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# Assessing the Feasibility of Adopting BIM in Project Management——A Case Study of UK DCFC Stadium

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**Abstract.** As business ventures seek to capitalize on modern technologies as tools for ensuring competitive advantage, Diamond Castle Football Club (DCFC) anticipates implementing BIM technologies. About the definition of BIM and compared to the traditional construction method, this paper envisions the implications of applying BIM for the case of the DCFC project. Finding indicates despite the few limitations, BIM has many benefits for the projects from inception to post occupancy stage. Besides, it ensures ecological sustainability and ensures long-term cost-effectiveness.

**Keywords:** Construction Project Management, BIM, Stadium Projects

## 1. Introduction

The twenty-first century is referred to as the "information age," and it is characterised by the widespread adoption of new technology across a wide range of industries. Streamlining business operations, improving problem solving, and ensuring that businesses initiatives maintain market relevance in a competitive climate have all benefited from the use of such technologies. Global trends have challenged the Architecture, Engineering, and Building (AEC) industries, just as they have affected other industries. Global trends have increased the complexity of AEC projects and demonstrated the limitations of depending on traditional construction methods [1]. Because of this, specialists from various industries have turned their attention to finding long-term, effective, and economical solutions to alleviate such disparities. Building Information Modelling (BIM) is a potential breakthrough in the architecture, engineering, and construction (AEC) industries that aims to inspire construction projects in a virtual environment.

Various studies have been carried out to determine the significance of incorporating BIM into construction projects. Included with the work of [2]，who envisioned case studies that elaborated on how implementing AEC in the building industry had resultant benefits for all stakeholders. Improved communication among project teams, increased profitability, lower costs, improved time management, and improved customer connections are all examples of what can be accomplished. This research has mostly examined BIM applications during the conception and construction stages, with little attention paid to the importance of BIM applications once a building has been occupied.

[3] offered a case study of BIM deployment in a hospital construction project in Moss, Norway, in 2015. The project was sponsored by the Southern and Eastern Norway Regional Health Authority and was a large hospital construction project in the city. This case study demonstrates how effective digital cooperation in the construction industry may be achieved through the use of BIM. [3] conducted a case study on the use of BIM to healthcare buildings and discovered that BIM may be utilised to solve the increasing rent reduction costs and complexity that are inherent in healthcare construction. According to the authors, the application of the BIM modelling process to each project, including visualisation and time savings, is discussed in detail in the paper. Aside from that, because these studies have concentrated on a variety of construction projects, little has been done on the subject of developing stadium projects.

Using the Diamond Castle Football Club as an example, this paper will investigate the feasibility of implementing Building Information Modeling (BIM) throughout the development process (DCFC). On the stadium project, the paper will go into further detail on the benefits and downsides of adopting BIM in the design and construction process. To understand BIM, we'll first discuss what it is and how it differs from traditional building procedures such as 2D and 3D Computer-Aided Design (CAD)

## 2. Defining BIM

BIM has diverse meanings for different experts; for some, BIM is a method for designing and documenting building information. According to [4] , the true benefit of BIM is to offer correct information with great efficiency throughout the whole building life cycle. According to other, building information modelling (BIM) envisions a holistic approach to planning, constructing, and managing buildings, according to [5], is a procedure for managing the information generated during the lifecycle of an asset. As defined by [6], Building Information Modelling (BIM) is a technique that involves a collection of steps that are designed to produce, communicate, and analyse building models. AGC (2005) made the following statement.

BIM is a digital representation of the facility that is data-rich, object-oriented, intelligent, and parametric. It can be used to get views and data that meet different users' needs and analyse them to get information that can be used to make decisions and improve the facility's performance. As viewed from the management perspective, [7] said that "BIM (Building Information Model) is a method that comes from a lot of different policies, processes, and technologies." This technology is used to keep basic architectural design and project data digitally managed for the entire life cycle of a building, from start to finish.

According to [8] , building information modelling (BIM) is a technique, a process, or a product that can be used to generate a virtual intelligence model. In addition to promoting collaboration, visualisation, and constructability evaluation, BIM can also be used in conjunction with other construction management tools (such as timetable and estimated estimations) to provide benefits to all stakeholders throughout the facility's life cycle.

When it comes to this project, BIM will be used as a digital transformation in AEC based on the intelligent model for integrating information. There are many ways to say what BIM is. Also, a project management tool that tries to make sure that all of the people who work on a project work together for a long time, from when the project starts to when it's done [9]. A source of inspiration for this research was the existing level of uncertainty on the extent to which BIM will affect the project life cycle, encompassing the pre-construction, construction, and post-construction stages. DCFC also needs to be able to show that the BIM model can be used for a long time to help manage the stadium and run it as a facility.

## 3. Limitations of Traditional Constructions Plans

Before DCFC adopts the new BIM technology in developing the new stadiums it is vital to bring an understanding of how and why traditional plans may not be viable. Such a move is key in decision making in case DCFC ought to have traditional as a back-up-system. Besides DCFC anticipates benefiting from modern digital development systems and tools that will aid in creating a robust and cost-effective long-term environmental for fans and staff. Therefore, despite the long-term use and success in creating other old stadiums the call to unpack some limitations of traditional construction plans is inevitable. Such limitation includes.

### 3.1. Poor Documentations

Traditional construction plans, such as those created with 3D CAD software, describe a building in terms of independent views, such as plans, elevations, and sections, for example. In this manner, altering a single view has the unintended consequence of requiring the inspection and updating of all other views. The efficiency of the construction process could be improved if the construction papers, such as drawings, procurement details, submission processes, and other specifications, can be conveniently interconnected [10]. Given the high rate of mistake associated with this process, the 3D CAD plan is painted in a dismal light, and this is due to inadequate documentation [11].

### 3.2. Time Consuming

Aside from producing inadequate documentation, the independent view is also responsible for time wastage throughout the entire project cycle. A consequence of this is that the designer spends more time updating the plethora of lines that serve as the foundation of his 3D plan rather than concentrating on the creative components of the project, as is evident. In contrast to the use of BIM, such time wasted affects

overall productivity. It takes a long time and a lot of money to discover a structural design that is suited for an architect's ideas when employing conventional design approaches [12].

### 3.3. Lack of Stakeholder's Integration

Specifically, [13] stated that BIM has an impact on the traditional modes of operation of an organisation in terms of project delivery. Such a typical modus operandi has been identified as a contributing factor to project failure in terms of meeting established objectives as a result of inadequate stakeholder management. When stakeholders are not integrated into the decision-making process, there will be conflicts that will affect the entire project cycle. Therefore, due to a lack of stakeholder integration and consequent management, the building industry has been pushed to use BIM.

### 3.4. Over reliance on past experience

It is necessary for planners to draw on their previous projects and expertise in order to evaluate the construction sequence and come up with an appropriate construction strategy for a specific construction project. The authors of [14] asserted that, rather than standards and well-founded figures, generating building plans is mostly influenced by the past project experience of the planner and the construction manager involved. Obtaining a thorough understanding of the project's aspects and integrating the relevant information on their own is a significant task for the planners. Because personal experience is unreliable, placing too much rely on it exposes you to a significant danger of financial and time loss.

### 3.5. Unspecified project division

[11] argued that accepting responsibility for updating building information model data and maintaining its correctness implies a significant amount of risk. Once several BIM software packages have been integrated, it is vital to determine who will be in charge of controlling data entry and who will be held accountable for any errors [15]. Risk and liability are more likely to be increased as a result of the integrated idea of BIM since it blurs the degree of accountability so much. If there is a perceived design flaw in the DCFC project, it will be addressed. If the architect, the engineer, and other participants to the BIM process are all looking to each other in an attempt to discover who was responsible for the issue identified, it might be tough to figure out who was responsible for what.

## 4. Benefits of BIM in DCFC stadium In the Design Phase

### 4.1. Enhanced Visualization

A key component of BIM is the inclusion of tools that allow designers to see the many design features. In order to achieve radical changes in the conceptual stage of design, which is critical in ensuring project success from the search to tender stage, this type of visualisation must be used [12].The DCFC stadium is next to a business park that has recently been created on the edges of a tiny town on the outskirts of the M25 ring road, which connects London with the rest of the country. The sole odd component of this development is a big beautiful arch that will rise high above the closed roof. Enhanced visualisation is critical in determining which structural design will be most appropriate for the DCFC stadium project because there are numerous idea designs that can be implemented in this scenario.

### 4.2. Increased Accuracy

DCFC is expected to feature a high magnitude structure, with a projected magnitude equivalent to that of Wembley stadium, according to predictions. Therefore, maintaining accuracy may be a significant constraint. Although BIM offers promising and superior software such as Tekla, which is well-known for its accuracy in designing such large projects, it is not without its limitations. Tekla Structures allows for the modelling of reinforced concrete, precast concrete, main steel, and secondary steel structures. This greater precision provided the Baku Stadium engineers with a competitive advantage in terms of efficiency throughout the design stage, as they were able to deliver structural plans for 17000 tonnes of steel in only 8 months [27]. This is due to increased precision, and so technologies such as Tekla BIM can present a promising possibility for the DCFC.

### 4.3. Reducing Design Time

A key characteristic of traditional design tools, such as 2D CAD, is the reliance on the human element for the majority of resource-intensive operations during the design stage. To give an example, a large-scale project such as the DCFC may require the hosting of up to 80,000 people to sit around the football pitch. To ensure every one sit in the stadium to have a clear view of the stadium. In millimetres, the C Value represents the vertical distance between your line of sight and the eyes of the person in front of you. The C value of each individual must be at least 60, in addition to the large number of people, and the amount of space available for the stands must be kept to an absolute minimum [1]. It is possible that using a typical approach to compute such an operation will be complicated and time-consuming. When it comes to computational design software, BIM provides for the use of software that is preconfigured with optimization algorithms, which allows for the movement around of variable values such as step height. This fantastic functionality will enable designers to eliminate the need for manual calculations, resulting in significant time savings.

# 5. Benefits of BIM in DCFC stadium In the Construction Stage

## 5.1. Aids in Clash Detection

Many have linked the earliest concepts for the stadium to the Wembley Stadium in London, which was built in the same year. The construction phase of such landmark projects as the Wembley Stadium is considered to be a critical step in the overall project cycle. During this stage, the viability of the project plan is determined, and any discrepancy in this stage may result in poor project execution later. One of the disparities is the amount of conflict that occurs at this moment. It has been suggested that the use of BIM technology might significantly enhance the coordination process since it has the potential to discover spatial conflicts within the construction design, which are extremely difficult to detect when coordination is conducted using traditional 2-D drawings [16].

Because realistic models are available during this phase, it is possible to plan a coordinated sequence of phases, crews, and supplies to ensure that the construction process runs well. In this case, superior animation is used to ensure that a coordinated process and steps are followed, resulting in a predictable path for the intended outcome.

## 5.2. Optimizing Operational Procedures

Building a football stadium is characterized by its vast construction scale, complicated structure, and lengthy building duration. This necessitates the use of a sophisticated construction plan, technology, process, and coordination management to complete the project [17]. Consider, in particular, a massive, beautiful arch that will soar high over the closed roof of the DCFC stadium. The scale of the concrete formwork and the height of several beams employed in the project, which are both excessively high, may result in significant construction risks throughout the building phase. Real-time monitoring of on-site construction and construction drills using BIM technology can also be used to predict risk factors during construction, hence allowing for the prevention and elimination of potential safety concerns in advance [17]. Construction phases can be completed quickly and efficiently if a well-trained site team is available. This will result in a more efficient process. As a result, site engineers must guarantee that the site crew is properly instructed on how to employ paperless workflow. Another product given by Tekla BIM sight for 3D models is a training tool that makes it simple to instruct site employees. It is also a strategic tool for communicating the geographical diversity of participants in the project, which is important for communication.

# 6. Benefits of BIM in DCFC stadium In the Construction Stage

When completed, the Wembley Facility in London, which is now under construction, will be comparable in size to the DCFC stadium, according to predictions. Operational activities will consequently be required to account for a significant portion of the project cycle in order for it to be successful. BIM is a good technique that DCFC can consider using in order to ensure that the organization accomplishes its long-term objectives of ecological sustainability and economic effectiveness

## 6.1. Long-term cost-effectiveness

The concepts of time and cost are two of the most fundamental aspects of construction.The ability to reduce these elements is what determines the long-term success of the projects. [18] proposed the interoperability of BIM in a stadium project in China. A case study about a stadium construction project in Guangdong Province, China has been study. Navisworks was able to assist the construction team in conducting conflict detection tests, identifying a high number of conflicts in advance, and collaborating with project engineers to assist the team in resolving those conflicts [19]. When components in Navisworks are assigned a timetable, [18] recommended that components developed at various times appear in a sequential order. Equipment such as tower cranes, lorries, and other such items were also included in the simulation to aid in the analysis of site layout and space congestion problems. It has been established that the construction progress simulation may be carried out, and the efficiency of the construction process has been enhanced [18].

BIM makes it possible to use tools such as Kreo to ensure that every part of a project is kept under tight control. With the help of Artificial Intelligence (AI), Kreo can assist project managers in streamlining post-occupancy operations by running what-if scenarios and making informed decisions as a result [26]. After the building stage is completed, BIM can continue to provide assistance in the area of facilities management. [20] developed a system for managing and maintaining facilities that is based on building information modelling (BIM) and radio frequency identification (RFID) technology. Using an Industry Foundation Class (IFC) data structure, a facility maintenance database, and an RFID reader, the suggested system is capable of connecting a BIM model to a handheld screen while also displaying data that is accessible through the internet on the screen. The system is deployed in a football stadium building maintenance case study in order to validate the proposed system and demonstrate its usefulness in the field of stadium maintenance administration. Building information modelling (BIM) allows users to access installation materials and maintenance information gathered during the building system's early design and construction stages. The facility management system can be used in a variety of applications by the facility management professionals. Using BIM as a platform for knowledge sharing, [21] proposed a knowledge-sharing system that can be used by facility managers and their maintenance teams to ensure that all systems operate as intended.

## 6.2. Sustainability Benefits

The energy consumption of a building on a daily basis is considered to be the most important factor in its overall efficiency. Using the Al Shaab stadium in Baghdad as an example, [22] provided a case study. The results of the study demonstrate that solar energy gains influencing the building were explored with the assistance of the Building Information Modeling (BIM) tool. Calculations of energy gain and loss were performed based on environmental data. Beyond enabling the building of energy-efficient models during the operations phase, Building Information Modelling (BIM) ensures that plans for renovation and maintenance are in place that advocate for the utilization of renewable energy sources [28]. BIM provides an ideal opportunity to include sustainable measures into a project throughout its many stages since it allows multidisciplinary information to be layered and collected into a single model [2]. As a result, BIM includes software such as eQUEST, which is used to anticipate the future power consumption of buildings and can be quite useful in the case of DCFC.

As an example, [23] used advanced concepts of sustainable architecture to incorporate into the design process of the Amazon World Cup stadium construction project case, highlighting the rainwater harvesting system - water will be captured by gutters on the roof, stored in reservoirs, and used for lawn irrigation and bathroom flushing. When it came to building information modelling in 4D (4D BIM), the management team opted to first show the project in 3D using ArchCad and Google Sketchup software, and then integrate the 3D and 4D models with Microsoft Project to achieve the fourth dimension (3D plus time). The use of BIM can assist construction teams in better defining logistics, identifying disruptions, doing accessibility checks, running scenario simulations, and creating work status views. Building information modelling (BIM) has been proved to be useful in the construction of green buildings during the early design stages, leveraging information from the building industry as well as numerous energy efficiency evaluations. Building information modelling (BIM) can transform a 2D-based design into a 3D-based design, as well as produce and manage all of the information generated throughout the construction process. It can be used to give previous review, cost estimation, quantity takeoff, and energy analysis throughout the design stage of a

structure [24]. So here can draw the conclusion that BIM may assist in the completion of building projects that employ continuous design practices. The DCFC Stadium may refer to the sustainable design of Amazon's World Cup Stadium to carry out a similar roof gutter design and then apply it through BIM in order to meet sustainable aims, even though London's annual rainfall and humidity are not as good as Amazon's.

# 7. Downsides of BIM Implementation for the Case of DCFC Project

## 7.1. High Implementation Cost

Despite the numerous benefits that can be derived from BIM implementation, there is a significant financial investment required. This includes the expense of the high-end hardware and software that was used. Furthermore, each BIM working station incurs additional costs for backup and server infrastructure. Structures and installation modelling, as well as architectural design, require a large amount of labour for BIM to be successful [12]. Hiring such a large workforce will necessitate significant financial resources, which will be borne by DCFC.

## 7.2. Designer Education Cost

The team's effectiveness is defined by the efficiency and quality of the task force's work, which are both important factors. It is possible that if this task force is not familiar with BIM, it will have an adverse effect on overall productivity as a result of delays in the project's execution [25]. It can even become enmeshed with the condition of a precipitous drop in production in some cases. It is possible that the construction of the stadium will be delayed, particularly if the designers are not adept in BIM. The deployment of BIM technology necessitates the development of skills in the creation and manipulation of models.

However, due to a lack of BIM understanding, the majority of the participants are unable to correctly employ BIM technologies, as a result of their inexperience. They are accustomed to capturing data using traditional ways that are familiar to them. Because the data's format is incompatible with the model, it cannot be entered directly into the model. It is required to receive BIM training in advance, which raises the expense of education in the short term. Education and training are required for the wealthy BIM operators, and this will result in a significant financial outlay. Because of this, DCFC must invest in staff training, which is costly and would provide results only once the entire BIM technology is prospectively applied in its entirety on large construction projects.

## 7.3. Inadequate Regulation

Despite the widespread usage of BIM, laws and regulations to define and supervise BIM are still in their infancy in terms of their clarity and effectiveness [12]. In the stadium project, the BIM standards and formats used by different project participants, such as designers, investors, and builders, differ from one another. They each have their own opinions about the format and level of detail that should be included in the architectural models during the connection process. Conflicts may arise during the delivery process if a standardized BIM format is not used. These disagreements may result in an extension of the construction period or the occurrence of construction faults. Conflicts can be avoided if proper planning and formulation of the BIM format are done in advance.

# 8. Conclusion

Diamond Castle Football Club (DCFC) expects integrating Building Information Modeling (BIM) technologies as commercial enterprises strive to capitalise on modern technologies as tools for securing competitive advantage. Following a discussion of the definition of BIM and a comparison of BIM to the traditional construction approach, this paper considers the consequences of implementing BIM in the context of the DCFC project. According to the findings, despite a few restrictions, BIM provides numerous benefits for projects throughout their life cycle, from conception to post-occupancy. Furthermore, this paper ensures environmental sustainability while also ensuring long-term cost-effectiveness.

The employment of traditional construction methods has proven to be a source of project derailment in the AEC industry. Some of the observed drawbacks include inadequate documentation, the need for

extensive time investment, a lack of stakeholder integration， over reliance on past experience and unspecified project division. Traditional building processes have difficulty in assuring data correctness, and a lack of coordination across teams results in conflicts between diverse groups of people.

When compared to traditional ways, BIM technologies are far more appropriate tools for supporting the DCFC stadium project management process. As a result, this cannot be used to assist in the execution of the DCFC project because it is not feasible in terms of achieving their long-term goal. The use of BIM in the construction of the DCFC stadium has several 7 advantages at several stages of the project's life cycle, including the design stage, the construction stage, and the post-construction stage.

It is possible to improve the accuracy of construction project performance while also shortening the design practice time. BIM can aid in the detection of clashes during the construction stage and the implementation of a predictable and coordinated process. The optimization of operating procedures might also take place at the same time. Developing Information Modeling (BIM) can also help DCFC achieve long-term cost-effectiveness and sustainability while building a new stadium.

However, if BIM is used in the stadium development process, it has demonstrated to have positive implications. This is true for all three stages of the stadium building process. One or more of the anticipated benefits is improved visualization; higher accuracy; decreased design time; assistance in clash detection; streamlining processes; assuring long-term cost effectiveness; among other things. Although BIM deployments have many potential benefits, they are expensive, necessitating a significant upfront commitment in terms of money and time.

## 9. Recommendations

About the analysis of the befits and downsides of implementing BIM, DCFC should undertake the following measures.

In recognition of how unusual it will be from other stadiums; a massive arch will rise far above the roof of DCFC Stadium when it is closed. Construction BIM is used in conjunction with Geographic Information System (GIS) to represent the spatial data of the site and of the planned building in order to improve Visualization and to aid in Clash Detection throughout the construction process.

For the purpose of ensuring the cooperation of different construction departments in order to eliminate the absence of BIM related application knowledge background, it is advised that DCFC ensure training of staff and all participants on BIM technologies and applications. Meanwhile, DCFC can establish a Stakeholder Management Committee to ensure collaboration throughout the duration of the project.

Consider the significant training expenditures and software license prices connected with the use of BIM to participate in construction planning arrangements, as well as the significant time commitment required. It is recommended that DCFC submit a draught considering a proposal to prospective funders to verify that the project has sufficient funding to proceed.

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