution. For them, BIM in this kind of management is beneficial because it helps in resolving disputes and in clearing ambiguity. The analysis of their gathered primary data shows that dispute resolution, contractual frameworks and legal awareness impact positively on the adoption of BIM, unlike risk management that has insignificant effect on BIM adoption. It also shows that clearly specified BIM protocols are required for effective adoption. Thus, it becomes imperative for project managers to proactively tackle risks for efficiency, meaningful collaboration, and the implementation of project terms. By so doing, the successful execution of construction projects can be guaranteed. Insights from the findings of their study make it clear that strategic management of BIM in the course of managing projects using it would produce the desired results expected for the betterment or improvement of the research on the legal implications of BIM adoption.

The result of EL Mounla's et al. review of 61 articles on BIM indicate that it produces appreciable innovative results in construction activities and does better when combined with the concept of Lean construction [2]. Thus, the position of the present study on the efficacy of combining BIM with SM for more efficiency in planning and execution of construction projects cannot be disputed. Like EL Mounla's et al. study, the present study argues that the combination of the two promises betterment [2]. It follows that this study uniquely contributes to bridging a research gap, as it proposes a better way of planning the successful execution of construction projects. This study proposes the sustainable combination of strategic management (SM) and Building Information Modeling (BIM) in the planning of construction projects so as to achieve a successful execution. Doing so entails interdisciplinary interplay and collaboration between professionals in construction and information technology fields and those in project management. Then, exchange of knowledge, expertise and services take place consistently.

Salako's study discusses and identifies the strategies for implementing construction management planning [3]. It upholds the view that for a successful execution of projects, effective project management planning tools must be deployed adequately. These include leveraging BIM and other technologies for the realization of a successful execution of projects. The planning techniques identified are classic technique and waterfall method, which allow for timely execution of construction projects. The highest barriers to effective planning and execution of construction projects are cost management and unfavorable government regulations. According to Salako, the implementation of technology-based strategies guarantees huge results in construction [3]. Thus, integrating them into the planning processes of construction projects would allow for the realization of project successes. The submission of the study stresses the inclusion of management strategies in construction contract terms and conditions at the beginning phase of projects. This point underscores the position of the present study on the combination of SM and BIM in the planning of projects in ways that guarantee successful execution.

Bagader and Sultan review some articles on the impact of SM on construction activities in Suadi Arabia [11]. The review proves the existence of a research gap on the ways of achieving sustainable development goals in the construction sector. The study indicates that organizations have to consistently assess and improve their strengths and weaknesses in order to attain considerable performance in the industry. It holds that SM is a mechanism for attaining organizational performance, adopting current innovations and tackling the threats to operations and efficiency. There is no doubt that SM would produce more results than those affirmed by their study when combined with BIM as well as other smart technologies and software packages of the contemporary era.

Wang and Chen make a review of some literatures on the integration of BIM and project management in the life cycle of construction [42]. They are of the view that BIM is both a digital construction and management instrument. In other words, they argue that BIM plays a critical role in the management of construction projects other than playing construction or building role in the life cycle of projects. For them, BIM strengthens the weak life cycle of construction projects [42]. By noting that BIM improves management efficiency in construction projects, Wang and Chen agree with this study that strategic management and BIM be combined to attain maximal or more beneficial results. By lending credence to this study, its views are justified and its novelty sustained [42].

To determine the impact of BIM on the management of construction projects, Hadi reviewed some previous literatures [4]. According to Hadi, the execution of projects begins with planning [4]. As such, it is imperative to combine workable measures like BIM and SM proposed by this study. While each of them is known to be effective, result-oriented and/or problem-solving, combining the two would mean getting more from them as a result of the combination. The review shows that BIM improves project performance, leading to a successful execution. The Hadi's study holds that BIM is one of the current technological innovations for addressing the challenges confronting the construction industry [4]. It charges organizations in Iraq to adopt BIM and the like other technologies for the attainment of the results that traditional means of activities are incapable of providing. It also urges stakeholders and researchers to create wide awareness about BIM and make concerted efforts to get rid of or surmount the constraints to the adoption of BIM. Thus, this research is an attempt in that direction.

Torzhevskaia's study states that construction activities are largely more business-based than strategically coordinated [12]. Consequently, a range of problems confront the sector. To deal with the problems accordingly and pave way for meaningful achievements in the sector, SM has to be deployed in running most construction activities. Some of the techniques of SM needed for efficiency in planning and execution of construction projects are critical and technological skills. Of course, construction projects are critical activities of the industry. Thus, the dire need for SM in pursuing the achievement of successes in construction projects cannot be overemphasized. The current study seeks betterment in the industry and thereby proposes the combination of SM with BIM to attain efficient planning and execution of construction projects. Kanyora and Okello indicate that strategic management is a valuable tool for decision-making, corrective actions and the realization of pursued organizational goals [13]. Drawing evidence from the case of Kenya, they agree that construction projects have to be well managed strategically and even technologically so as to improve performance, increase the contribution of the construction industry to gross national product, and attain organizational goals. Their study reveals that goal-setting is one major aspect of strategic management that drives planning to execution, as performance is

achieved maximally. Organizations in Kenya as well as elsewhere in the world are charged to consistently devise competitive strategies with which effective planning and execution of projects can be achieved. Obviously, Kanyora and Okello lend credence to the present study that strategic management is a viable mechanism for achieving targeted organizational and institutional goals [13]. Like others, they do not consider the combination of SM and BIM as viable mechanisms for achieving effective planning and execution of construction projects. That research gap is filled by the present study.

Conclusion

Basically, BIM has been revolutionizing the construction industry. It provides the digital form of physical projects. It helps a lot in design, costing, estimation, budgeting, projection, decision-making, effective communication among stakeholders for a meaningful collaboration, and detection of prospective issues like shortages and challenges to effective execution. Construction schedule is optimized by BIM, which reduces delays. Given these, the study proposes the deployment of BIM in combination with SM to attain efficiency in planning and execution of construction projects at both national and international levels. Drawing evidence from extant studies, this study has proven that BIM and SM are pathways to efficient and sustainable planning and execution of construction projects. That is to say they are viable mechanisms for effective planning and execution of construction projects. Given their huge positive impact on construction projects, it is imperative to adopt and combine them in effective planning and execution of construction projects.

The study concludes that the successful completion of any projects begins with efficient planning that finally produces results in execution. The critical role played by BIM and SM, particularly when combined, makes it imperative for this study to advocate their combined usage in planning for the successful execution of construction projects. Stakeholders are charged increase the adoption of BIM in construction and other activities. Also, SM should be deployed by different professionals and leaders in managing resources and projects. Interdisciplinary collaboration should be practiced among professionals of construction and other fields. The project management professional, as a strategic manager, should be deeply involved in the planning and implementation phases of construction projects.

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