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Driving Competitiveness Through Technology in Facilities Management

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Abstract – Advancements in technological innovations, driven by globalization, have significantly transformed the field of facilities management (FM). Modern tools such as drones, robotics, sensors, cloud-based platforms, and the Internet of Things (IoT) are now widely utilized by facilities managers to add value to organizations. These technologies not only impact the core operations of businesses but also influence their employees. Therefore, based on a comprehensive review of existing literature, it is recommended that facilities managers carefully evaluate the potential effects of adopting such innovations on their workforce.

This research proposes an alternative approach to enhancing the facilities management profession, which integrates multiple disciplines to ensure the seamless functionality of the built environment by combining people, place, process, and technology.

The study reveals that the integration of BIM in facilities management significantly reduces operational costs, improves maintenance efficiency, and enhances sustainability. The findings demonstrate a reduction in waiting times for issue resolution, highlighting the transformative potential of BIM in FM. These outcomes underscore the importance of adopting advanced technologies to achieve competitive advantages in the built environment.

Keywords: Facilities Management, Technological Innovations, Human Resource Management, Digital Transformation, Building Information Modelling

I. Introduction

Technological innovations have become a cornerstone of the built environment, driving significant advancements that enhance business operations and strengthen competitiveness in the global economy. The scope of facilities management (FM) has expanded beyond its traditional roles of designing, constructing, and maintaining buildings to include a wide array of support services such as landscaping, fleet management, human resources, and food services. Consequently, the adoption of advanced technological tools has become indispensable for achieving operational efficiency.

Building Information Modeling (BIM) is a digital framework that represents the physical and functional characteristics of a building, serving as a critical tool for planning, design, construction, and management. Facilities Management (FM), on the other hand, involves the strategic coordination of people, place, process, and technology to ensure the functionality, safety, and sustainability of built environments.

This study aims to investigate how cutting-edge technologies, particularly BIM, can revolutionize facilities management practices. By examining the Manchester Town Hall Complex as a case study, the research delves into the challenges and advantages of BIM implementation, with a focus on improving operational efficiency, reducing costs, and promoting sustainability. The study also addresses industry-specific issues such as interoperability and data accuracy, offering practical insights for FM professionals to enhance their practices.

As a multidisciplinary field, facilities management integrates people, place, process, and technology to create functional, safe, and productive built environments. These interconnected elements form the foundation for optimizing workplaces, with technology playing a central role in streamlining facility managers' operations and improving customer experiences. This highlights the transformative impact of technology on modern FM practices.

A. Research Problem

The application of building information modeling (BIM) in facilities management (FM) faces some complex challenges. These challenges include:

- Understanding of facilities management is still limited in the construction sector.
- There is difficulty in determining the accurate data that (FM) specialists need during the operation and maintenance phases.
- The initial investment in a BIM application poses a financial challenge for many organizations.
- The gap between different BIM programs and applications, which hinders the efficient exchange of data and information.

B. Research Question

How can state of the art technologies such as BIM address key challenges in facilities management?

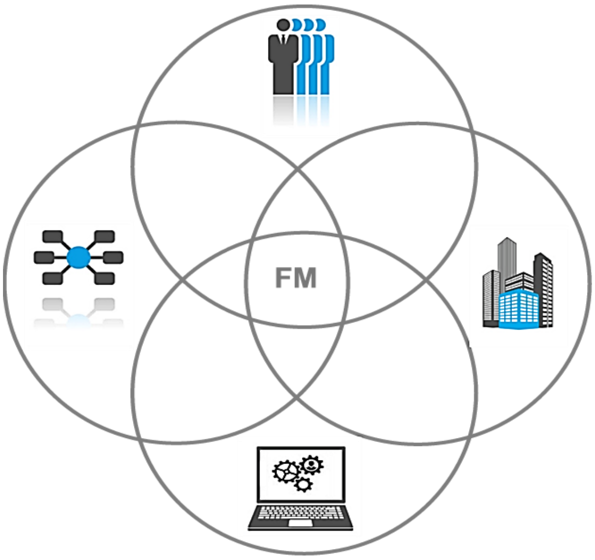


Fig. 1.: Facilities Management Scope

C. Facility Management

Facility management (FM) is a multidisciplinary profession dedicated to ensuring the functionality, safety, and sustainability of the built environment. It achieves this by integrating people, place, process, and technology. FM encompasses a wide range of responsibilities, including maintenance, space planning, energy management, health and safety, asset management, and support services. By optimizing operational efficiency and enhancing occupant comfort, FM aligns facilities with organizational objectives, creating environments that are both productive and sustainable.

Implementation requires clear goals, skilled personnel, accurate data, and modern tools like CAFM or BIM. Key needs include adequate resources, regulatory compliance, stakeholder collaboration, and continuous improvement to align operations with organizational objectives and ensure efficiency.

Fig. 2.: Facilities Management Implementation Needs

Tools enhance efficiency and decision-making. Key tools include CAFM for maintenance and asset tracking, IWMS for integrated facility management, BIM for centralized 3D modeling, and EAM for asset optimization. EMS reduces energy consumption, IoT enables real-time monitoring, and mobile apps support remote management, ensuring streamlined operations and cost savings.

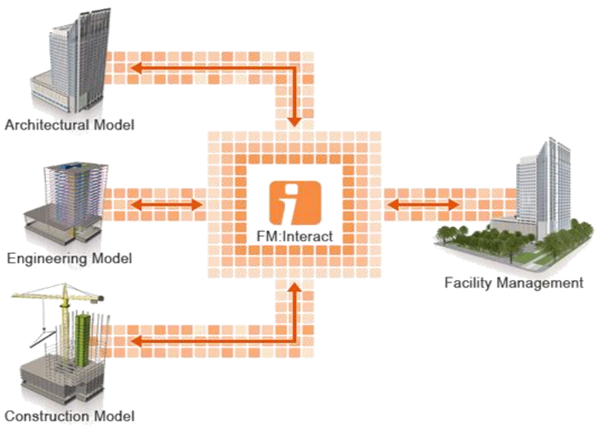


Fig. 3.: Facilities Management FM Tools

D. Building Information Modelling

Computerized Maintenance Management Systems (CMMS) and Computer-Aided Facility Management (CAFM) software applications are often used to handle repetitive, time-consuming, and duplicative data recollection tasks that, while necessary, do not directly add value to the cost of building operations.

Building Information Modeling (BIM), an advanced Information and Communication Technology (ICT) innovation, has gained significant popularity across the building life cycle. One of BIM's key advantages is its ability to provide data-rich information from earlier project stages, which can be transferred and reused during the facilities management (FM) stage in the form of an as-built model.

In construction, BIM data serves multiple purposes: it enables contractors to simplify cost estimation through automated quantity take-offs, facilitates clash detection to ensure that designs are buildable, and ultimately reduces errors and change orders.

E. BIM MATURITY LEVELS:

BIM maturity levels are used to assess the level of development and implementation in a BIM project. These levels are valuable as they clarify the expectations for the supply chain's deliverables while enabling the client to understand precisely what the supply chain is offering.

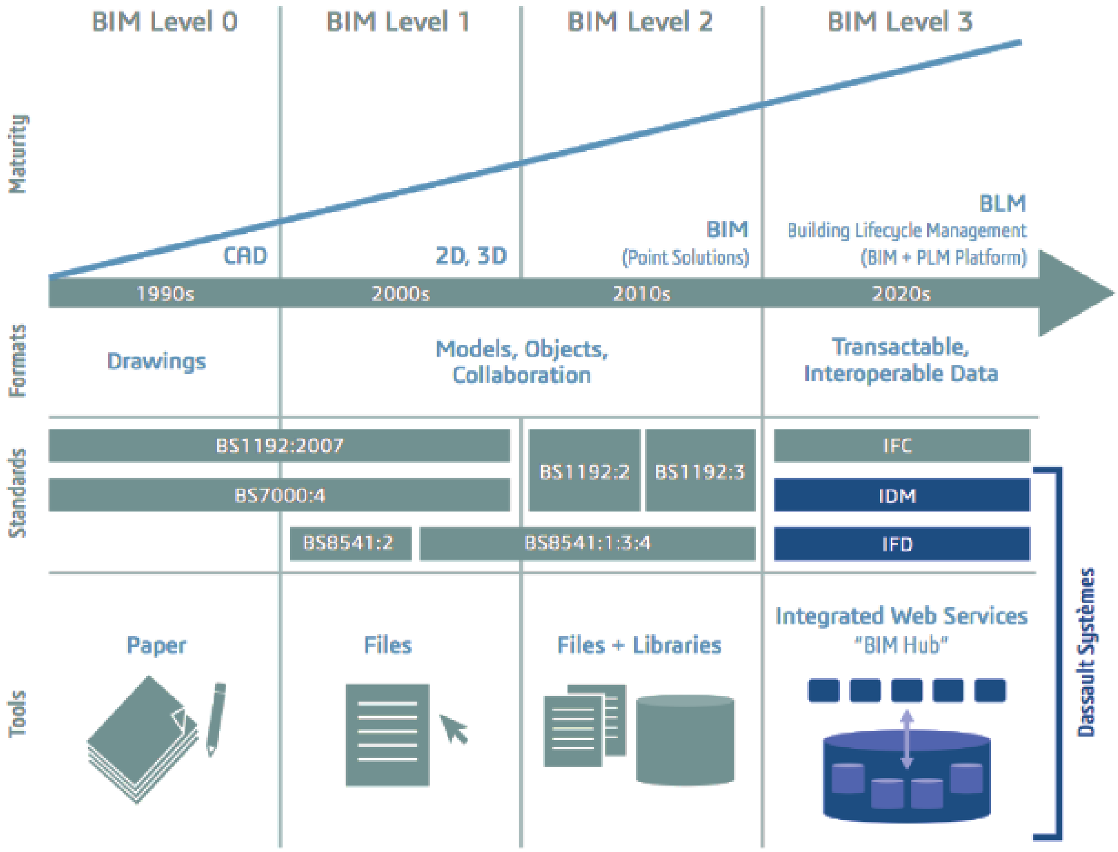


Fig. 4.: Maturity level

F. BIM five fundamental Dimensions

At its core, Building Information Modeling (BIM) revolves around building geometry but also serves as a structured database of non-graphical information. This information provides comprehensive details about the identity and properties of building components.

BIM maturity levels describe the progression of a BIM project through sequential operations, from initial planning to final delivery, ensuring consistency and clarity across all stages.

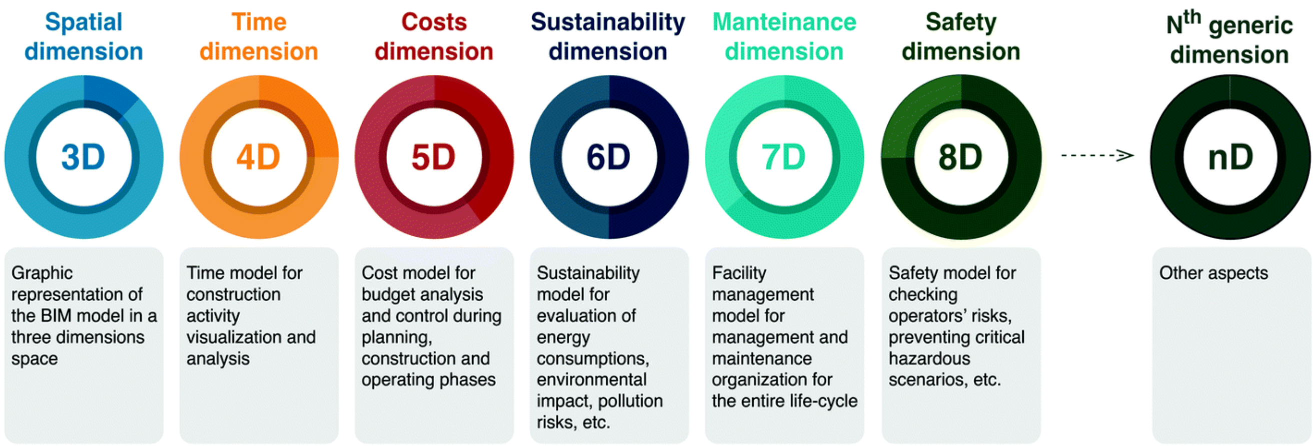


Fig. 5.: BIM Fundamental Dimensions

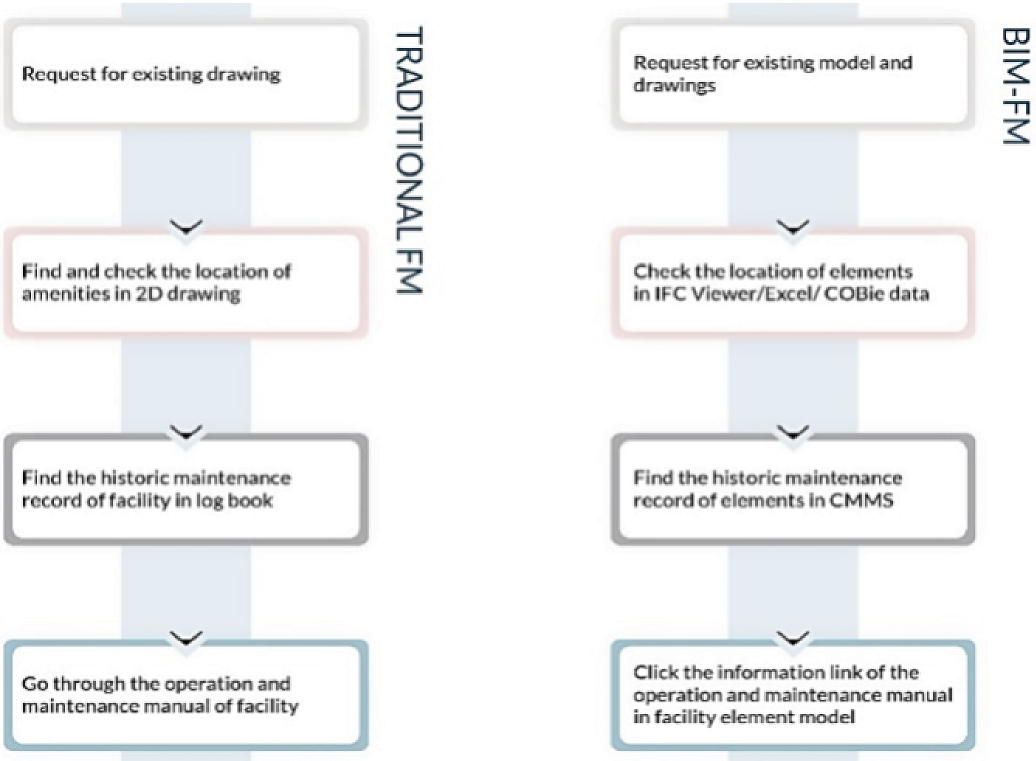


Fig. 6.: Difference between traditional FM and BIM

G. Difference between traditional FM and BIM

Traditional Facilities Management (FM) often depends on manual processes, fragmented documentation, and 2D drawings, resulting in inefficiencies, outdated information, and a reactive approach to maintenance. In contrast, Building Information Modeling (BIM) for FM leverages a centralized 3D digital model that integrates real-time building data, improving visualization, collaboration, and decision-making.

BIM enables predictive maintenance, reduces operational costs, and promotes sustainability by streamlining operations throughout the building's lifecycle. This makes BIM a far more efficient and proactive alternative to traditional FM practices.

II. - CASE STUDY

Manchester Town Hall Complex:

The Town Hall Complex Transformation Program involved the refurbishment of the Town Hall extension and the central library, both recognized as Grade II* listed buildings.

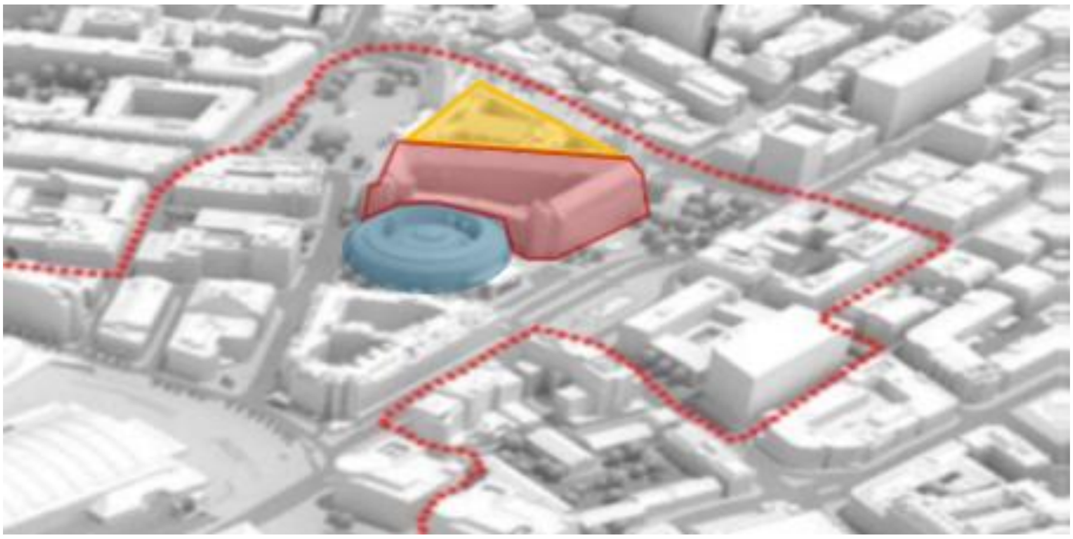


Fig. 7.: Manchester City Council

- Design and Completion: Designed by E. Vincent Harris in 1927 and completed in 1938.
- Location: Manchester, United Kingdom
- Project Value: £100 million
- Key Participants:
- Client: Manchester City Council
- Contractor: Laing O'Rourke
- Architects: Ryder Architects, Ian Simpson Architects
- Structural Engineer: Scott Wilson
- Environmental Engineer: BDP
- Fire Engineer: Arup Fire
- Mechanical & Electrical Engineers: NG Bailey
- Project Timeline: Start - April 2011, Completion - 2014

III. Project Scope

Opening Historic Spaces: Making significant historic areas, such as the Rates Hall and the Electricity and Gas showrooms, accessible for public use.

Creating Welcoming Customer Service Areas: Opening up the "heart" of the building to foster customer service and designing a series of inviting spaces.

Repurposing the Council Chamber: Retaining the Council Chamber and its associated facilities on Level 3, transforming them into a versatile suite of bookable meeting spaces.

Flexible Work Environments: Developing flexible, open-plan office spaces across all office levels to support modern working practices.

A. Process-BIM Stages of develop.

Design and Construction Level Assessment: This process involves splitting the work into five teams, with specific tasks assigned to each team for implementation.

1. Architecture Team 1 (AT1) – Design Stage: The BIM maturity level of AT1 is assessed, showing that it varies significantly. The maturity is high in areas directly related to architectural development but lower in business-related areas, such as supporting change management.
2. Architecture Team 2 (AT2) – Detailing Stage: BIM maturity for AT2 follows a similar pattern as AT1.
3. Mechanical, Electrical & Plumbing (MEP) Firm: This team is responsible for their respective disciplines, focusing on integrating BIM to enhance project efficiency.
4. Contractor: The contractor's involvement in BIM is assessed, ensuring that construction practices align with the BIM model.
5. Cross-Analysis and Overview: A comprehensive analysis and overview of the BIM maturity across all teams, ensuring integration and identifying areas for improvement.

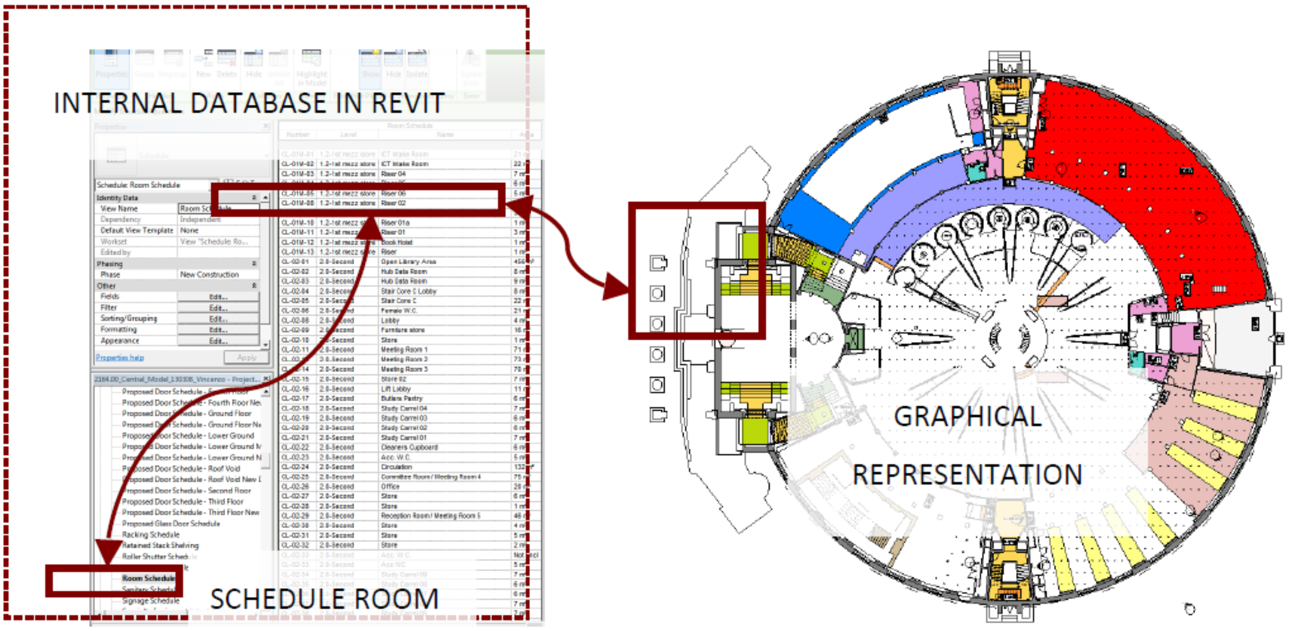


Fig. 8.: View of bidirectional link between data and visual representation for ALT1

Fig. 9.: For AT1: Refer to the phases of the project.

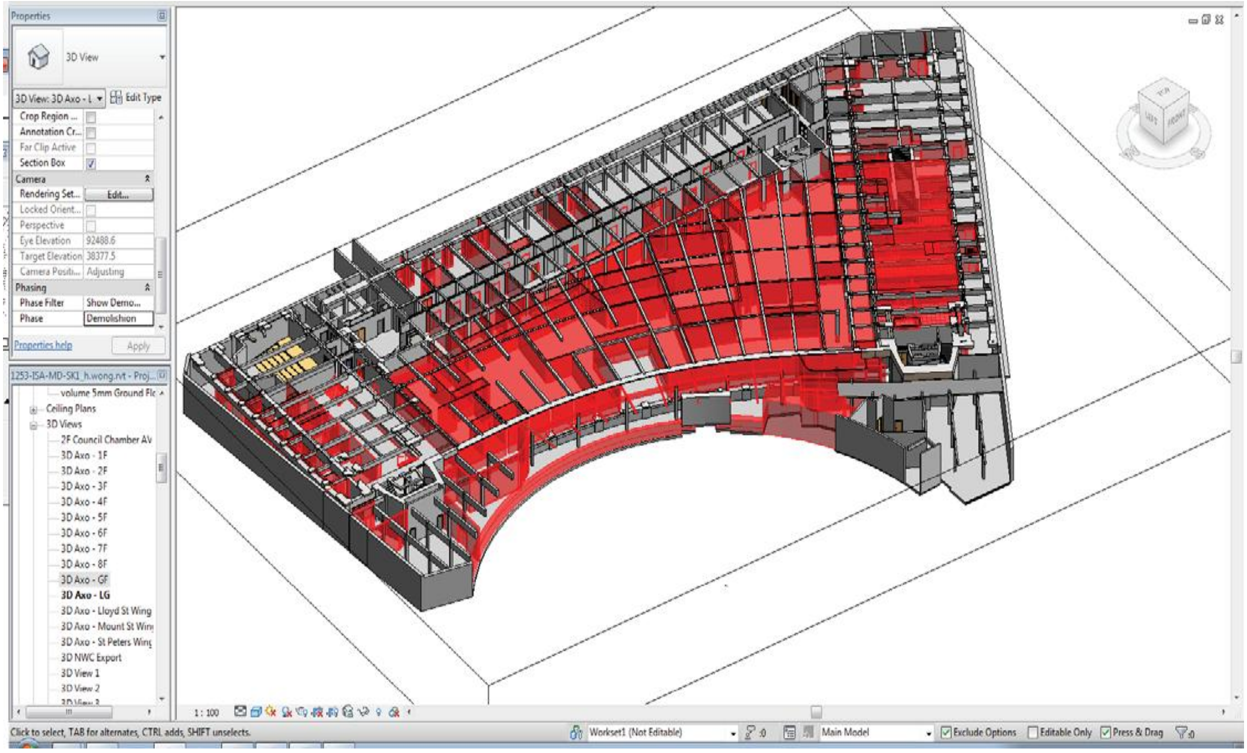


Fig. 10.: AT2: The model has 3 phases, existing, demolition, and new construction.

IV. Methods

It can be confidently stated that the primary application of BIM during the observed period was visualization to support decision-making. The model's capacity to communicate design information to the project team, as well as to individuals unfamiliar with 2D drawings, was considered highly valuable and suitable. Initial 3D images are presented to showcase this feature, along with additional figures demonstrating other uses of BIM.

Fig. 11.: Public Space -Working Without Walls

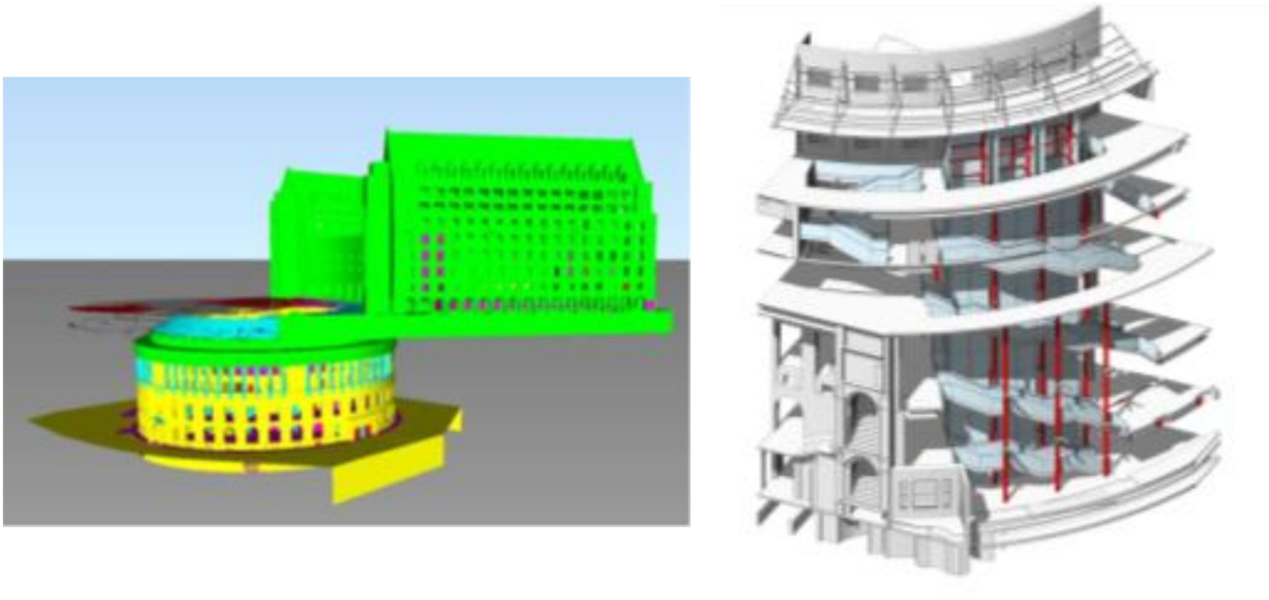


Fig. 12.: Central Library –Removal of Existing Book Stacks

V. Results

- The project was completed by the specified deadline.
- The project was delivered within the authorized budget.
- There was a significant reduction in man hours, ranging from 57% to 80%.
- Although individual savings per task were relatively small (8 to 13 hours), the repetitive nature of maintenance operations led to substantial annual savings.
- The main benefit was a dramatic reduction in waiting time to address issues, ranging from 96% to 99%, minimizing disruptions and inconveniences for users, thus helping to avoid reputational damage.
- BIM demonstrated significant and measurable value in operational facilities management (FM).

VI. Survey Analysis

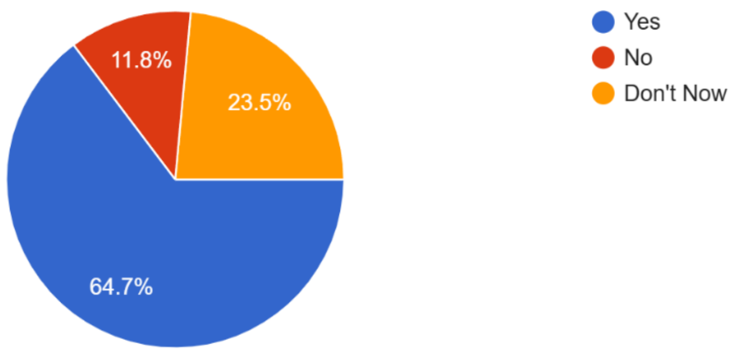
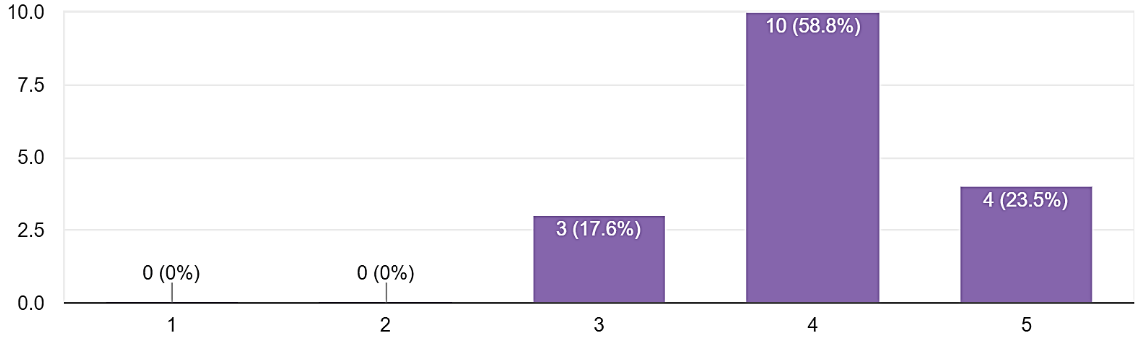
The primary objective of this survey is to assess the accuracy of data within BIM models used for facilities management. It aims to measure the impact of BIM on the efficiency of maintenance and repair operations, as well as identify the key factors influencing the successful application of BIM in projects. This understanding will help address the challenges faced in facilities management techniques, which are crucial to achieving the goals of strategic facilities management.

The survey was conducted with a target group of **30** participants.

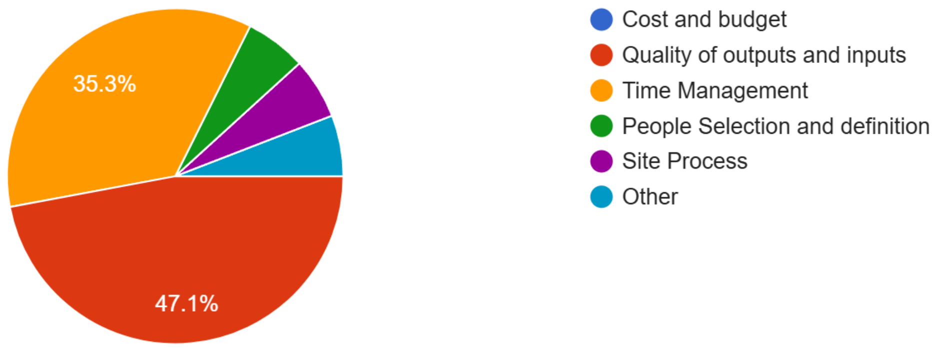
Target group:

- Owner - Architect - Engineer (Mechanical, Electrical, Civil)
- Contractor (General) or (Specialty) - Facility / Property Manager - Chief Engineer
- Facility Technician / Mechanic – Consultant

Table I – A Survey To Measure The Efficiency Of The Impact Of BIM And Identify The Factors Affecting The Success Of BIM Application In Facility Management In Projects

1	As we can define facility management is the branch of management which involved with mange (People, Technology, Process, and Place). Has your company ever been involved with Facility Management? 
2	Which process of facility management does your company use in managing projects? 
3	As compared with other Working places you frequent, descript how many degrees BIM can Improve Facility Management 

<table>
<tr><td>4</td><td>Which Scope will improve Form Implement BIM in FM?



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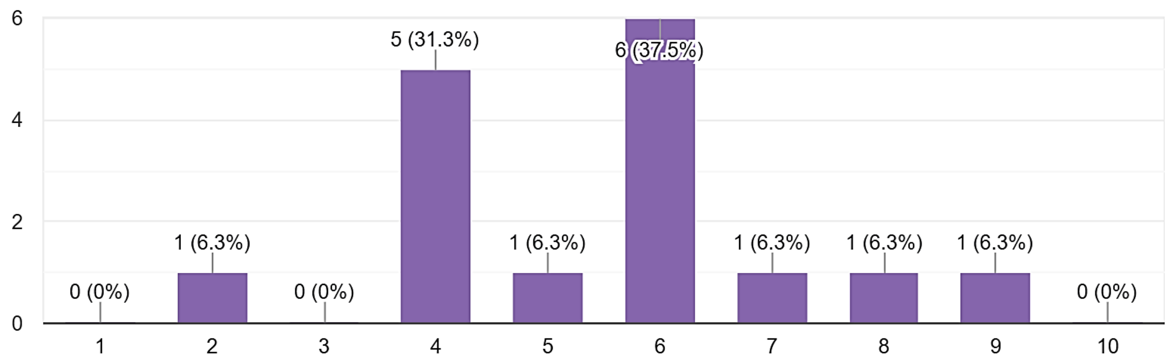
<tr><td>5</td><td>As noted, the five LOD (level of development throw the project), (100LOD-pre-design, 200LOD-schematic design, 300design development, 400LOD construction process, 500LOD as built) Descript which level of development your company can provide without problems.



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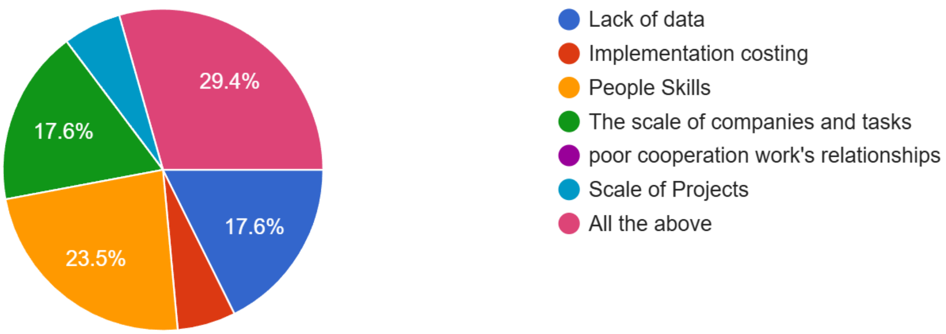
<tr><td>6</td><td>Specify what the most problems faced your company to implement BIM in FM



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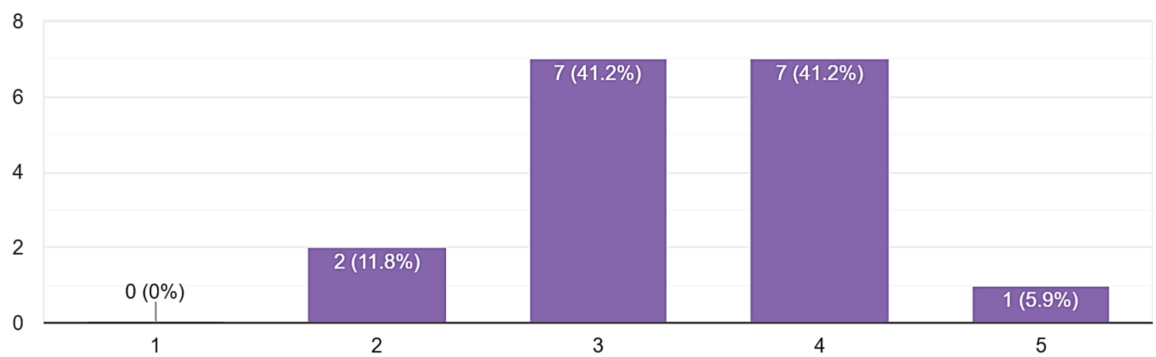
<tr><td>7</td><td>Specify for which degree the project fulfils the planning scope, aims, and requires after final delivery to the owner.



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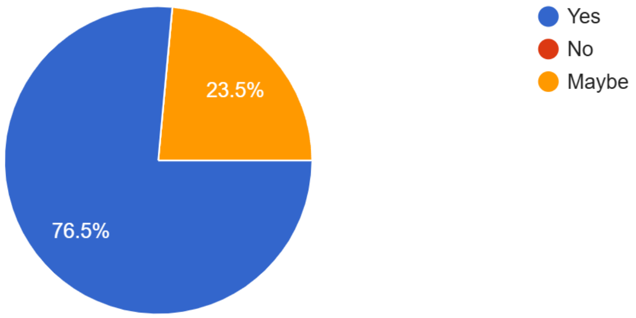
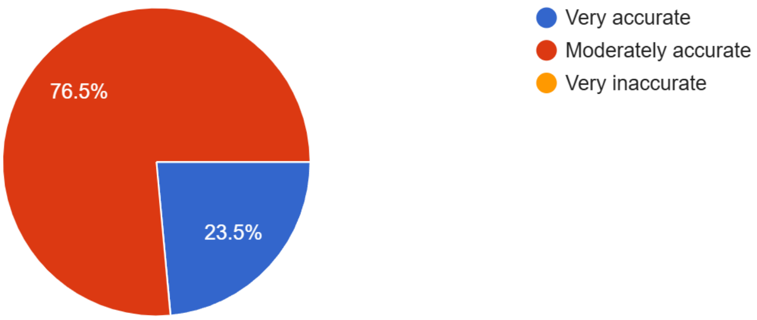
8	Can the complete implementation of BIM, carried out by fully trained, knowledgeable, and experienced construction professionals, lead to substantial reductions in costs and errors? 
9	How accurate is the current data of new technologies in FM (BIM, visualization VI, Internet of Things? Machine Learning) 

VII. Conclusion

- BIM innovations help in reducing overall project costs, improve management efficiency, and enhance lifecycle assessments in construction projects.
- They also increase productivity and accuracy while minimizing cycle times, waste, and inefficiencies.
- Furthermore, these technologies promote sustainability and facilitate better management of buildings throughout their entire lifecycle.
- Based on the findings, it is recommended that FM professionals prioritize the adoption of BIM and IoT technologies to streamline operations and reduce costs.
- Future research should focus on developing standardized protocols for BIM data integration and addressing interoperability challenges.
- Additionally, training programs for FM staff on BIM tools and processes should be implemented to maximize the benefits of these technologies.

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