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by Abbas Abdulameer Khalaf

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Digital Transformation and Understanding the Impact on Construction Project Management in Iraq

Abbas Abdulameer Khalaf
Imam Alkadhum University College, Iraq
abbas.alamir@iku.edu.iq

Author correspondence: abbas.alamir@iku.edu.iq

Abstract: *The construction sector is currently undergoing significant changes as a result of the adoption of digital technologies. The utilisation of Building Information Modelling (BIM) has garnered considerable interest in recent years from scholars and industry experts. The sector has seen major changes as a result of its rising success. Given these changes, the traditional knowledge and skills possessed by project specialists or managers seem insufficient in properly supervising the new information component of construction project management. As projects advance, the inclusion of new roles such as BIM managers, BIM coordinators, BIM modellers, and information managers is becoming crucial to meet the demand for enhanced capabilities. Multiple studies have analysed these novel roles from a theoretical perspective, but have not investigated their correlation with conventional roles in project management, nor have they explored how project managers and BIM specialists position themselves in relation to the overall processes outlined in the BIM implementation guides. This case study illustrates that the duties of BIM specialists varied among various fields and go beyond solely technical assignments. Moreover, the information sub-process predominantly focuses on BIM managers, leading to the establishment of two distinct sources of leadership within a project: BIM managers and project managers. According to the poll, professionals believe that the BIM collaboration methods described in the BIM implementation plan and project documents are too general. Moreover, there is always a difference between specified methods and the ones actually used in the project.*

Keywords: *Digital Transformation, Understanding, Construction Project, Management.*

1. INTRODUCTION

The implementation of the Building Information representing (BIM) methodology in representing building data greatly revolutionises project management in the domains of architecture, engineering, and construction. This methodology is groundbreaking and fundamentally changes the approaches used in the conception, supervision, and construction of construction projects (Huang, Ninić & Zhang, 2021). This method uses a multidisciplinary 3D model of the building to improve and record its design, while also allowing for the simulation of different aspects of its construction or operation (Sacks et al., 2022). A number of academic papers (Raza et al., 2023; Mellado & Lou, 2020; Olanrewaju et al., 2020) have investigated the potential of Building Information Modelling (BIM) to improve efficiency in the industrial domain. Historically, the construction sector has demonstrated lower productivity rates when compared to similar industries as automotive and aeronautics (Marmol, Ferreira & Fangueiro, 2021). The construction sector is characterised by its fragmentation, where various actors from different organisations collaborate on a temporary basis to achieve a shared objective. Effective collaboration is crucial for project success, although it remains challenging

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in the industry despite extensive and diverse research endeavours. Establishing explicit collaboration protocols is so crucial in the sector. Fragmentation, together with inefficient collaborative processes and inadequate information management, significantly contribute to the industry's low productivity rates. Information technology has historically been regarded as the remedy for the issue (Riazi et al., 2020), although it has not achieved significant success in terms of industry adoption rates. The BIM technique has seen promising advancements in recent technology. The BIM technique, through the use of a three-dimensional model, equips the construction industry with the necessary tools to effectively manage both the process and product aspects of construction projects. However, the adoption of the BIM approach is elevating the significance of information management and establishing it as a key aspect of construction project management, akin to the conventional business-oriented viewpoint. In this novel paradigm of project management, information flows do not appear to consolidate around project managers who lack the necessary skills to effectively handle it, as the existing rudimentary management tools are demonstrating their limitations. Consequently, in construction projects, additional positions such as BIM manager, BIM coordinator, BIM modeller, and BIM facilitator are emerging to supplement the responsibilities of project managers. In addition to the Project Management Body of Knowledge (PMBOK) (Takagi & Varajão, 2020), there are other emerging manuals that offer instructions and procedures for effectively using the BIM approach. These instructions are sometimes referred to as a BIM management plan or BIM execution plan. However, it appears that the duties of BIM specialists, once limited to technical tasks, have now expanded to include more administrative responsibilities. The jobs of project managers and BIM specialists, such as BIM managers, often have a lot in common. This indicates that there are multiple potential possibilities for how these professions will develop and coexist in building projects in the future. Prior research has focused on comprehending these novel roles solely on a theoretical basis, without considering their placement in relation to conventional project management roles or how project managers and BIM specialists position themselves in relation to the generic processes suggested in BIM implementation guides. This article analyses the disparity between the planned adoption of Building Information Modelling (BIM) and the actual methods employed in a project, as perceived by BIM and project specialists, using an exploratory case study. The article is structured into three primary sections. The initial section examines the development of the managerial function in a building project. Following the literature review, there is an explanation of the research approach. Subsequently, the primary findings of the case study are given.

Literature review:

Roles of BIM and project managers

Major changes underway in construction

The construction industry has historically been averse to adopting information technology, resulting in lower productivity and automation levels compared to industries like aerospace and automotive (Regona et al., 2022). Construction has recently embarked on a digital transformation because to the urgent need for improvement and growing demands for sustainable growth and industrialization. This shift has resulted in significant changes in construction methods (Norouzi et al., 2021). One significant observation is the increasing prevalence of the BIM approach to building information modelling (Ahankoob, Manley & Abbasnejad, 2022). The method of integrating all construction project activities into a three-dimensional digital model has garnered significant interest in recent years from scholars and industry professionals (Manzoor, Othman & Pomares, 2021). The increasing prosperity of the building industry has facilitated a significant surge in the use of digitization and industrialization. However, in accordance with the principles of Industry 4.0, a novel concept is emerging that aims to integrate the BIM approach with other significant difficulties and techniques associated with the ongoing paradigm change in the construction industry. This is the fourth-generation construction. Construction 4.0 should not be seen as a mere extension of "Industry 4.0" in the construction sector, but rather as a novel concept that addresses the significant issues faced by the construction industry. Therefore, construction 4.0 should encompass three key aspects: the integration of digital technologies, the implementation of industrialised construction methods, and the promotion of sustainable practices in the construction industry. The digital shift is associated with the utilisation of BIM technologies as well as other related technologies such the Internet of Things (IoT), cloud computing, 3D printing, smart sensors, augmented reality, mobile technologies, and Big Data. The emergence of mobile technologies and the Internet has facilitated the development of various apps, such as the sharing economy. This economic model relies on the exchange of information between users through mobile applications (e.g., Uber, Airbnb) to enable access to goods and services. The construction industry is also being impacted by this trend, and the first specialised apps are beginning to appear. Similar to Uber and Airbnb, the Kwipped programme facilitates the direct rental of construction equipment between construction experts. Additionally, Shltr enables the collective recruitment of labour for construction sites. Construction industrialization seeks to identify methods to minimise waste in the construction supply chain and enhance efficiency on building sites, with the ultimate goal of boosting production in the industry. This encompasses several methodologies, such as Lean or Last Planner, as well as the crucial aspects of transdisciplinary prefabrication and off-site building. The sustainability of construction is associated with the three pillars of sustainable development, namely economic, ecological, and social challenges. It also involves addressing issues connected to transforming procurement practices and implementing integrated design, among others. Although Construction 4.0 and the "Uberization" of construction are still in their early stages compared to other industries, the same cannot be said for the BIM method. Its level of adoption appears to have reached a threshold where it is unlikely to be reversed. The BIM approach is being adopted more and more by top architecture, engineering, and construction firms. In fact, several governments and government agencies worldwide, such as the United States, United Kingdom, Singapore, and the European Union, have even made it mandatory. The European Union directive (Directive 2014/24/EU) also strongly urges member countries to adopt this approach. Multiple studies have shown the substantial benefits that the BIM technique can provide to the building industry. Nevertheless, these studies also indicate that it primarily functions as a disruptive technology, leading to significant alterations in the structure and functioning of projects. The utilisation of three-dimensional models as the primary database and exchange medium throughout the building's life cycle greatly enhances the requirement for integration in information sharing. Furthermore, the emergence of new technology related to Building Information Modelling (BIM) enables a comprehensive understanding of the project that goes beyond only the initial stages of the building's lifespan. It encompasses the full life cycle of the structure, including its utilisation and eventual decommissioning. Given these changes, the conventional expertise of experts or project managers appears unable to effectively handle the new informational approach to construction project management (Cobb, 2023). Emerging positions such as BIM managers, BIM coordinators, BIM modellers, and information managers are becoming essential in building projects, as they require new talents.

Emerging roles of BIM managers, coordinators and champions

Lee and Borrmann (2020) argued that the introduction of technological systems like BIM requires changes in management procedures, which go beyond just technical aspects. Undoubtedly, the BIM method has the potential to serve as a catalyst for project managers to revamp their procedures in order to seamlessly integrate the various stakeholders participating in contemporary building projects. Jackson (2020) categorised the impact on construction project management into three primary types: 1) the requirement to effectively manage project information and documentation systems; 2) the necessity to explicitly acknowledge, depict, and handle the interdependencies resulting from the extensive integration and collaboration among project tasks; and 3) the imperative for the project team to utilise comprehensive virtual prototypes as central components for project design and management. BIM management encompasses various levels of responsibility and technical proficiency, necessitating the establishment of new positions focused on technology utilisation and modelling standards. Additionally, these jobs are responsible for managing the adoption of BIM in varied settings. An increasingly mentioned new position is that of the BIM manager, which is not merely a direct substitute for the traditional CAD manager.

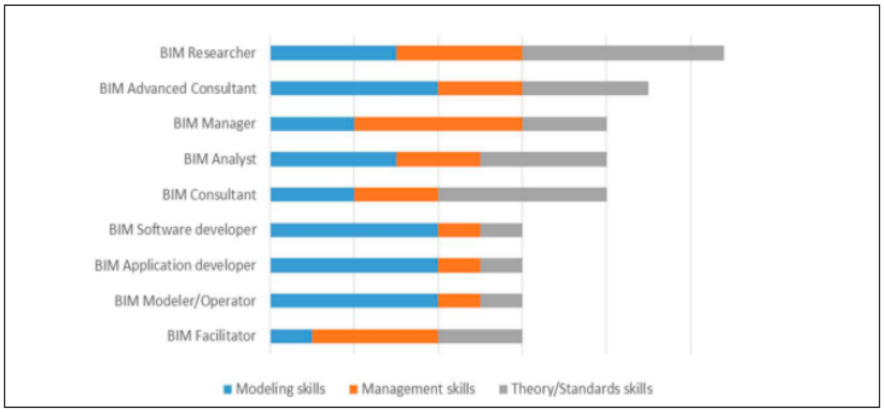

Figure 1: A distribution of the weights of BIM-specific knowledge expected for different BIM specialists (Barison & Santos, 2010).

Barison and Santos (2010) suggested a comprehensive list of the novel roles and obligations associated with the BIM methodology. Figure 1 illustrates the new responsibilities and the allocation of the abilities relevant to the BIM methodology, which are anticipated from various professionals. A notable discovery from the research conducted by Barison and Santos (2010) is that these jobs are not solely associated with technical expertise. Additionally, they encompass elements pertaining to integration and leadership. In their 2023 publication, de Souza et al put out a comprehensive analysis of the role descriptions for different BIM specialists, as commonly outlined in existing BIM guidelines. This study has demonstrated substantial findings, including the development of these roles in a manner that lacks coordination. Hu (2023) categorise these positions into four primary groups: two project roles (BIM project manager and BIM coordinator) and two organisational roles (BIM modeller and internal BIM manager). In this essay, we will examine project responsibilities as a component of our research. Unless explicitly mentioned, we will employ the term "BIM Manager" as a comprehensive phrase encompassing the two project positions: BIM Project Manager and BIM Coordinator. While the inventories put forth by Hu (2023), and by Barison and Santos (2010) are intriguing, they are constrained by their reliance solely on literature and do not offer insights into understanding these responsibilities from the viewpoint of project and BIM specialists themselves. Furthermore, the manner in which these responsibilities coexist under specific project delivery methodologies, such as the accelerated project, remains uncertain. In order to gain a comprehensive understanding of the many roles and challenges related to contemporary BIM practices, it is important to delve deeper and examine an actual BIM project that encompasses these diverse responsibilities.

2. RESEARCH METHODOLOGY

Research Approach: The Exploratory Case Study

Elbasheir Khalid Elbasheir (2022) defines a case study as a thorough examination of a particular entity with the objective of comprehending a broader category of like entities. Case studies are typically characterised as empirical investigations that provide a detailed and comprehensive description of a specific event, often drawing on diverse sources of data (Cao et al., 2022). Case-based data can be utilised to build theoretical hypotheses and structures. The case study method can incorporate both quantitative and qualitative evidence (Xun, Zhang & Yuan, 2022). Data for this study can be obtained through many means such as observations, verbal recordings, and fieldwork. Multiple methods of data collection, including ethnographies and participant observations, can be utilised (Oswald & Dainty, 2020). Case studies are a research technique, as defined by Oswald and Dainty (2020). The case study method is used to characterise situations, rather than analyse them or model causal linkages, according to Priya (2021). According to Welch et al (2020), a case study can be categorised as descriptive, explanatory, or exploratory. The primary objective of the exploratory case study is to enhance comprehension of intricate social phenomena (Paparini et al, 2020). It serves as a rational and logical initial approach when there has not been significant empirical study conducted on the specific subject of interest (Holtz, 2020). The utilisation of this methodology may be warranted in situations where the topography is unfamiliar or when preconceived notions are imposed (Palacio Buendia et al., 2021). In such instances, it is feasible to more precisely delineate an issue, propose hypotheses to be subsequently examined, develop ideas for novel services, collect input on an emerging concept, or conduct a preliminary assessment of a questionnaire (Olanrewaju et al., 2021).

Data collection

This article presents an exploratory case study that focuses on the extension of the Basmaya project, a city development initiative. The major purpose of the study is to examine the implementation of the Building Information Modelling (BIM) technique in the project. The study took place over the first six months of 2015 and employed a methodological approach that utilised four primary data gathering tools: a thorough examination of project documents, a survey, semi-structured interviews, and observations. The literature review encompassed project documents provided to researchers, such as the BIM execution plan, project breakdown chart, BIM object tree and nomenclature, file transfer protocol, conflict and interference management process, quality control plan, conflict area guide, BCF-based collaborative communication process, and development level specification (LOD) file. The poll was divided into three sections that align with the three commonly studied aspects of BIM implementation: technology, organisation, and processes. The questionnaire was exclusively distributed to individuals with managerial positions in this specific initiative. These individuals are BIM managers and project managers who work in various fields such as architecture, mechanical engineering, electrical and plumbing, structural engineering, general contracting, and client representation. A total of ten responses were received, with eight of them being complete. Subsequent semi-structured interviews were carried out to further explore several facets of the use of Building Information Modelling (BIM) in this project. Nine individuals were interviewed in total. Through the utilisation of ethnographic research methods, the researcher ultimately witnessed the project activities and documentation at the location.

Key findings

Background

The corporation overseeing the Basmaya project aims to promote its expansion by diversifying its real estate holdings. The ultimate objective is to provide residential complexes within the borders of Iraq. In order to optimise the expansion of the project, the newly implemented infrastructure must adhere to stringent standards of quality and operational efficiency. The management of the South Korean firm "Hanwha" made the decision to adopt the Building Information Modelling (BIM) approach for this expansion project. This decision was based on the recognition of the necessity to enhance coordination during the design and construction stages, as well as to optimise equipment management. A BIM execution plan was established based on the client's expertise and the advice provided by a consulting firm. The client's primary goal is to effectively deploy the BIM approach throughout the design and construction stages, and to integrate the BIM information into their current equipment management system for future use. An iterative strategy was implemented to thoroughly examine the project's requirements and ensure a comprehensive understanding of the problems. Despite its significance, this phase resulted in a substantial delay. Due to these factors and others, a rapid implementation strategy was chosen for the project. An accelerated project refers to a project that can be completed in a much shorter time period, up to 70% less, compared to a similar project following standard methods (Kerzner, 2022).

Management roles in the project

The project is overseen by a project manager designated by the owner, with support from external consultants. The five primary disciplines involved are architecture, structural engineering, civil engineering, MEP engineering (mechanical, electrical, and plumbing), and general contracting. The project team consisted of one project manager and one BIM manager for each discipline (see to Figure 2).

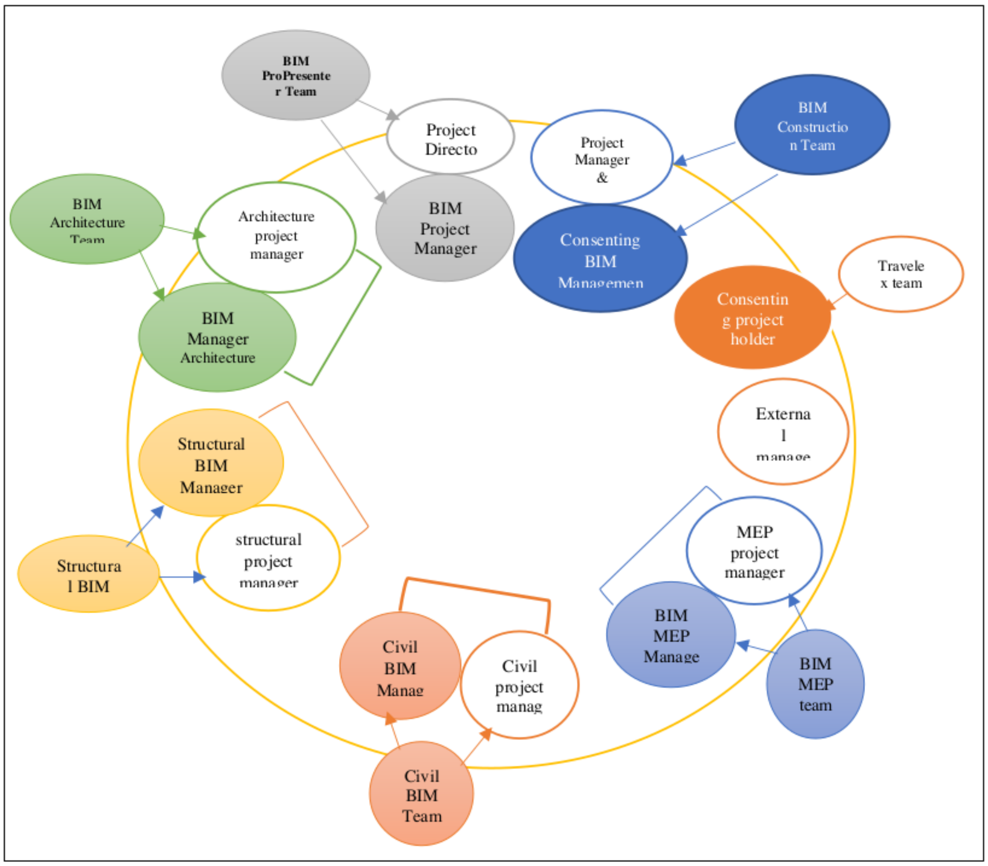

Figure 2: Diagram of roles and responsibilities as planned in the project

Every company has its own hierarchy and organisation, but the BIM execution plan specifically highlights the duties of BIM managers. From a theoretical standpoint, these responsibilities mostly pertain to the management of model content, ensuring quality control, and coordinating 3D elements. Typically, both the architectural firm and the MEP business assign specific individuals (apart from the project manager) to fulfil this position inside their organisation. The BIM manager assigned by the structural engineering company appears to have a broader scope of responsibilities, similar to those of a project manager. He receives assistance from a BIM coordinator who is accountable for the internal administration of the BIM model. Practically speaking, the responsibilities of BIM managers vary significantly across different disciplines. The architecture business has designated a BIM manager who is responsible for both technical and managerial tasks. He is accountable for the weekly retrieval of the architectural models and their incorporation into the other models. This document predefines the items that will be examined to find collisions within and across different fields of study. In addition, he ensures that each designer conducts internal quality control on the architectural model they have worked on throughout the week. The MEP firm possesses a distinctive hierarchical structure as a result of the intricate and intricate nature of its commercial operations. The assigned BIM manager is paired with a specialised BIM administrator for each branch (mechanical, electrical, plumbing, etc.) to coordinate the team's activities. It conducts visual examinations of MEP models. Aside from overseeing the quality control of MEP technicians' models, the BIM Manager is responsible for managing and rectifying warnings inside the Revit programme. The objective is to generate models with minimal errors. The BIM manager assigned by the structural engineering business has a broader scope of responsibilities compared to the other two disciplines. He collaborates with the project manager to strategize and coordinate the tasks assigned to the structural engineers. Additionally, it guarantees the integrity of the 2D conceptual rendering created by its designers, while absolving itself of any accountability for the substance of the 3D models. The responsibility for conducting quality checks on the models lies with the BIM coordinator in this function. The function of a BIM coordinator in this context bears a strong resemblance to the role of a BIM manager in other companies. The general contractor has designated two BIM managers for the project, with a focus on technical aspects related to 4D (phasing and scheduling) and 5D (cost management) modelling.

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The applicability of the processes proposed in the BIM execution plan

Collaboration is essential for the optimal development of a BIM execution plan. BIM managers serve as facilitators to assist the team in creating a unified plan and cohesive strategy for generating the models throughout the project. The strategy is supposed to be both realistic and implementable, with the planned processes closely resembling those that would be put into action. In practice, the procedures outlined in the BIM execution plan have not been rigorously implemented. Instead, they were regarded as directives to instruct professionals in their work. A practitioner, whose organisation had not previously used the BIM approach, stated that it is challenging to implement the proposed processes because they are solely engaged in modelling work rather than production activity. In summary, 25% of the participants (a total of 8 individuals) hold the view that the suggested procedures are adequately specific and comprehensive, whereas an equal percentage holds the contrary opinion. The remaining half appears to hold a neutral stance. When attempting to assess the disparities between the BIM execution plan procedures and the actual procedures, there is a divergence of perspectives among the responders. On a scale ranging from 1 to 10, with 1 representing no deviation and 10 representing a very big deviation, 50% of respondents reported "only a few deviations", while an equal amount indicated "medium and significant deviations". In order to gain a deeper comprehension of the inconsistencies between the procedures outlined in the BIM execution plan (as well as other project papers) and the procedures that are actually implemented, it is beneficial to examine how practitioners interpret the various processes. The project utilised three primary categories of procedures: information sharing and synchronisation processes, 3D coordination and interference detection processes, and quality control processes. The variation is considered to be average across all three groups of processes. Nevertheless, although the percentage of individuals who claim that the methods employed fully adhere to the guidelines outlined in the BIM execution plan is consistent across all three process groups, it appears that the disparities are less notable for synchronisation processes (25% selected "low deviation" as opposed to 12.5% for other processes). Throughout the semi-structured interviews performed in the first half of 2023, all participants expressed the belief that the methods suggested by the implementation plan were excessively theoretical, overly generic, and not tailored to the specific project. "The BIM execution plan processes are mostly theoretical and not widely used by many people on a daily basis, despite the fact that they outline the main principles of the project," stated a BIM manager. Overall, the suggested procedures are regarded as challenging to implement and insufficiently aligned with the project's actual circumstances. "The outlined processes are commendable, but they are inherently natural and self-evident." The user's text is enclosed in tags. "It would have been ideal to display the information requirements at specific intervals, as the current level of detail is insufficient," stated another BIM manager. In addition to concerns over formalisation, practitioners have criticised the implementation plan for its failure to address the specific requirement for a fast-tracked project that facilitates coordination among many disciplines. "Although we attempted to implement the procedures outlined in the BIM execution plan, the fast-tracked project did not follow a linear progression," observed a BIM coordinator. The structural engineering company had to promptly release its initial findings, ahead of other companies, while considering the development of architectural and MEP models. After consulting with the other parties involved, it was ultimately determined that the deadlines would exclusively apply to MEP engineers and architects for the specific portions of the model required for the creation of the structural models. The study highlighted the necessity for collaboration between the architects and the structure, which was addressed by the two businesses through the exchange of handwritten sketches. These sketches serve as a rapid and effective means of transmitting important information from the architects to the structural firm. This allows the structural company to adjust its models and produce its deliverables with the necessary quality and punctuality. "Architects frequently employ this method to expeditiously convey their concepts, allowing us to subsequently revise our model based on these preliminary drawings. This approach proves to be a prompt and effective means of conveying time-sensitive information." Furthermore, a number of practitioners observed difficulties pertaining to quality control systems. The structural engineering company found that many of the quality control techniques included in the execution plan were not appropriate for their specific circumstances. Practitioners argue that implementing the proposed quality control measures would need a complete three-week period, which is completely inconceivable for a project that is progressing rapidly and where models are constantly changing. The participants collectively embraced the idea of enhancing the models and conducting interference detection at the designated periods, provided that the relevant aspects were accurately modelled. Another facet of quality control is to the contractor who, in accordance with the building plan procedure, was accountable for validating the models and ensuring their adherence to the Uniformat categorization system. The contractor's intended management of this procedure created concerns over contractual obligation. While the assertions could not be verified throughout the observation period, certain BIM managers expressed the belief that they should assume responsibility for interdisciplinary quality control.

Whole-Team Project Use of a Common Physical Space

A notable aspect of this project was the requirement for all project team members to occupy a shared physical location, which was provided by the managing business in close proximity to the building site, over the whole period of the project. The concept here bears resemblance to the notion of Big Room and seeks to cultivate creative synergy across different disciplines. The notion of the Big Room originates from Lean Construction principles and involves the consolidation of cross-functional teams in a single location to collectively address and investigate issues (Bhawani, 2021). One of the goals of the study is to comprehend the respondents' perception of the impact on project effectiveness and the potential challenges that arise from collaborating with other disciplines in a shared workspace. Working in close proximity during a project, as opposed to a typical setup, has a significantly beneficial effect on communication, collaboration, trust among stakeholders, and the sharing of information and data. "The project office has dedicated its attention to this particular project, with no other project expected to dominate their focus. All teams are actively engaged in this project," stated a BIM coordinator. "The common space is highly beneficial as it facilitates collaboration between the owner and other disciplines, acting as an integrator. It promotes efficient information sharing and enables effective brief meetings," states the project manager. The close physical proximity fosters a shared synergy, facilitating collaboration towards a common objective, streamlining the design phase, enhancing the effectiveness of decision-making, and promoting comprehension of the unique BIM procedures involved in a project. "During the initial phase, there is approximately one Building Information Modelling (BIM) meeting per month, which appears to be adequate, considering that the work environment allows for direct communication with the relevant individuals in case of an issue," stated a BIM manager. Another BIM manager stated that the advantage of being in a shared physical area is the ability to quickly find solutions without wasting time or information while collaborating with other professionals. Furthermore, a significant majority of participants expressed strong enthusiasm for pursuing employment in similar arrangements in the future.

Discussions

Although the study's results are challenging to apply broadly because of its experimental nature, they do emphasise certain topics of debate regarding the challenges faced by professionals when using the BIM technique. We suggest examining two aspects: the consolidation of information sub-processes centred on the BIM manager and the dependability of BIM processes for efficient collaboration.

Crystallization of the information sub-process around the BIM manager

The case study demonstrates the emergence of two unique leadership positions inside the project, as a result of the crystallisation of the information sub-process centred around BIM managers. The first aspect pertains to the project plan implemented by the project manager. It involves the organisation and coordination of project tasks based on a hierarchical framework. The second management system, which is connected to the BIM execution plan, is implemented by the BIM manager and primarily focuses on the administration of project information. In the construction business, there are two main flows: the flow of information and the flow of materials. The flow of information is a crucial component of the supply chain, as highlighted by Chileshe, Jayasinghe and Rameezdeen (2019). This aligns with the information sub-process outlined by Vendrusculo (2021). Although the information subprocess may not be as tactile as the material sub-process, it is essential for the success of building projects. This is because information, along with material and energy, is one of the three main components of socio-technical systems (Sony & Naik, 2020). The adoption of the BIM approach has transformed the administration of building projects into a matter of information. The function of the BIM manager, responsible for overseeing the flow of information, has become increasingly crucial in construction projects. It is plausible to anticipate a substantial reduction in the gap between the responsibilities of a project manager and a BIM manager in the future. Project managers must acquire BIM abilities, whereas BIM managers must enhance their project management expertise. In due course, these two talents may combine to establish a unified job with the ability to oversee the informational aspects of building project management.

The applicability of the proposed BIM processes for effective collaboration

As previously stated, establishing precise collaboration procedures is crucial in the sector. A significant number of professionals indicate that there is a notable difference between the intended BIM procedures and the actual BIM procedures implemented in the project. The BIM method aims to enhance collaboration in the industry, and it is crucial for the underlying BIM procedures to be dependable. The general linear processes outlined in BIM execution plans and standards appear to be inadequate for complicated projects, such as the one presented in this paper. An advantage of the research given by Eastman (2011) is the utilisation of systemic theories to address the intricate interaction between project structures and processes. Likewise, the BIM methodology could gain advantages from a more comprehensive comprehension of the interconnected nature of the construction sector, with the aim of enhancing cooperation procedures. The current strategies for enhancing construction collaboration draw inspiration from successful methods in other industries, such as aerospace and automotive. Various studies (Alami et al., 2023; Chen, de Soto & Adey, 2018; Robinson & Mazzucato, 2019) have also supported the use of a systematic approach to tackle issues in the construction industry.

3. CONCLUSION

This article examines the responsibilities of BIM specialists and project managers, focusing on how the information subprocess centres around the BIM manager. It also discusses the effectiveness of the proposed BIM processes for cooperation, based on an experimental case study. The initial problem that arises is associated with the novel responsibilities necessitated by a BIM project, which encompasses the position of the BIM manager. The project manager's role is no longer the sole central position in the project. The BIM manager has now emerged as a significant participant, assuming some management responsibilities. The establishment of the information sub-process centred on BIM managers highlights the significance of information management in BIM projects and the necessity to precisely redefine the linkages and interactions between the workflow and the information flow. The information-centric strategy suggested by Chen et al (2020) for construction project management is highly valuable for the future. The final obstacle pertains to the efficacy of existing BIM processes (as advised in BIM execution plans or guidelines) in effectively facilitating the implementation of the BIM methodology in construction projects. These techniques appear to be overly general and fail to fully consider the intricate dynamics of the construction sector. Subsequent research will prioritise the modelling of novel cooperation and supply chain dynamics in Building Information Modelling (BIM) projects.

REFERENCES

Ahankoob, A., Manley, K., & Abbasnejad, B. (2022). The role of contractors' building information modelling (BIM) experience in realising the potential values of BIM. *International Journal of Construction Management*, *22*(4), 588-599.

Alami, A. H., Olabi, A. G., Alashkar, A., Alasad, S., Aljaghoub, H., Rezk, H., & Abdelkareem, M. A. (2023). Additive manufacturing in the aerospace and automotive industries: Recent trends and role in achieving sustainable development goals. *Ain Shams Engineering Journal*, *14*(11), 102516.

Barison, M. B., & Santos, E. T. (2010, June). An overview of BIM specialists. In *Proceedings of the International Conference on Computing in Civil and Building Engineering* (pp. 141-146). Nottingham University Press Nottingham, UK.

Bhawani, S. (2021). *A Function-Based Lean Construction Methods Ontology Supporting the Lean Implementation Planning Process Developed for Construction Projects*. The Pennsylvania State University.

Cao, D., Shao, S., Huang, B., & Wang, G. (2022). Multidimensional behavioral responses to the implementation of BIM in construction projects: an empirical study in China. *Engineering, Construction and Architectural Management*, *29*(2), 819-841.

Chen, Q., Adey, B. T., Haas, C., & Hall, D. M. (2020). Using look-ahead plans to improve material flow processes on construction projects when using BIM and RFID technologies. *Construction innovation*, *20*(3), 471-508.

Chen, Q., de Soto, B. G., & Adey, B. T. (2018). Construction automation: Research areas, industry concerns and suggestions for advancement. *Automation in construction*, *94*, 22-38.

Chileshe, N., Jayasinghe, R. S., & Rameezdeen, R. (2019). Information flow-centric approach for reverse logistics supply chains. *Automation in Construction*, *106*, 102858.

Cobb, C. G. (2023). *The project manager's guide to mastering Agile: Principles and practices for an adaptive approach*. John Wiley & Sons.

de Souza, M. P., Fialho, B. C., Ferreira, R. C., Fabricio, M. M., & Codinhoto, R. (2023). Modelling and coordination of building design: An experience of BIM learning/upskilling. *Architectural Engineering and Design Management*, *19*(1), 74-91.

Eastman, C. M. (2011). *BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors*. John Wiley & Sons.

Elbasheir Khalid Elbasheir, K. (2022). *Assessment of BIM Workflows for Construction Management: Case Study of Sevran Beaudottes Underground Station* (Doctoral dissertation, Politecnico di Torino).

Holtz, P. (2020). Does postmodernism really entail a disregard for the truth? Similarities and differences in postmodern and critical rationalist conceptualizations of truth, progress, and empirical research methods. *Frontiers in psychology*, *11*, 545959.

Hu, C. (2023). Leadership competencies within BIM-oriented project management; based on an analysis of project manager and BIM manager.

Huang, M. Q., Ninić, J., & Zhang, Q. (2021). BIM, machine learning and computer vision techniques in underground construction: Current status and future perspectives. *Tunnelling and Underground Space Technology*, *108*, 103677.

Jackson, B. J. (2020). *Construction management JumpStart: the best first step toward a career in construction management*. John Wiley & Sons.

Kerzner, H. (2022). *Project management metrics, KPIs, and dashboards: a guide to measuring and monitoring project performance*. John wiley & sons.

Lee, G., & Borrmann, A. (2020). BIM policy and management. *Construction management and economics*, *38*(5), 413-419.

Manzoor, B., Othman, I., & Pomares, J. C. (2021). Digital technologies in the architecture, engineering and construction (Aec) industry—A bibliometric—Qualitative literature review of research activities. *International journal of environmental research and public health*, *18*(11), 6135.

Marmol, G., Ferreira, D. P., & Fangueiro, R. (2021). Automotive and construction applications of fiber reinforced composites. In *Fiber Reinforced Composites* (pp. 785-819). Woodhead Publishing.

Mellado, F., & Lou, E. C. (2020). Building information modelling, lean and sustainability: An integration framework to promote performance improvements in the construction industry. *Sustainable cities and society*, *61*, 102355.

Norouzi, M., Chàfer, M., Cabeza, L. F., Jiménez, L., & Boer, D. (2021). Circular economy in the building and construction sector: A scientific evolution analysis. *Journal of Building Engineering*, *44*, 102704.

Olanrewaju, O. I., Chileshe, N., Babarinde, S. A., & Sandanayake, M. (2020). Investigating the barriers to building information modeling (BIM) implementation within the Nigerian construction industry. *Engineering, Construction and Architectural Management*, *27*(10), 2931-2958.

Olanrewaju, O. I., Kineber, A. F., Chileshe, N., & Edwards, D. J. (2022). Modelling the relationship between Building Information Modelling (BIM) implementation barriers, usage and awareness on building project lifecycle. *Building and Environment*, *207*, 108556.

Oswald, D., & Dainty, A. (2020). Ethnographic research in the construction industry: a critical review. *Journal of construction engineering and management*, *146*(10), 03120003.

Palacio Buendia, A. V., Pérez-Albert, Y., & Serrano Gine, D. (2021). Mapping landscape perception: An assessment with public participation geographic information systems and spatial analysis techniques. *Land*, *10*(6), 632.

Paparini, S., Green, J., Papoutsi, C., Murdoch, J., Petticrew, M., Greenhalgh, T., ... & Shaw, S. (2020). Case study research for better evaluations of complex interventions: rationale and challenges. *BMC medicine*, *18*, 1-6.

Priya, A. (2021). Case study methodology of qualitative research: Key attributes and navigating the conundrums in its application. *Sociological Bulletin*, *70*(1), 94-110.

Raza, M. S., Tayeh, B. A., Aisheh, Y. I. A., & Maglad, A. M. (2023). Potential features of building information modeling (BIM) for application of project management knowledge areas in the construction industry. *Heliyon*, *9*(9).

Regona, M., Yigitcanlar, T., Xia, B., & Li, R. Y. M. (2022). Opportunities and adoption challenges of AI in the construction industry: A PRISMA review. *Journal of open innovation: technology, market, and complexity*, *8*(1), 45.

Riazi, S. R. M., Zainuddin, M. F., Nawi, M. N. M., Musa, S., & Lee, A. (2020). A critical review of fragmentation issues in the construction industry. *Journal of Talent Development and Excellence*, *12*(2).

Robinson, D. K., & Mazzucato, M. (2019). The evolution of mission-oriented policies: Exploring changing market creating policies in the US and European space sector. *Research Policy*, *48*(4), 936-948.

Sacks, R., Wang, Z., Ouyang, B., Utkucu, D., & Chen, S. (2022). Toward artificially intelligent cloud-based building information modelling for collaborative multidisciplinary design. *Advanced Engineering Informatics*, *53*, 101711.

Sony, M., & Naik, S. (2020). Industry 4.0 integration with socio-technical systems theory: A systematic review and proposed theoretical model. *Technology in society*, *61*, 101248.

Takagi, N., & Varajão, J. (2020). Success management and the project management body of knowledge (PMBOK): An integrated perspective.

Vendrusculo, E. (2021). Development of Knowledge Management upon the use of BIM Technology.

Welch, C., Piekkari, R., Plakoyiannaki, E., & Paavilainen-Mäntymäki, E. (2020). Theorising from case studies: Towards a pluralist future for international business research. *Research methods in international business*, 171-220.

Xun, X., Zhang, J., & Yuan, Y. (2022). Multi-information fusion based on BIM and intuitionistic fuzzy DS evidence theory for safety risk assessment of undersea tunnel construction projects. *Buildings*, *12*(11), 1802.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17