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Change Management of Organizational Digital Transformation: A Proposed Roadmap for Building Information Modelling-Enabled Facilities Management

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Abstract: Building Information Modelling (BIM) plays a pivotal role in the digitization of facilities management (FM), fundamentally transforming the built environment sector. However, managing the change in organizations to successfully transition into a BIM-enabled FM system remains a significant challenge. To address this, this paper starts with a literature review of existing theories and practices of change management and digital transformation in the built environment sector. Based on the analysis of barriers and strategies identified in the literature review, a five-step roadmap for change management in BIM adoption is proposed. It includes establishing a change management team, conceptualizing the initiative, developing an implementation plan, managing the transition phase, and maintaining the change. The roadmap aims to guide organizations to effectively adopt BIM for FM, resulting in streamlined transition, enhanced operational efficiency, and improved asset performance. Further research is needed to validate the proposed roadmap and its potential for generalization to other sectors and countries.

Keywords: roadmap; Building Information Modelling; change management; digital transformation; facility management

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1. Introduction

The advent of digital disruption, a phenomenon characterized by profound shifts in the cultural, market, industry, or process paradigms due to digital innovations [1], has precipitated transformative changes across various sectors. In the realm of facility management (FM), this disruption is predominantly manifested through the integration of Building Information Modelling (BIM) [2]. BIM, a sophisticated digital tool, facilitates the creation, management [3], and utilization of a comprehensive 3D model of a building [4], encompassing its entire physical and functional attributes [5]. This paradigm shift extends beyond mere technological advancement, heralding a new era in FM characterized by enhanced operational efficiency, cost-effectiveness, and superior building performance [6].

The incorporation of BIM into FM practices offers a multitude of benefits [7–12]. It equips FM professionals with an intricate digital representation of facilities, accessible throughout their lifecycle, thereby significantly augmenting the management of building information [13]. This enhancement is pivotal in optimizing operational performance, achieving cost reductions, and ensuring the safety and comfort of building occupants [14]. Moreover, BIM engenders improved collaborative synergies among diverse stakeholders, including architects, engineers, and contractors, by facilitating the utilization of a unified

digital model [15,16]. This collaborative approach is instrumental in enhancing communication, minimizing errors, and streamlining project execution [17]. Additionally, BIM's capabilities in automated monitoring and predictive reporting are crucial in optimizing building operations and maintenance endeavors [18].

Notwithstanding these advantages, the assimilation of BIM within FM is replete with challenges, predominantly in the domain of organizational change [19]. The transition to BIM-enabled FM necessitates the deployment of robust change management strategies [20]. Such strategies encompass a comprehensive assessment of the change impact, the development and articulation of an implementation plan, and the provision of requisite training and support to ensure a seamless transition [21].

Despite the burgeoning recognition of BIM within the Architecture, Engineering, and Construction (AEC) industry [22] and its manifest benefits, its adoption within the FM sector is comparatively nascent and faces resistance [23,24]. This research endeavors to bridge this gap by proposing a roadmap for the adoption of BIM in FM, underpinned by change management principles. This roadmap aims to systematically guide organizations through the intricacies of adopting BIM in FM, thereby maximizing its potential benefits for FM.

In essence, the FM industry, tasked with the effective stewardship of physical assets, confronts a spectrum of challenges, including inefficient data management, suboptimal collaboration, and inadequate asset performance tracking. BIM emerges as a quintessential tool in navigating these challenges and enhancing the efficacy of FM processes. However, the transition to a BIM-enabled FM paradigm is contingent upon a comprehensive change management process, which constitutes the focal point of this study.

1.1. Research Question and Method

The primary research question addressed in this study is as follows: how can change management principles be effectively integrated into a roadmap to aid organizations in the built environment sector in their transition to BIM-enabled FM? To answer this, this study employed a literature review, formulating a five-step roadmap for BIM-enabled FM digital transformation. The proposed methodology integrates change management principles with BIM practices. This approach encompasses team establishment, initiative conceptualization, detailed planning, transition management, and sustainability mechanisms, all aimed at optimizing operational efficiency in the built environment sector.

1.2. Theoretical Framework

The theoretical framework of this study is rooted in the intersection of change management theories, digital transformation models, and the application of BIM in FM. By integrating the principles of change management [19,25,26] with the intricacies of digital transformation and the collaborative and data-centric nature of BIM in FM, this study presents an integrated roadmap. It aims to address the challenges and strategies vital for a successful transition to a BIM-enabled FM system, offering organizations in the built environment sector a structured perspective on digital transformation.

2. State of the Art: BIM for FM

This section aims to set the context and define the scope of the review, focusing on the pivotal role of BIM in FM, the challenges of digital transformation in this domain, and critically effective change management strategies for successful BIM-FM implementation.

2.1. The Role of BIM in FM

BIM represents a significant shift in FM, offering a digital approach to managing building assets throughout their lifecycle [27,28]. BIM's integration into FM practices has been increasingly recognized for its potential to streamline operations and enhance collaboration among stakeholders [29,30]. Several studies [31–33] have demonstrated how BIM facilitates efficient data management and operational workflows, leading to improved

decision-making processes in FM. Additionally, research indicates that while new buildings constitute only 1–2% of the building count, the focus on BIM applications in FM is primarily on these new constructions [34,35]. The operational and maintenance costs, which are estimated to be 5 to 7 times the original investment, underscore the importance of BIM throughout a facility's lifecycle [36,37].

2.2. Challenges in Digital Transformation for BIM-Enabled FM

Transitioning to BIM-enabled FM involves significant challenges, particularly at the organizational level. Key barriers include resistance to technological change, the need for significant upskilling, and the integration of new workflows into existing systems. Research [9,10,38] highlights these challenges, emphasizing the necessity for strategic approaches to manage this digital transformation. The literature suggests that the success of BIM implementation in FM is as much about managing organizational change as it is about technological adoption. Studies have also shown that a significant amount of time and effort is spent retrieving information from electronic and physical documents, leading to frequent redundancy [23,39].

2.3. Change Management Strategies in BIM-FM Adoption

Effective change management strategies are crucial for the successful adoption of BIM in FM. The literature in this domain has identified several strategies that have proven strategies. These include comprehensive stakeholder engagement, phased implementation plans, and continuous training programs [40]. For example, Liao and Teo [41] demonstrated how structured change management approaches could mitigate resistance and foster a culture receptive to BIM technologies in FM settings. These strategies are not only about managing the transition but also about sustaining the change for long-term benefits. Additionally, the literature indicates that BIM's greatest benefits lie in the operation and maintenance (O&M) phases of a building's lifecycle [42].

2.4. Gaps in Current Research and Practice

While there is extensive research in the literature on BIM adoption and change management, there remains a notable gap in research specifically addressing comprehensive change management frameworks tailored for BIM in FM [42]. This gap suggests a need for more focused research on developing and validating structured methodologies that cater specifically to the nuances of BIM implementation in FM. This is where the proposed roadmap in this study aims to contribute, offering a structured approach to facilitate and sustain BIM adoption in FM environments.

This section has synthesized key aspects of BIM in FM, the challenges of digital transformation, effective change management strategies, and the gaps in current research. The insights gained lay a solid foundation for the proposed roadmap, which is aimed at addressing these identified gaps and facilitating a structured approach to BIM adoption in FM.

3. Methodology

This study adopts a multidisciplinary approach, integrating change management theories, digital transformation models, and BIM practices in FM. The methodology encompasses a focused literature review and the formulation of a structured roadmap for BIM-enabled FM.

3.1. Literature Review

The literature review conducted in Section 2 synthesizes the key elements of BIM in FM, focusing on the challenges of digital transformation, effective change management strategies, and the gaps in current research. It provides a foundation for the proposed roadmap aimed at addressing these gaps and facilitating a structured approach to BIM adoption in FM.

3.2. Roadmap Formulation

Informed by the literature review, a five-step roadmap is conceptualized to guide organizations in adopting BIM for FM. This roadmap integrates principles of change management and BIM practices, focusing on team establishment, initiative conceptualization, detailed planning, transition management, and long-term sustainability.

3.3. Validation and Generalization

The proposed roadmap will undergo validation through expert interviews and case studies in real-world FM settings in a future study. This phase aims to refine the roadmap and assess its applicability across various sectors and geographical contexts. The limitations of the current approach and avenues for future research, including broader empirical testing and adaptability studies, are also identified.

4. Proposed Change Management Roadmap for BIM-Enabled FM

In the evolving field of FM, the integration of BIM represents a paradigm shift, necessitating strategic management for effective transition [43]. The challenges in this transition are multifaceted, encompassing technological aspects [44–48], cost-related issues [32,48–54], and legal and contractual considerations [46,53,55,56]. Furthermore, the integration of BIM into existing systems introduces complexities related to interoperability [28,42,47,55,57–65]. The proposed roadmap in this paper offers a method for the smooth transition to BIM-enabled FM.

The proposed change management roadmap, as shown in Figure 1, comprises five steps. Adapted from conventional change management models and insights from digital transformation studies [21,66], the roadmap is designed with a generic framework. This universality ensures its applicability and adaptability for diverse organizational contexts.

Figure 1. Change management roadmap.

4.1. Organizing a Change Team

4.1.1. Strong Leadership

The initiation of the change management process hinges on establishing strong leadership, drawing from models like Kotter's 8-Step Change Model [59] and Prosci's 3-Phase Process [67]. The leader, ideally a senior manager or someone with significant influence, should possess the ability to strategically drive and steer the change initiative [68]. This role involves influencing stakeholders and managing change from a strategic perspective.

- Actions: identify a leader who demonstrates commitment to change and strategic thinking.
- Timeline: complete within the first two weeks of the roadmap initiation.
- Resources: access to organizational resources and decision-making authority.

4.1.2. Change Management Team

The change leader is tasked with assembling a multidisciplinary team comprising individuals from various departments, with a focus on the existing FM team due to their familiarity with the BIM system requirements and challenges [68].

- Actions: 1. The selection of team members based on expertise and departmental representation. 2. The inclusion of a senior member capable of implementing decisions. 3. The addition of a planning division member for resource oversight. 4. The

engagement of external BIM consultants or managing agents for system selection and feasibility assessment.
- Timeline: Formation of the team within one month of leadership assignment.
- Resources: Human resources from within the organization, along with external consultants as needed.

4.2. Formulating the Change

4.2.1. Identify and Define the Need for Change

Initiating change begins with recognizing its necessity at a strategic level, incorporating stakeholder requirements [69]. Key stakeholders, including FM team members, operational teams, contractors, managing agents, and senior management, are identified and analyzed using the stakeholder power/interest grid (Figure 2). This grid categorizes stakeholders based on their power (ability to influence outcomes) and interest (level of concern or involvement) into the following four quadrants: high power/high interest, high power/low interest, low power/high interest, and low power/low interest. This classification helps to prioritize stakeholder engagement and manage their impact on the change process. Utilizing the stakeholder grid, we assess challenges and opportunities from various perspectives, thereby shaping effective plans and enhancing an awareness of the change initiative's purpose [70].

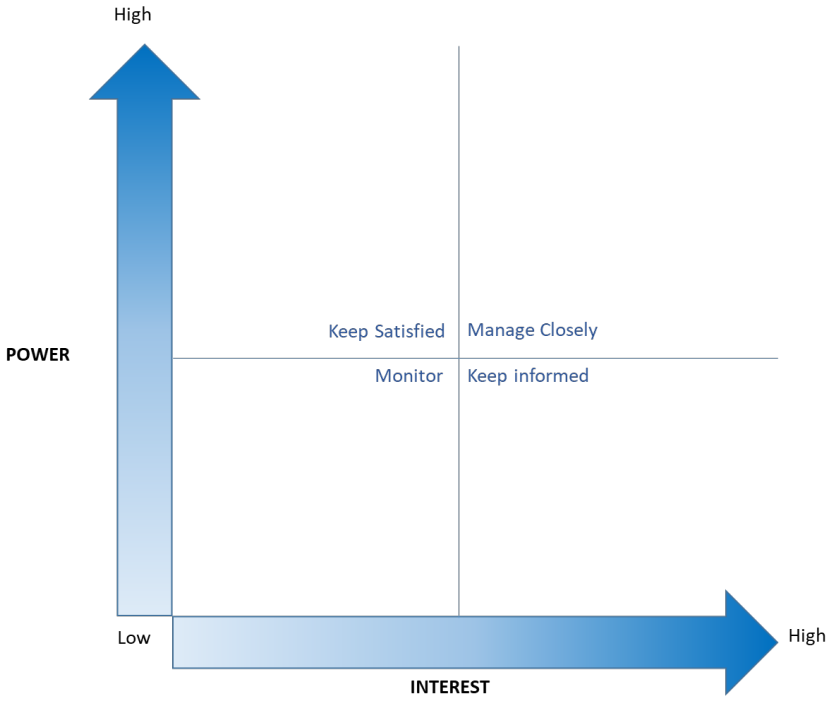

Figure 2. Stakeholder power/interest grid.

4.2.2. Delineating Scope of Change

It is recommended that the change manager develop a clear vision and strategy aligned with the organization's goals [71]. This involves a three-step process: identifying critical success factors (CSFs) for the change, defining measurable key performance indicators (KPIs) for each CSF, and creating a detailed roadmap or benefits register [72]. For BIM implementation in FM, CSFs could include time savings and improved information accuracy. A benefit breakdown structure, as shown in Figure 3, organizes the strategic objective, its benefits, outcomes, actions, and deliverables. Strategic objectives are long-term goals, benefits are the expected positive results, outcomes are the specific changes anticipated, actions are the steps towards these goals, and deliverables are the tangible products of these objectives. Ideally, there should be 5 to 8 CSFs focusing efforts on high-impact actions.

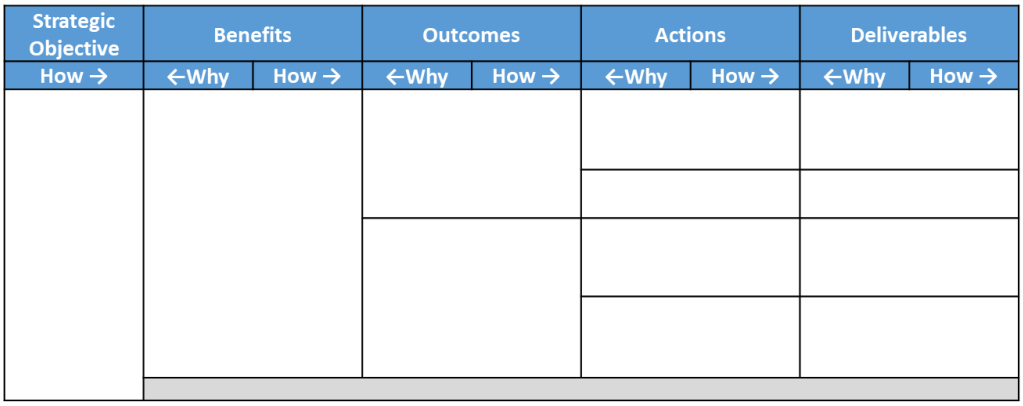

Figure 3. Benefits breakdown diagram.

To prioritize CSFs in BIM adoption for FM, the pairwise comparison method is recommended for evaluating their relative importance [73]. After ranking the CSFs, the team, with key stakeholder involvement, defines the success metrics. This involves setting target levels and practical evaluation methods for each criterion. KPIs for BIM implementation in FM might include the BIM execution plan [42], time and cost savings [74], the collaboration protocol [75], return on investment (ROI) [76], BIM maturity level [77], and integration with other systems like CMMS and ERP [49]. An example is shown in Table 1. The choice of KPIs should align with the organization's specific goals for BIM adoption [78].

Table 1. KPIs for the BIM adoption of FM.

Areas	KPI	Criterion	Target Level	Flexibility
Manhour saved	Manhours saved retrieving information	Hours per month	10	2
	Manhours lost while locating incorrect service locations	Hours per month	5	3
Cost savings	Cost saved from reactive maintenance	Percentage saved on maintenance	5%	1%
Accurate information handover	Incidents due to poor handover of information	Number per year	0	1

4.3. Planning the Change

4.3.1. Organize Stakeholder Engagement

Effective communication is critical for success and managing resistance. Stakeholder engagement, involving all relevant parties like the FM team and senior management, is essential. The change team should develop a roadmap with key milestones, ensuring stakeholder involvement at each stage, particularly for significant BIM service integrations [68].

4.3.2. Plan Transition and Integration

In the development of the BIM model for FM, a phased approach is recommended, where pilot projects focus on testing changes in specific services [79]. Acknowledging and celebrating the successful integrations from these pilots is crucial, as the insights gained can significantly guide broader implementation strategies. The change plan should be flexible, emphasizing the regular delivery of results to sustain support and engagement [80].

4.4. Managing the Change Transition

4.4.1. Implement a Training Plan

Given BIM's primary focus on design and construction, FM team members may require extensive training [10]. The early initiation of this training helps ease resistance and facilitate BIM adoption [81].

4.4.2. Assessment Result and Benefits

The continuous assessment of the transition's performance is crucial. This includes evaluating work practice changes, skillset enhancements, and overall organizational performance. Short-, medium-, and long-term goals should be set for BIM adoption, focusing on reducing reliance on traditional data sources and fully integrating BIM into FM processes.

4.4.3. Adjustments to Address Deviations and Resistances

The change initiative, particularly in BIM-FM integration, must adapt at each milestone, considering internal and external shifts that influence implementation and goal fulfillment. Resistance is a natural response to change, often stemming from a preference for the status quo over perceived risks [82]. Concerns about adapting to new operational methods, managing the BIM system, increased workload, and organizational restructuring contribute to this resistance.

The effective management of resistance is critical. A recommended approach is Kurt Lewin's force field analysis (Figure 4), which helps identify the driving and restraining forces within an organization [82]. This analysis involves scoring these forces based on their impact on the change process and strategizing them to strengthen positive forces while mitigating resistance [83]. Incentivizing change, such as through rewards or recognition, and ensuring proper training can facilitate acceptance and successful implementation.

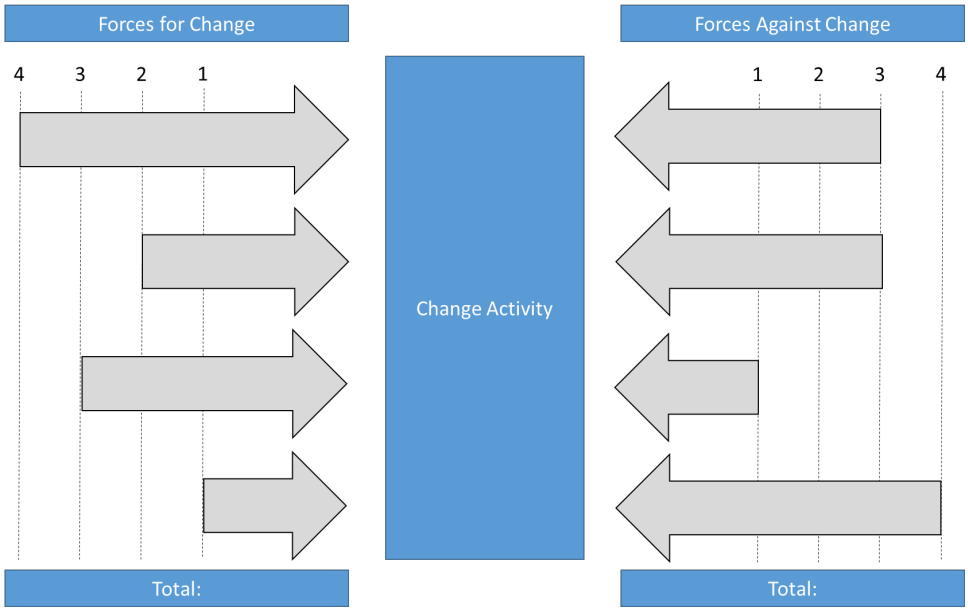

Figure 4. Force field analysis tool.

4.5. Sustaining Change

4.5.1. Conduct Sensemaking Activities

To solidify the change, the FM and change teams must engage in sensemaking activities. These include conducting interviews, workshops, and team meetings to foster a comprehensive understanding of the transition's impact. The goal is to seamlessly integrate the changes, continually monitoring and adapting to feedback from all stakeholders, which is crucial in ensuring the success and sustainability of the transition.

4.5.2. Assessing Benefits Realization

Assessing the realization of benefits is a critical component of sustaining change. This assessment, conducted progressively, gauges the transition's effectiveness in meeting organizational objectives. By employing benefit maps and a structured benefits register (depicted in Figure 5), the change team can effectively track and report the progress of each

identified benefit, ensuring their alignment with the strategic goals. The benefits register, while particularly relevant to multi-project initiatives, can be adapted for broader strategic oversights in the context of an organization's broader digital transformation agenda.

Strategic Objective	Benefits	Projects	Business Expectation/ Measure of Success
Implement BIM in Facility Management	Revised FM workflow	Map Electrical Systems in the BIM 3D Model	Reduce time spent on documentation and improve accuracy of data
		Adopt maintenance scheduling into BIM	Improve clarity on maintenance regime
	Improved competency in staff	Training FM team in BIM	Reduce resistance and equip staff with skillset
	...	...	...
		...	...
		...	...

Figure 5. Benefits register.

4.6. Evaluation of Change Management Success

In this study, successful evaluation combines quantitative metrics like timeline adherence, budget compliance, and BIM system performance with qualitative indicators, including stakeholder satisfaction, employee engagement, and cultural fit. Regular audits and stakeholder feedback are integral, enabling strategic adjustments for effective change management in FM settings.

4.7. Stakeholder Engagement in Implementation

In the BIM implementation change process, key stakeholders such as the FM team members, operational staff, contractors, managing agents, and senior management are identified for their crucial roles and influences. Engagement methods include individual interviews and workshops to address concerns, team meetings for consistent communication, and Electronic Direct Mails (EDMs) for updates and feedback. The project manager is tasked with dedicating specific times for stakeholder interactions, focusing on structured feedback mechanisms to measure acceptance and confidence levels. This is achieved through surveys and feedback forms post-engagement and regular review sessions to assess feedback and adapt engagement strategies. This comprehensive approach ensures that all stakeholder perspectives are integrated into the BIM implementation process.

4.8. Enhancing BIM Proficiency in FM Teams

When enhancing FM team members' proficiency in BIM, our revised approach outlines a comprehensive training plan comprising introductory sessions on BIM basics, intermediate courses on software usage, and advanced modules on BIM application in FM tasks. This training is delivered by a combination of internal BIM experts and external specialized consultants, utilizing a blend of online learning platforms, interactive workshops, and practical hands-on sessions. To assess the transition's success, we established the following clear metrics: the adoption rate is tracked through the percentage increase in BIM usage among team members, while the results and benefits are measured by tangible indicators such as time efficiency and error reduction in FM operations. Regular assessments and feedback sessions ensure continuous improvement and alignment with our strategic goals of BIM's integration in FM.

5. Conclusions and Recommendations

In this paper, we examined the impact of digital disruption in the built environment industry, an area traditionally resistant to rapid change. Central to this transformation is

Industry 4.0, introducing a series of innovations, with BIM emerging as a key technology. This study focuses on developing the change management roadmap for BIM-enabled FM.

This research emphasizes that the integration of BIM in FM is nascent, yet it is progressively garnering attention for its considerable potential advantages. The built environment sector is increasingly focusing on BIM-FM integration, urging organizations to adapt to digital transformation complexities and BIM integration.

To address these challenges, this paper proposes a change management roadmap, blending traditional models with modern digital transformation frameworks. This roadmap, developed through an extensive literature review, aims to guide organizations in adopting BIM in FM by navigating digital disruption complexities.

This research answers key questions about BIM's current state in FM, developing a strategic roadmap for BIM-enabled FM, and providing guidance for effective BIM utilization in FM. This roadmap is adaptable, catering to diverse regulatory environments and organizational cultures across countries.

In conclusion, the proposed roadmap offers a novel approach for BIM's integration in FM, outlining a five-step process for managing digital transformation. While versatile, it is not customized to specific organizations, highlighting a potential area for future research. As BIM's role in FM evolves, the continual reassessment and validation of this roadmap are essential, potentially through empirical studies.

5.1. Integration of BIM into FM and Best Practice

- Specific Integration of BIM into FM

One of the pivotal ways BIM can be integrated into FM is through the adoption of maintenance scheduling. By embedding maintenance schedules directly into the BIM model, facility managers can gain real-time insights into upcoming maintenance tasks, ensuring clarity and timely interventions. This not only streamlines the maintenance regime but also aids in predictive maintenance, potentially extending the lifespan of building components.

- Equipping Staff and Reducing Resistance

A successful BIM integration requires a skilled workforce. Organizations should invest in comprehensive training programs tailored to their staff's current skill levels. By demystifying BIM through hands-on training, resistance can be reduced, and staff can be empowered to harness the full potential of BIM in their daily tasks.

- Best Practices for BIM-FM adoption:

Stakeholder Engagement—Engage all stakeholders, from the top management to ground-level staff, ensuring everyone understands the benefits and processes of BIM.

Pilot Projects—Before full-scale implementation, run pilot projects to identify the potential challenges and refine the adoption process.

Continuous Training—BIM is an evolving field. Regular training sessions ensure that the staff stay updated with the latest advancements.

- Change Management Strategies:

Clear Communication—Ensure that the reasons for BIM adoption and its benefits are clearly communicated to all staff members.

Feedback Mechanism—Establish a feedback mechanism where staff can voice their concerns and suggestions regarding BIM's adoption.

Reward System—Recognize and reward staff who actively engage with and champion the BIM adoption process.

- Overcoming Implementation Challenges:

Resource Allocation—Dedicate resources, both in terms of manpower and capital, specifically for BIM's adoption.

External Consultation—Engage with external BIM experts or consultants to guide the implementation process.

Regular Review—Periodically review the BIM adoption process, making necessary adjustments based on the challenges faced and feedback received.

5.2. Research Repicatiability

In order to replicate the research, it is necessary to follow certain steps and consider certain factors. Firstly, delve deeply into related literature. Specifically, study the change in digital business management and BIM-supported FM. This reveals existing knowledge and research gaps. A detailed plan for gathering, processing data, and evaluating the roadmap's potential and validity is essential. Secondly, consider the research environment. For instance, the feasibility of reproduction depends on a company's ethos, size, structure, and current systems. Enlist the help of key stakeholders in your research. Ensure the drawn-up roadmap meets the organization's needs. A small-scale study is useful here, validating and refining the roadmap. Use this study's data to strengthen and improve your roadmap. Implement it in the company afterward. Lastly, assess how well the roadmap helps move and develop the digital organization. Replicating this study is influenced by different factors, including the research plan, context, and method. Ensure your roadmap is practical, relevant, and effective for managing changes and assisting the digital organization's evolution.

5.3. Key Contributions

This study makes several significant contributions to the field of BIM-enabled and change management. Firstly, a thorough review of the literature reveals the primary barriers and challenges faced by organizations transitioning to BIM-enabled FM. This understanding forms the foundation for addressing potential improvements in the digital transformation processes within the built environment sector. Secondly, this research develops a comprehensive roadmap for change management as a key output for BIM's adoption. This roadmap, constituted of five strategic steps, offers useful guidance for organizations within the built environment sector, assisting in managing the complexities associated with the transition to BIM-enabled FM. Furthermore, this study presents a unique integration of traditional change management principles with BIM adoption in the context of FM. This tailored approach plays a pivotal role in managing digital transformation within the sector, providing a model that goes beyond generic change management models. Lastly, this study underscores the need for additional empirical research to validate and generalize the proposed roadmap. This contribution not only augments the existing body of knowledge but also paves the way for future explorations in this field. Overall, this research represents a significant advancement in the integration of BIM and change management practices within the built environment sector.

5.4. Limitations and Cultural Considetations

The proposed roadmap, while comprehensive, may face challenges in settings with limited resources or technical expertise. Organizations should assess their capabilities and adjust the roadmap's implementation accordingly. The adoption and success of our roadmap may vary based on cultural and organizational nuances specific to different countries. It is essential for organizations to tailor the roadmap, considering local practices, values, and organizational structures to ensure its effectiveness.

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