Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 2, February 2025

The 5D Building Information Management Implementation by Quantity Surveyors in the UK

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Abstract— **This research seeks to study the incorporation of the QS function and practice into the BIM 5D system to allow greater reliability of 5D BIM and to give a systematic approach to the integration of QSs into the BIM method to enhance the implementation of 5D BIM. In this study, mixed methodology and semi-structured interviews were utilized in the case study of BIM in the construction sector, specifically BIM 5D, which is focused on the cost aspect of the projects. This study combines a literature analysis with semi-structured interviews and a mixed methodology. The literary review compiles and questionnaires were sent to participants with experience in using the BIM 5D survey, and semi-structured interviews followed with the participants in the case study, quantity surveyor consultants, BIM consultants, project managers consultants on perceptions of the benefits and obstacles that prevent the implementation of BIM 5D. A mixed method has used a mixture of qualitative and quantitative methods and semi-structured interviews. The questionnaire was presented by offering 10 questions through a survey questionnaire. The answers to the questionnaire were done by 40 participants with experience in the field of construction. The answers were analyzed, and the answers were uneven analyzing the results through a Graph of the data, and approximately 70% of their answers were in agreement with the questions been asking. Three semi-structured interview case studies were questioned. The questionnaire was presented regarding BIM 5D digital cost estimation, and its management would accelerate future construction projects in terms of cost estimation. The performance of the respondents was useful and will be taken into consideration and deeper in its study and analysis. Results indicate through a survey The opinion was that the majority of the principals agreed that the use of BIM 5D by increasing the efficiency and visualization, in addition to, In addition, it is possible to achieve other advantages such as improving value management services for the client and rapid identification of design changes, which facilitates the process of implementing the project in record time and saves time and money, and we do not forget that the construction sector suffers from difficulties and obstacles through the work of Qs in terms of estimating its cost Building materials, and after BIM 5D entered the world of construction and was used mainly, the work of QS became easier than it was in the past.**

Keywords— **BIM 5D; Quantity Surveyor; Construction industry; Project management; UK.**

I. INTRODUCTION

BIM technology refers to the creation and implementation of n-dimensional software models. (n-d) To iterate planning, designing, building, and using it, it helps designers and engineers visualize what will be built in the virtual world and determine the design or construction. BIM was discovered back in the eighties of the last century. Cost estimation elements are now easier than they were in the Previous by BIM 5D Elements of cost estimation are made possible by BIM 5D including design visualization, quantitative take-off acceleration, and cost-effective estimate generation and measurement. BIM 5D has tremendous advantages for enhancing cost-estimating practices but faces some difficulties through incompatibilities between BIM model development Also, guidelines for estimating the cost of QS, and some data exchange issues. There are challenges facing QSs one of the most important duties of QSs is to check the BIM 5D model for accuracy. The lack of details and missing data in BIM 5D models lead to design errors and miscalculations.

A. BIM in the UK construction Industry.

The building, architectural, and building (AEC) industry has recently begun to pay close attention to building information modelling (BIM). The term "BIM" refers to the creation and application of software, n-dimensional (n-D) models that replicate the planning, design, building, and use of a facility. It assists designers, engineers, and builders in visualizing what will be built in a virtual world and in identifying potential design, building, or organizational procedures (Azharet al., 2010). The idea behind building information modelling, according to Smith (2007), is to construct a structure digitally before doing so physically to solve difficulties and analyze and evaluate potential effects. BIM is defined by Succar (2008) as "a set of interacting regulations, processes, and technology providing a strategy to govern the fundamental construction design (Ranadewa,2013).

B. BIM levels.

The BIM'S history Before the 1980s, the Architectural, Engineering, and Construction (AEC) industries usually used hand-drawn, alphabetic designs on parchment, employing drawing boards, T-squares, and pencils, to describe building elements in symbolism. Early in the 1980s, as computer technology advanced, designers started utilizing inverse kinematics CAD (Woo, 2007). Building, Information, and Modelling, or BIM, is a three-letter abbreviation that was created by architect and Autodesk building industry consultant Phil Cohen in 2002. (Beck, 2008). However, according to Eastman (1999 as quoted by Fanous, 2006), who claims to have invented the BIM concept at Georgia Tech University's College of Architecture and Technology, Chuck Eastman might be credited with having done so 30 years ago. Construction product model" is the phrase. "The delivery of rich, relevant data from conceptualization to design to the construction and deconstruction of a structure over its life

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 2, February 2025

cycle," was how Eastman defined a building prototype. There continues to be debate over whether BIM is a new age that will revolutionize nearly everybody in the construction and construction industries. BIM has delivered a new phase for the industry (Neeley, 2010) (Ranadewa,2013).

The high quantity of input data that characterizes construction activities must be taken into consideration throughout the entire construction phase. BIM enables efficient and quick handling of data. A digital or informative model begins out with plenty of data. This is a fundamental premise for how it will be used moving forward at every stage of the project. BIM has a wide range of dimensions that supply accurate geometric representations of objects in a three-dimensional environment. The fifth dimension of the building information model, or 5D BIM, which is produced by finance, is one of these. As a technology, BIM enables improved program budgeting and assists 5D in tracking the precise resource requirements in each stage of a life cycle. As a result, funds are constantly monitored. 5D comprises more than just calculations and cost estimates. The overall 5D model depends on how well its components were processed. It is built on a 3D different parametric model, based on which a quantity bill can be produced and exported. This quantity bill contains all anticipated materials, structures, and objects (Mandičák,2019).

The 4D-BIM model now includes a 5D BIM model which is 'cost'. Each geometric detail in a 3D-BIM model is data required to carry out a mainly focused Each activity is represented in a 4D-BIM model. required to finish the job. By adding a price by connecting databases to the 4D-BIM model and using an actual 5D-cost BIM for materials, equipment, and labour the model could be produced to give the building crew using a practical tool. The instruments used in Using the availability of 5D-BIM models date back less than ten years. The created 5D-BIM model can be used by construction specialists to quickly provide feedback about a company's costs, allowing the designer to adjust the proposed project to fit the budget. Whenever the project cost is anticipated to be greater than the owners can afford, the converse situation commonly happens in the construction industry, resulting in significant design adjustments and perhaps the loss of the most eye-catching features of the design. When analysing the company's budget, the 5D-BIM model can provide owners and interior designers with more insight, fostering trust among the program's various stakeholders. Additionally, projects utilizing 5D BIM could eliminate the requirement for a considerable contingent on the part of the client (Sattieni,2014).

Kehily, McAuley, and Hore (2012) suggest using 5D BIM software tailored specifically for the QS field since they believe it offers a reasonable medium cost for LCC. The LCC computation structures and language can be transferred to the 5D BIM system after the quantities have undergone post-processing (similar to Capex estimation). among the top 5D BIM estimation programs, like Exactal CostX and Nomitech CostoS, provide us with an inbuilt customization capability that enables users to add sections and functionalities to the program's standard spreadsheet. Theoretically, consumers might modify cost information using spreadsheet methods to account for the extra LCC factors that are difficult to separate from the models. Theoretically, a 5D BIM system may use this approach to handle the stochastic LCC computations. The system would be grounded in current LCC methodologies by defining a calculating approach in a spreadsheet or database that could be implemented into 5D BIM, as suggested by current LCC methods (OGC, 2007; BSI/BCIS, 2008; RICS, 2014) (D and J,2017).

C. BIM Advantages.

According to Gee (2010), BIM is a multi-dimensional approach with capabilities for 3D modelling, cost estimates, planning, and scripting that serves as a communication and collaboration method throughout a construction project. Elements of cost estimating are made possible by 5D BIM, including design visualization, quickening quantity take-off, creation of an accurate and efficient cost estimate, and measurement (Jiang, 2011). BIM technology will continue to advance and gain popularity; therefore, quantity surveyors must work more quickly while still increasing production work. The QS industry now faces fresh difficulties as a result of this circumstance (Esa2, Comparing the estimating task of QS to the traditional paper drawings, the BIM 5D characteristic of cost estimation with building model integration makes it simple. The building industry is moving toward digital construction thanks to BIM 5D Soon, et al. (2016) released a BIM 5D implementation methodology for consultant QS businesses in a country's development through the International Organization of Quantity Surveyors Convention Paper. The framework has not yet been verified; however, it could provide consultancy QS with some basic guidelines on how to improve their BIM 5D understanding and corporate strategy when implementing BIM. The major applications using BIM 5D in QS practice are presented (Puidin,2018).

According to industry terminology, BIM 5D is the connecting of 3D model elements to a fifth dimension (cost) inside a digital information environment. Consequently, the responsibility of the 5D BIM QS will be to comprehend how well a model, along with its characteristics as well as other data, will be formed and communicated at various stages during a project to initiate needed modifications to quantities, rates, and certain other incidental cost adjustments at each stage of work as necessary. It is unproductive and incredibly expensive to nearly exclusively use a spreadsheet for cost management of large, complex operations. Using the standard procedures for conceptual design, QTOs, quantity insight into a worksheet, and rate implementation to generate an estimate will undoubtedly require a variety of different applications and information deceits to generate precision, if any, and will have numerous negative effects when decided to apply along a spectral range of cost consultants, increasing the probability of risks. The utilization of connected technical software methods employing automated digital quantification 5D BIM to enable the team members to operate on the same information source is a significant departure from the status quo (COUCH4, 2016).

The cost control services provided by QS are crucial for the building sector. A conventional QS's primary responsibilities include taking off, creating bills of quantities, and estimating and costing building projects (Raphael & Priyanka, 2014). When it comes to the huge range of services that QS is needed to deliver, BIM enters the picture, promising a greater accuracy rate and fewer errors thanks to its descriptive data that is pre-built and makes it simple to capture numbers when QS is

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 2, February 2025

underway. Quantities may be extracted from 3D models thanks to BIM 5D. BIM 3D model, BIM 4D project schedule, and contractual pricing are all included in 5D BIM. With the assistance of this tool, amounts can be automatically generated, saving both time and money when generating estimates or bills of quantities. BIM gives the QS the ability to calculate quantities like quantity and total surface area that become precise enough for estimating needs even during the program's design phase. As the model is developed, more specific values are now being extracted to create the foundation that may be required in the future (Raphael & Priyanka, 2014) (Qian,2019).
BIM 5D is used throughout a project's life cycle as an important information source, not just when it comes to building. In the cloud database, for instance, BIM makes it simple to exchange and update the drawings and requirements, and BIM 5D then produces more reliable and accurate cost estimates. To move information between multiple disciplines more quickly and easily and to cut down on errors or pointless work, BIM platforms offer a fluid flow of data exchange across participants. A participant-friendly budget and the status of the building project can also be clearly displayed using 5D BIM Additionally, BIM 5D can be used to quickly analyze and make early decisions about alternative designs. In other applications or software, BIM 5D frequently carried out cost control and financial estimation. By including relevant data and resources during the design phase, 5D BIM can improve the monitoring of project expenses both in the short and long term (Kaboli,2020). According to Baldwin and Jellings (2009), 5D can automatically analyze all components and materials and extract appropriate quantities from the design. According to Eastman et al. (2008), BIM 5D supporters are highly helpful for VM since the quick response time of BIM 5D software provides a great possibility to do VM all through the design stage. Integrated Construction Company, according to Baldwin and Jellings (2009), used BIM 5D to create large monthly payment requests, account reconciliation, and estimates (Ranadewa,2013).
According to Mitchell (2013), the BIM 5D objective during design is to develop a living expenses plan that presents a clear structure for making early cost considerations that have the greatest influence on the results of the program. This is especially true for models and recommendations for sustainable construction that have longer service effects. Using the most recent model data, the costs of the living plan have to be enabled to be updated and distributed (on a regular, biweekly, or monthly period). The BIM 5D goal throughout development includes offering a clear framework for awarding and managing contractual agreements. As the model's Phase of Development (LOD) advances and serves as the foundation for quantity take-off, the model map that generated the cost management plan becomes much more comprehensive. The model diagram that produced the cost plan will become more informative as the prototype development stage (LOD) advances and serves as the foundation for quantity take-off for allowing tender documents, the appraisal of variants, scope changes, and payment schedule during construction, as well as substitute work during the construction process. After construction, the BIM 5D objective is to produce a cost-integrated "as constructed" version that can be synced with the FM systems to transmit replace prices, baseline dates, anticipated and actual lifespan, and estimate operating and maintenance expenses (Smith,2007). To generate a relevant cost estimate or cost plan, Jellying and Baldwin (2009a) emphasize the significance of creating a properly built BIM 5D model. According to McCuen (2009), RICS (2009), and Kiviniemi et al. (2007), the degree to which the proposal has been described to the quantity surveyor, the quality of the information provided, and the specifics of the construction techniques displayed in the specifications and drawings by the designer all play a role in the accuracy and reliability of BIM-based estimates. The precision of BIM 5D-based cost estimates is also influenced by how well-constructed the assembly and items are in the model (Sabol, 2008).

D. BIM Disadvantages.

Using standard BIM 5D technology in the industry generally presents some difficulties, and despite their excellent pricing and estimating abilities, BIM 5D solutions do not eliminate the requirement for a proper estimating format (Eos Group, 2008). The quantifying data from such BIM tools can be exported to a Microsoft Excel spreadsheet (Eastman, 2011), and the QS will then need to convert it into its own estimating format. Additionally, according to Eastman, BIM 5D models and papers currently lack the ability to capture "intellectual assets" like site circumstances, general requirements, and indirect costs, as well as work instructions like means and techniques of the building (2011). Sawhney (2016) has stressed that the QS should evaluate the BIM 5D model as a result. regarding completeness and consistency, since cost estimates may only be as accurate as the specific information or data provided to the QS, which, if faulty, can produce incorrect data (Stanley, R., and Thurnell, D., 2013). Furthermore, the element specified by the designer affects the precision and quality of BIM 5D estimations (McCuan, 2009). The constraints within the sector that hinder a comprehensive deployment are another issue the UK industry is encountering with the Adoption of BIM 5D. Among the main obstacles are the high application fees, the absence of national standards, and the shortage of qualified employees (Liu et al., 2015). Many small businesses believe it would not be worthwhile to spend more money on upgraded ICT systems and training at this time (Steve R,2014) (Robinson,2013).
BIM 5D has tremendous advantages for enhancing cost-estimating practices, but the technology also presents certain difficulties. The difficulties typically go together with the mismatch between both the BIM model development and the information quality of the BIM 5D technology the QS cost estimating guidelines and a few data exchange issues (Ismail,2017). By Monteiro and Martins (2013) The QTO procedure cannot be entirely mechanized the building cannot be "accurately represented" by the model. The fact that it is important to maintain a delicate balance between the amount of graphics detail required to the ability to generate precise quantities and the usefulness of current software applications as well as the data sets develop in complexity. Because of these problems, it is difficult to rely on these difficulties for precise cost estimations when using BIM 5D in QTO (Wang et al., 2014). The creation of a knowledge-based strategy to deploy QTO was mentioned by Aram et al. in 2014. Out of a BIM 5D the creation of a body of knowledge that enables rules to be

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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implemented to artefacts to develop an understanding of the product and how it can be measured, mentioning that the geometric model itself frequently does not contain the correct LOD information to instantly automate the QTO process. In agreement with this strategy, Rajabi et al. (2015) found that the problem of inadequate model detail might be resolved by enabling the consumer to take off where appropriate and add more details. Within the BIM 5D (Oloke,2020).

The immediate cost allocation on the construction process can be approximated by connecting the timetable loaded QTO list with the external system, which includes equipment, personnel, and the cost of materials. It is also necessary to include some other estimated costs such as materials hoists, overhead cranes, and scaffolding that cannot be directly related to each part of the project. To determine the entire project cost, it is necessary to factor in some indirect expenses such as monitoring fees, maintenance charges, bonding or insurance, etc. To generate a BIM 5D model and perform a BIM 5D simulation, the chronology file can be modified to include the cost data and loaded into a BIM 5D software system. The 5D BIM model, however, neither provides nor accurately depicts a program's actual cash outflow or inflow. as opposed to taking into account income trends and the actual payments made by contractors, since it is focused on the contractor's anticipated daily consumption on the building site. In light of this, cash (Cheng,2016).

Depending on how well the project has indeed been described to the QS, the precision and complexity of BIM-based estimates will vary (McCuen, 2009). One of the biggest problems QSs in the field face is the lack of data in BIM models is known as the building information model. Essentially, this occurs as a result of the designers' portrayals (either 2D or 3D models). Because QSs can only expense the information they have been given, it is very difficult for them to estimate costs in other ways. Important because BIM models include the data needed by a QS to create accurate estimates. It is difficult to get complete information from architects and other design professionals because of the opportunity for designer responsibility, and their BIM model (Smith, 2016). The Royal Organization of Chartered Surveyors (RICS) also has emphasized that one of the most important duties for QS is to examine the BIM 5D model for precision and especially in situations; however, it has been confirmed on multiple occasions that the prototype does not encompass the necessary data to support model-based quantification and QTOs (Smith, 2016) Stanley and Thornell (2013) have pointed out this problem, stating that lack of detail and missing data in BIM 5D models lead to design mistakes and erroneous estimations. Additionally, the design data generated by BIM 5D software solutions are insufficient for use in cost estimation. However, it is crucial to emphasize that designers must refrain from integrating data in the manner they see fit because it could Information may result in poor judgment and exaggerated program estimates (Sabol, 2008). According to Wu et al. (2014), BIM 5D models that lack the data that QS needs to provide precise cost estimates may be difficult to manage and search for the data inside the model. Therefore, it is essential to first determine the information required that will be needed to support the cost evaluation process (Cox,2019).

E. Quantity surveying practice in the UK.

The technique of quantity surveying is reliant on BIM's fifth dimension (5D). The construction schedule (4D) and the contractual rate (cost) for purposes such as quantity surveying are combined to create the 5D BIM. It boasts a building's efficiency about the cost of building. Because quantities, take-offs, and counts are done automatically from the models by BIM, preparing an estimate can take less time and money (Olatunji et al., 2010; Wijayakumar & Jayasena,2013). It offers a quicker way to analyze data and create cost estimates by doing away with tiresome manual take-off and estimation errors caused by people. Compared to the conventional manual taking-off procedure based on drawings, BIM can provide many benefits. All design perspectives have to be manually revised and modified when changes are made, which takes time and increases the chance of error. When done manually, adjusting the amounts to accommodate the design changes takes a considerable lot of time and work. It would be up to the QSs to continually check what has been added, changed, or taken away. This laborious approach has serious consequences if the changes weren't recognized. BIM has an added advantage over CAD in how it handles design change because of parameterized change technology, which coordinates changes and preserves consistency when changes occur. A modification made in one drawing view will be reflected in all subsequent drawing versions as well. It permits the QSs. to quickly recognize design modifications and promptly update the quantity changes as the design is modified (Rahim3,2014).

F. Challenges facing QSs.

BIM 5D models often fall short regarding quality and data when compared to the requirements of quantity surveyors. Managing and finding the necessary data within the models for the production of cost estimates makes it tough for quantity surveyors. Debates then start to emerge over the data that quantity surveyors will need access to in BIM models. To improve the application of BIM 5D for cost estimating, each of these elements must be carefully considered. Sabol (2008, p. 2) urges the necessity for standards and procedures to support the amount of design data that is required for useful estimates" as well as a "framework" to ensure that data is entered into the BIM elements consistently for a project (Wee,2014).

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G. QS & BIM 5D.

5D BIM QS will be to comprehend how well a model, along with its characteristics as well as other data, will be formed and communicated at various stages during a project to initiate needed modifications to quantities, rates, and certain other incidental costs and adjustments at each stage of work as necessary. It is unproductive and incredibly expensive to nearly exclusively use a spreadsheet for cost management of large, complex operations. Using the standard procedures for conceptual design, QTOs, quantity insight into a worksheet, and rate implementation to generate an estimate will undoubtedly require a variety of different applications and information deceits to generate precision, if any, and will have numerous negative effects when decided to apply along a spectral range of cost consultants, increasing the probability of risks. The utilization of connected technical software methods employing automated digital quantification 5D BIM to enable the team members to operate on the same information source is a significant departure from the status quo (COUCH4, 2016).

Comparing the estimating task of QS to the traditional paper drawings, the BIM 5D characteristic of cost estimation with building model integration makes it simple. The building industry is moving toward digital construction thanks to BIM 5D Soon, et al. (2016) released a BIM 5D implementation methodology for consultant QS businesses in a country's development through the International Organization of Quantity Surveyors Convention Paper. The framework has not yet been verified; however, it could provide consultancy QS with some basic guidelines on how to improve their BIM 5D understanding and corporate strategy when implementing BIM. The major applications using BIM 5D in QS practice are presented (Puidin,2018). The high quantity of input data that characterizes construction activities must be taken into consideration throughout the entire construction phase. BIM enables efficient and quick handling of data. A digital or informative model begins out with plenty of data. This is a fundamental premise for how it will be used moving forward at every stage of the project. BIM has a wide range of dimensions that supply accurate geometric representations of objects in a three-dimensional environment. 5D BIM, often known as the building information model's fifth dimension, is finance, is one of these. As a technology, BIM enables improved program budgeting and assists 5D in tracking the precise resource requirements in each stage of a life cycle. As a result, funds are constantly monitored. 5D comprises more than just calculations and cost estimates. The overall 5D model depends on how well its components were processed. It is built on a 3D different parametric model,

This study aims to investigate the significance of integrating the role and practice of quantity surveyors (QS) to enable and prepare and respond to BIM 5D technology and to develop a comprehensive and coordinated strategy for QS to enhance the implementation of BIM 5D technology at a lower cost, as time and cost are two critical elements in project delivery. Additionally, this area of research identifies errors in initiatives early, which is advantageous for both the QS and the client. Numerous research projects examine the significance of quantity surveyors implementing BIM 5D and how it complements the function of the cost of the project administrator as a crucial and competing approach to making a financial decision. And enable cost and schedule estimation, but it could also aid in the easing of other factors. Example of the value of utilizing the procedures listed underneath to analyze cash flows before beginning construction, QTO planning estimates operating costs, cost life cycles, and their estimation. BIM 5D can quickly produce estimates of quantities using various 3D BIM technologies, and when combined with 4D scheduling, it can create a 5D financial plan. It can also help QS explore design options early in the project. Through this study and the helpful data and advantages offered by this study the construction sector, quantity survey necessities for the use of BIM 5D can be met. Additionally, the current construction council in the United Kingdom is aiding all government agencies in creating high admittance strategies, and BIM 5D methods can be established by groups in the construction companies small and medium. This research aims to investigate the impact of using BIM 5D on construction project cost, explore the BIM 5D implementation addressing advantages and disadvantages, address the problem facing quantity surveying practice in the UK, identify the implication and barriers lay behind implanting BIM 5D, compare projects using traditional surveying method versus BIM 5D and to outline the benefits of using BIM 5D for small to medium size project.

II. METHODOLOGY

According to Given (2008) The methodology of any research study. The research study serves as the foundation since it gives the justification for the actions performed to conduct this study. issue. Accordingly, the objective of This research approach aims to give reasons for selecting the research approaches for their examination in this research aims of it. Consequently, this methodology talks about determining methods for the identification, processing, or Data interpretation and analysis. Searching was done with many approaches the study methodology and results of this study will be discussed. the method that will be used for gathering data for this study's investigator. It will be used in this investigation for interviews and a survey using mixed approaches. As Given that findings are inherently objective, they could be utilized for lucid scientific proof, typically given in the form and graphs (Shibani et al., 2021, Agha et al., 2021). combines mixed methodology including the collection and evaluation of quantitative and qualitative data. These techniques can each

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 2, February 2025

answer a separate set of questions, thus merging them can produce more understanding and depth thorough answers. Because it combines the advantages of both methods, you can acknowledge and study the results more clearly and in-depth. Through these benefits, the mixed methodology of this research was identified, which can assist you to obtain a more comprehensive view than a stand-alone quantitative or qualitative study (Agha et al,. 2022)

This study used semi-structured interviews and a web-based questionnaire survey using JISC/BOS online survey. Because this study is limited to the UK construction industry, needs to get precise opinions and in-depth understandings of "what is the present situation of the Adoption of BIM and "how Can sophisticated BIM 5D capabilities be used in the UK construction industry in a real-world setting? A mixed method approach is primarily used, combining questionnaire surveys for quantitative results with interviews for in-depth contextualize understanding (Creswell et al., 2004).

Mitchell Brandtman is chosen by a construction industry expert from several institutions, including the Royal Institute of Chartered Surveyors (A), the Royal Institution of Chartered Surveyors (RICS), and the UK Institute de Quantitative Analysts (AIQS). The web-based survey consisted of 10 questions and was created to investigate the following three crucial areas of knowledge of BIM 5D and its present status perceived benefits and obstacles to BIM adoption and current level of preparation for the adaptation of BIM 5D technologies. Before conducting the main survey questionnaire, a pilot study was carried out to check for incorrect questions, ambiguity, and any problems in answering (Polit et al., 2001). Follow-up semi-structured interviews occurred after the completion of the questionnaires (Zhang and Hui,2016).

There are two primary approaches to sample selection: stochastic and non-probabilistic (Acharya, Prakash and Nigam 2013). The quasi-sampling method selects individuals randomly, but the stochastic method gives each member of a demographic an equal opportunity to be selected (Etikan, Musa and Alkassim 2015). A non-probabilistic sampling technique was adopted for this study due to the investigators' minimal experience in the field and accessibility to possible interview subjects. The mixed method can be divided into three primary categories: deliberate sampling, sampling techniques, and convenience sampling techniques. The interviews for this study were conducted using a deliberate sampling technique. Participants were selected using this method based on their familiarity with and previous experience with the original study subject (Morse 1991) (Agha et al., 2021). Employment size model and the purpose of picking participants for this research is to select people who work in the field of construction in the United Kingdom from civil engineers, quantity surveyors, and managers in construction companies who are aware and knowledgeable in how to implement BIM 5D by quantity and how to adopt BIM 5d in terms of cost to be able to give analytical information and critical points of view for the research to recruit participants with experience in the subjects of the study, a Google search was conducted to identify and identify companies that submit proposals about it BIM 5D together Qs in terms of cost and design, And the identification of large companies that have a long history in the field of BIM, and they were contacted via e-mail to obtain their enthusiasm for an organised interview. Within the disciplines, par selected as participants were sought. in the majors of quantity surveyors, BIM consultants, and project managers (Shibani et al., 2021).

III. DATA COLLECTION AND ANALYSIS

A. Questionnaire Analysis

The questionnaire used in this research is a list of questions used to collect useful data and information from the participants in the survey about their attitudes, experiences, or opinions. It includes written questions and semi-regular interviews.

Q1. Do you agree with BIM 5D implementation dis in Design visualization, and precise cost estimate?

In order to understand the degree of the impact of BIM 5D on design depiction and cost estimation in projects, I have opted quantitative method and descriptive statistics analysis for the above-mentioned question 1, this sort of issue was chosen in order to conduct objective research to determine the responses to the question posed in the research.

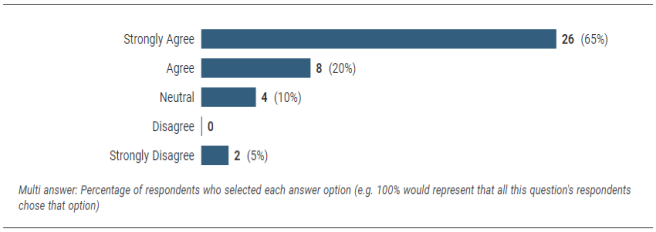

Figure 1: The implementation of BIM 5D

As The results chart in Figure1 showing displays the respondents' opinions, with a value of 85% agreeing, 10% viewing them as neutral, and 0% being the respondents' response rate. They are at disagree Additionally, 5% of respondents said they strongly disagreed This indicates that most of the respondents support the use of BIM 5D in design perception and cost estimation.

Q2. Do you agree with the help of BIM 5D amounts can be automatically generated, saving time and money?

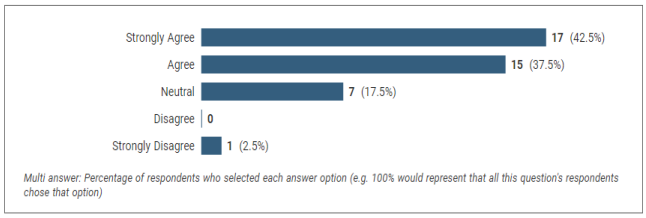

Figure 2: Helping of BIM 5D amounts can be automatically generated, saving time and money

Where the chart demonstrates that 80% of the respondents believe that BIM 5D quantities can be made automatically, which saves time and money in building projects, the chart clearly shows 17.5% of the respondents' answers perceiving them as neutral, with 0% being the respondents' response rate. They disagree. Moreover, 2.5% of respondents expressed severely strongly disagreeing with the This shows that 80% ofrespondents concur that using BIM 5D will result in project implementation savings in terms of both time and money.

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Q3. Do you concur that BIM 5D's Lack of integration reduces the model's effectiveness and dependability?

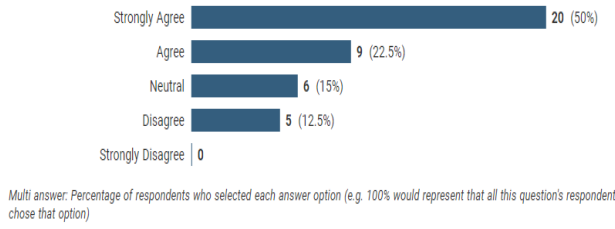

Figure 3 BIM 5D Lack of integration reduces the model's effectiveness and dependability

Where the graph demonstrates that 72.5% of respondents agreed that the absence of BIM 5D integration lessens the usefulness of the models, while 15% of respondents perceived the models as neutral, with a response rate of 12.5%. They disagreed. Furthermore, 0% of respondents strongly agreed that the absence of BIM 5D integration lowers the models' efficacy, and it is evident from the data that this is a large number of respondents.

Q4. Do you agree with the use of the BIM 5D model, which neither provides nor accurately depicts the program's actual cash outflow or inflow?

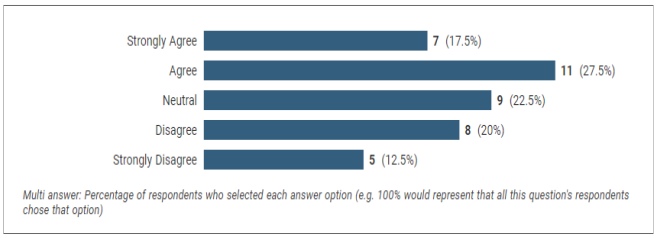

Figure 4: The use of the BIM 5D model, which neither provides nor accurately depicts the program's actual cash outflow or inflow.

The graph demonstrates that 45% of respondents concur that using BIM 5D does not adequately represent the actual cash flow of the programs from the internal flow. response rate revealed that 22.5% of respondents thought the models were neutral. They disagree. disagree 12.5 % of respondents strongly disagreed with what was said, indicating that the ratios between agreeing and disagreeing are close and that BIM 5D implementation does not give or accurately depict the programs' actual cash flow.

Q5. Do you think that by using BIM 5D, quantity surveyors can offer more accurate and trustworthy guidance on choosing the right building materials?

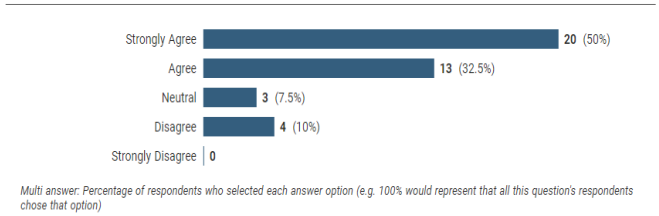

Figure 5: answer of using BIM 5D, quantity surveyors can offer more accurate and trustworthy guidance on choosing the right building materials?

As it is evident from the graph that 82.5% of respondents agree that utilizing BIM 5D enhances the accuracy of quantitative survey results. The graph amply demonstrates 7.5% of the respondents' answers perceiving them as neutral, with 10% being the respondents' response rate. They disagree. Moreover, 0% of respondents expressed severely Strong disagreement Here, it is shown that the majority of respondents, at a rate of 82.5%, think that using BIM 5D aids the quantity surveyors by giving more precise and reliable instructions for selecting the right building materials for the project.

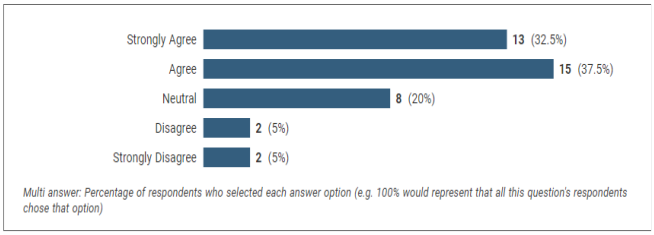

Figure 6 answers of the advancements in quality assurance and design cooperation. The amount of corrective work is reduced as a result.

The graph shows that 70% of the respondents agree that there are developments in quality assurance and design collaboration. strongly disagree the chart clearly shows 20 % of the respondents' answers perceiving them as neutral, with 5% being the respondents' response rate. They disagree. Moreover, 5 % of respondents expressed severe strongly Disagree According to the results, the majority of respondents (70%) think that less corrective work on projects leads to gains in quality assurance and design cooperation.

Q7. Do you agree 5D BIM Accurate quantity take-offs and cost estimates are critical to creating competitive bids and keeping your team collaborating efficiently?

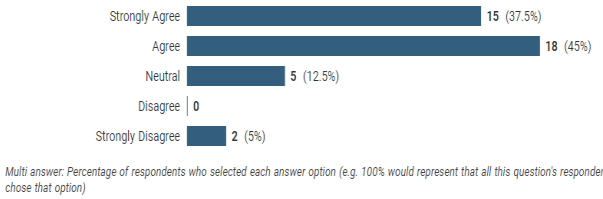

Figure 7 answer of agree that 5D BIM Accurate quantity take-offs and cost estimates are critical to creating competitive bids

Figure 7 indicated that 82.5% of the respondents agree that BIM 5D accurate take-offs of quantities and cost estimates are essential to keep your team collaboration efficient the chart clearly shows 12.5 % of the respondents' answers perceiving them as neutral, with 0% of the respondents' response rate. They disagree with Moreover, 5% of respondents expressed severely strongly disagree.

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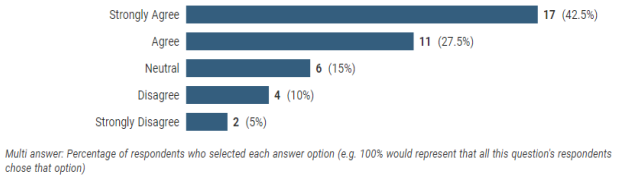

Figure 8 result of the 5D BIM Digital Cost Estimation and management would speed up future construction projects in terms of cost estimation and management for small to medium size projects

A graph in Figure 8 of the survey's results illustrated that 70% of respondents agreed BIM 5D and its management would speed up future construction projects in terms of cost estimation. The chart clearly shows 15% of the respondents' answers perceiving them as neutral, with 10% being the respondents' response rate. They disagree with each other. Moreover, 5% of respondents expressed severely

Q9. Do you believe that cost control tools will be enhanced and developed by 5D BIM During the construction process, for small to medium size projects?

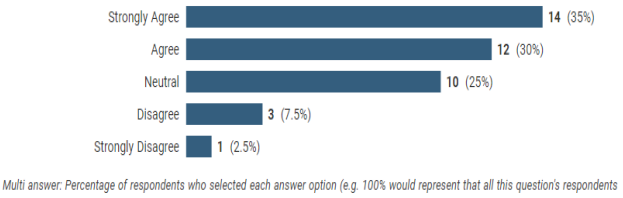

Figure 9: the cost control tools will be enhanced and developed by 5D BIM During the construction process

The graph in Figure 9 depicts the percentage of participants who agreed with 65% that BIM 5D during the construction process improves and develops cost control tools, while the remaining respondents had different viewpoints. the chart clearly shows 25% of the respondents' answers perceiving them as neutral, with 7.5% being the respondents' response rate. They disagree with each other. Moreover, 2.5% of respondents expressed severe or strongly disagreed.

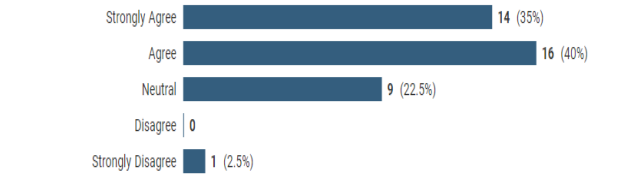

Figure 10 5D BIM can assist QS in identifying costs associated with deviation from the project plan and potential areas for cost savings

Figure 10 shows that 75% of respondents to a poll agreed that BIM 5D may assist QS in identifying expenses connected with deviation from prospective project plan regions to achieve cost savings. This was shown by the visual questionnaire. the chart clearly shows 22.5% of the respondents' answers perceiving them as neutral, with 0 % being the respondents' response rate. They disagree with each other. Moreover,2. 2.5% of respondents expressed severely or strongly Disagree this indicates a significant percentage of respondents asserting that BIM 5D can assist QS in identifying costs associated with deviating from potential areas of the project plan.

B. Interview Analysis

This section aims to analyse and explain the data acquired from the semi-structured interviews of three participants, as previously mentioned. I have opted qualitative method and content analysis for the above-mentioned question 8. I have collected data via online video of Ms Team 3 interviews and analysed it accordingly. The implementation of BIM 5D with QS. Through these interviews, the two Major Target Should Be Accomplished. To begin, recognize civil engineers' perspectives. Quantity surveyors and BIM consultants are both available. The logic underlying their beliefs and the factors that keep them from altering. The second purpose is to underline the genuine ideas proposed by them to grasp the deployment of BIM 5D and its management, which will speed up future building projects. Technological and textual analysis was utilized to analyse and explain these interviews using an interpretative strategy that searches for and communicates the major points between their responses (Haregu, 2012).
Participants were questioned regarding the key factors, Q8. Do you agree that 5D BIM Digital Cost Estimation and management would speed up future construction projects in terms of cost estimation and management for small to medium size projects?

Participant: A
“Yes, can be in terms of whether BIM 5D digital cost estimation speeds up upcoming construction projects. Early guidance is given, mistakes are minimised, and the task is finished in record time. The primary test for determining project viability is cost estimation. This is a crucial element that facilitates the completion of small- and medium-sized construction projects It provides a faster way to analyse data and generate cost estimates by eliminating cumbersome manual casting and estimation errors caused by people compared to the traditional take-off manual casting procedure” [Quantity surveyor consultant].

Participant: B
“Yes, BIM 5D implementation into contributed will provide the building with a clear structure and supervise them. A plan roadmap has been defined to include more specific information, and the desired result is an integrated cost estimation system that can be synchronized with other systems” [BIM Design consultant].

Participant: C
“Yes, BIM 5D contributes significantly in terms of project management terms of cost. It also provides common standards for cost comparison through the cost management life cycle allowing quantity surveyors to spend much more time imparting their skills and experience to the development team because it greatly cuts down on the time it takes to develop quantities allowing Sharing and exchanging project expertise regarding the length of time needed to produce quantities”.
[consultant projects management].

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IV. FINDING AND DISCUSSION

In this study, a mixed method combination of qualitative and quantitative methods was used. These methods included case studies, research, questionnaires, semi-structured interviews, and several case studies in the research. These case studies covered topics like quantitative management in BIM 5D and challenges facing QS in construction projects as well as analysis and costs based on BIM 5D. by a quantity surveyor.
Participants were polled on important issues, such as whether. Do you agree that 5D BIM Digital Cost Estimation and management would speed up future construction projects in terms of cost estimation and management for small to medium size projects?

Participant: A
"Yes, if you're asking if BIM 5D digital cost estimation expedites construction projects, the answer is yes. The task is completed at record speed, errors are minimised, and early guidance is provided. Cost estimation is the main evaluation tool for projects to determine their viability. This is a critical component that helps small- and medium-sized building projects get finished" [Quantity Surveyor consultant].

Participant: B
"Yes, the BIM 5D implementation constraint provides the building with a clear structure and supervises them, and allows the planned roadmap has been defined to include more specific information, and the desired result is an integrated cost estimation system that can be synchronized with other systems"[BIM Design consultant].

Participant: C.
"Yes, BIM 5D makes a major financial contribution to project management. Additionally, it offers uniform criteria for cost comparison across the consultant projects management cost management life cycle" [consultant projects management].

To explore the BIM 5D implementation addressing advantages and disadvantage
Regarding the benefits of implementing BIM 5D from the features of implementing BIM 5D in depicting the design and estimating the cost, it was participants responded specialists in the field of construction and quantity surveying, together with consultants in the field of BIM positively with a rate of 85%, meaning that only 15% of respondents were neutral or disagree. This shows that BIM 5D aids in the design and contributes to project cost estimation. Construction organizations can better control costs and quickly assess the quantity thanks to the usage of BIM 5D. It also helps with better decision-making, cost calculation, and accurate forecasting of the precise quantity to be completed. Amounts can be generated automatically throughout the implementation of BIM 5D, saving both time and money. The outcome was determined by the participants' responses who had experience and specialization in the fields of construction and quantity surveying. As can be seen in the graph, 80% of respondents agreed that it is possible to save time and money by implementing BIM 5D in projects. 17.5% were neutral, while only 2.5% disagreed. As is well known, time and money are two crucial factors in the construction sector, and this is a clear sign that using BIM 5D can help save both of them.

To address the problem facing quantity surveying practice in the UK By utilizing BIM 5D, quantity surveyors can provide more precise and reliable guidance and advice when selecting building materials. Most respondents (82.5%) agreed that BIM 5D helps surveyors, quantities in the selection of building materials, and other ratios were different. 7.5% were neutral, and 10% disagreed. The results came from a survey of participants with specialization in the construction sector, particularly quantity surveyors. Before BIM 5D was implemented, the surveyors in charge of construction and privatization suffered greatly from the choice of building materials. Through the use of BIM 5D technology, which provides a clear and firm picture, there is now a great degree of confidence in picking building materials. The task of quantity surveyors is now simpler than it always was. About the assertion that BIM 5D can assist QS in determining the costs associated with deviation from potential project plan areas, the largest percentage of respondents agreed 75%, which suggests that the majority of opinions believed that BIM 5D could assist QS in determining costs and addressing issues facing the practice of quantity surveying in the United Kingdom through the implementation of BIM 5D in Quantity Surveying, and the work of QS has become easier than it was in the past. The RICS (2011) conducted a study on BIM adoption among quantity surveyors in the UK and the US, which is presumably the most thorough study of its kind to date. The survey offers a snapshot of the extent of the Application of BIM by the surveying industry and the issues experienced, which may very well be relevant to numerous other nations where quantity surveyors operate. A poll asking 8,500 RICS members about their firm's use of BIM received 298 replies from quantity surveyors (156) and construction surveyors (96). The main conclusions drawn from the comments of the quantity surveyors are detailed below (Smith,2007). Only 10% of QS businesses routinely used BIM, and another 29% only occasionally did so. In line with this, 61% of QS businesses had no interaction with BIM. Concerning the QSs utilizing BIM, Building schedule (14%) and quantity extraction (8% each) were the two uses that occurred most frequently. Only 10% of QS firms are actively evaluating BIM solutions for deployment, and only 4% of QS firms consistently engage in BIM training (RICS 2011) (Smith,2007). This demonstrates that the level of BIM adoption by the Quantity surveying profession in this area is below what is required. Furthermore, it would be fascinating to observe the impact the UK government's requirement for BIM adoption has had on QS firms, considering that it was implemented at the time of this poll. The absence of customer needs, training, programming interfaces, and standards was identified as the major obstacles to QS firms embracing BIM (Smith,2007).

To identify the implication and barriers lay behind implanting BIM 5D When discussing the inherent limitations and non-integration of BIM 5D that reduces the effectiveness of the models and

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dependence, the largest percentage of respondents whose answers through the data graph were in agreement was 72.5%. This shows that the lack of integration of BIM 5D decreases the effectiveness of the models and that BIM 5D has a clear and significant impact on the non-integration of BIM 5D which decreases the effectiveness of the models. When discussing and identifying the effects and potential barriers to implementing BIM 5D, participants with experience in the construction industry were polled about their opinions. When asked if using the BIM 5D model does not provide or accurately depict the actual flow of programs, the participant response was 45% in agreement, meaning that almost half of the participants believe that BIM 5D implementation does not provide or accurately depict the actual flow of programs.

To compare projects using traditional surveying methods versus BIM 5D.

Regarding the comparison of the traditional survey and developments in quality assurance and cooperation in design through the use of BIM 5D, the amount of corrective work is reduced by polling the participants with specializations in the field of construction and surveying the quantities through the graph, the results showed that 70% agreed to use of BIM 5D technology, comparing the conventional scanning method with BIM 5D will reduce the project completion period, also saving time and money. Accurate estimates of quantities and costs are required, according to BIM 5D, to produce competitive bids that keep your team working together effectively. The majority of participants responded via the graph, with 82.5% agreeing that employing traditional survey methods will not result in operations accurate take-off, The use of BIM 5D makes an accurate take-off process and cost estimate easier.

To outline the benefits of using BIM 5D for small to medium size projects.

The responses of the participants in a survey who they experts in the field of construction and BIM managers in small and medium companies also were an approval rate of 70%, and this is the largest percentage of salvation, regarding the advantages of using BIM 5D and that estimating the digital cost of BIM 5D and managing it will accelerate future construction projects in terms of cost estimation for small and medium projects. According to the poll, the advantages of BIM 5D are significant, and the digital cost estimate will hasten the completion of future building projects for small and medium-sized projects. The benefits of using BIM 5D for small and medium-sized projects will lead to the development and improvement of cost management tools throughout the building process. The development and improvement of cost control tools by small and medium-sized businesses during the construction process is one of the benefits of BIM 5D. These benefits will result in faster and less expensive project completion.

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