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Government Initiatives to Promote BIM Adoption in Sarawak: A Systematic Literature Review

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ABSTRACT

Building Information Modelling (BIM) is a key driver in the digitalisation of Malaysia's construction industry. Although national-level initiatives by the Construction Industry Development Board (CIDB) and the Public Works Department (PWD) have advanced BIM implementation, adoption in Sarawak remains limited. This study identifies government initiatives aimed at promoting BIM adoption in Sarawak, with a focus on actions by CIDB and PWD. A systematic literature review (SLR) guided by the PRISMA 2020 framework was conducted using 11 academic papers and 27 grey literature sources. Findings were categorised into five themes: regulatory and policy measures, capacity-building, financial incentives, research and innovation, and pilot projects. The review reveals that Sarawak has established a strong regulatory foundation through its alignment with national strategies and has made visible progress in capacity-building initiatives such as training programmes, curriculum development, and proposed BIM centres. Nonetheless, financial incentives remain limited, research and innovation efforts are fragmented, and there is a lack of systematic post-project evaluation of BIM pilot projects. These gaps present ongoing challenges to achieving effective and industry-wide BIM adoption in the state.

1. Introduction

Building Information Modelling (BIM) is a technological innovation that has transformed the construction industry worldwide, enabling integrated planning, design, construction, and facility management through a shared digital representation of a project [14]. The benefits of BIM include improving collaboration, reducing errors, and enhancing overall project efficiency [10]. In Malaysia, BIM has been identified as a key driver of digital transformation under initiatives such as the

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Construction 4.0 Strategic Plan and the Digital Economy Blueprint, which aim to increase the productivity of the construction sector [7].

Government-led initiatives have played a critical role in promoting BIM adoption in Malaysia. The Construction Industry Development Board (CIDB) and the Public Works Department (PWD) have introduced a range of strategies including BIM guidelines, training programmes, pilot projects, and the establishment of digital support hubs such as the myBIM Centre [7,15]. According to the Malaysia BIM Report 2021, BIM adoption in Malaysia increased from 17% in 2016 to 55% in 2021, particularly among government-linked companies and large contractors [8]. However, challenges such as limited technical expertise, high implementation costs, lack of awareness, and inconsistent enforcement of policies continue to hinder wider adoption [9,23].

In East Malaysia, particularly Sarawak, the adoption of BIM remains limited despite the state's growing construction activities. Several studies have highlighted that BIM awareness in Sarawak is still in its infancy. For instance, Zaini *et al.,* [29] noted that although large infrastructure projects such as the Pan Borneo Highway have demonstrated the potential of BIM, implementation at the broader industry level is minimal. A survey by Lee *et al.,* [17] revealed that only 14% of Sarawakian construction professionals had hands-on experience with BIM, while 46% had only attended BIM-related seminars. Key challenges of implementing BIM in Sarawak include the absence of regional BIM policies, lack of skilled personnel, and limited localised training programmes [17,29].

To address these barriers, various initiatives have been launched by PWD and CIDB, at both federal and state levels, targeting BIM integration within Sarawak's construction industry. These include the promotion of BIM through roadshows and workshops, collaborations with universities to embed BIM in academic curricula, and capacity-building efforts aimed at upskilling the local workforce [14,23].

Comparative international studies further highlight the importance of strategic government intervention for BIM adoption. For example, in Saudi Arabia, government enforcement of BIM mandates, training, and incentive programmes led to substantial improvements in industry uptake [5]. Similarly, in Indonesia, coordinated efforts between regulatory agencies and industry players facilitated the acceleration of BIM adoption [21].

Despite the introduction of initiatives to promote BIM adoption in Sarawak by PWD and CIDB, academic discussions on the state-specific strategies remain limited. While national-level frameworks are well-documented, the extent and nature of government-led efforts in Sarawak require deeper exploration to understand how they align with the region's unique socio-economic and infrastructural context.

Despite the growing body of BIM-related research in Malaysia, existing studies largely concentrate on national-level policies, technical implementation, or general adoption barriers, with limited attention given to state-specific government initiatives and their practical manifestation. In particular, empirical and review-based studies focusing on Sarawak remain scarce, and available literature tends to emphasise awareness levels, technical readiness, or isolated project applications rather than systematically examining government-led initiatives across regulatory, institutional, and implementation dimensions. As a result, there is a lack of consolidated understanding of how federal BIM strategies are translated into state-level actions in Sarawak, and how these initiatives collectively shape the local BIM adoption landscape [17,23,29].

Although this study employed a systematic literature review approach guided by the PRISMA 2020 framework, only eleven peer-reviewed academic journal articles were identified as directly relevant to government initiatives promoting BIM adoption in Malaysia and Sarawak within the defined search period. This limited volume of academic evidence reflects the emerging and practice-driven nature of BIM policy implementation, particularly at the state level. To address this limitation

and to enhance the comprehensiveness and contextual relevance of the review, grey literature sources were therefore incorporated. These include official government reports, policy documents, and reputable local news articles that document current initiatives, implementation efforts, and policy directions. The inclusion of grey literature as a complementary data source is consistent with prior BIM initiatives study in Malaysia [15]. This approach enables a more holistic understanding of BIM adoption initiatives in Sarawak.

This study, therefore, aims to investigate the crucial government initiatives for enhancing BIM adoption in Sarawak by identifying the efforts undertaken by PWD and CIDB at both federal and state levels. Through a systematic literature review of academic and grey literature, this research provides a contextual understanding of BIM-related initiatives in Sarawak.

This study provides both academic and practical significance. Academically, it contributes to the BIM adoption literature by extending policy-focused analysis beyond national frameworks to a sub-national context, offering a structured synthesis of government initiatives at the state level. Practically, the findings provide policymakers, public agencies, and industry stakeholders with evidence-based insights into the strengths, gaps, and implementation imbalances of existing initiatives, supporting more targeted, coordinated, and effective strategies to enhance BIM adoption in Sarawak, particularly in progressing towards the state's 2030 BIM mandate.

2. Literature Review

2.1 National Policy Landscape for BIM in Malaysia

The Malaysian government has strategically positioned Building Information Modelling (BIM) as a foundation of its broader construction industry digitalisation agenda. Central to this vision is the Construction 4.0 Strategic Plan (2021–2025), developed by the Construction Industry Development Board (CIDB), which outlines a roadmap for leveraging emerging technologies in line with national priorities such as the Shared Prosperity Vision 2030 (SPV 2030), the National Policy on the Fourth Industrial Revolution (Industry4WRD), and the Digital Economy Blueprint (CIDB [7]). Within this framework, BIM is highlighted as a critical enabling technology to improve productivity, sustainability, and competitiveness in the construction sector.

The Construction 4.0 plan identifies twelve key emerging technologies, including BIM, artificial intelligence, modular construction, 3D printing, cloud collaboration, and blockchain, as central to transforming industry practices. To support this technological integration, the plan is structured around four strategic thrusts. These include capacity building to equip the workforce with relevant digital skills, excellence in research, innovation, commercialisation, and entrepreneurship (RICE) to stimulate industry-driven solutions, the adoption of smart integrated technologies, innovation, and infrastructure to improve construction processes, and the enhancement of the business environment to create supportive policies, regulations, and governance frameworks [7]. BIM, situated within this structure, is envisioned not merely as a digital modelling tool, but as a core process to facilitate coordination, collaboration, and data-driven decision-making across the project lifecycle.

Government mandates have played a crucial role in reinforcing the adoption of BIM in public sector projects. Under the Eleventh Malaysia Plan (RMK11), BIM was initially mandated for 10% of public projects valued above RM50 million. This requirement was significantly expanded in 2019, when it became mandatory for all public construction projects exceeding RM100 million in value to implement BIM [27].

Complementing these efforts is the National Construction Policy 2030 (NCP 2030), which positions sustainability and digitalisation as key pillars of Malaysia's construction future. BIM is promoted as a vital tool in supporting the United Nations Sustainable Development Goals (UNSDGs),

particularly in the context of sustainable urban development and housing. The integration of BIM in sustainable construction practices enables cost optimisation, waste reduction, and environmentally responsible planning, aligning national development with international sustainability targets [20].

These strategic interventions have had a measurable impact on industry adoption rates. According to the Malaysia BIM Report 2021, BIM implementation increased substantially from 17% in 2016 to 49% in 2019, reaching 55% by 2021. The report notes that adoption is more common among larger organisations, but small and medium-sized enterprises are gradually increasing their participation as awareness and capacity-building initiatives expand [8]. The report also highlights the reliance on CIDB and PWD BIM guidelines as the dominant frameworks used by practitioners, which has contributed to a more standardised implementation process nationwide.

To facilitate further growth in adoption, the report outlines several national strategies. These include the development of dedicated BIM training institutions to support graduate skill development, the provision of financial incentives to offset adoption costs, the formulation of comprehensive implementation guidelines, and the integration of BIM into higher education curricula. Awareness campaigns and industry engagement initiatives have also been critical in promoting BIM and encouraging broader participation across the construction value chain (CIDB [8]).

Despite this progress, several challenges remain. The high cost of software and training, limited digital literacy among some stakeholders, and a lack of consistent top management support continue to hinder full-scale adoption. These barriers highlight the need for sustained governmental intervention, regulatory alignment, and continuous upskilling of the workforce to ensure the successful mainstreaming of BIM across Malaysia’s construction industry [8].

In summary, Malaysia's policy landscape has provided a strong foundation for the institutionalisation of BIM through strategic planning, regulatory mandates, and industry engagement. With clearly defined targets, supportive policies, and a national vision for digital transformation, BIM is increasingly embedded within Malaysia’s construction development trajectory. Moving forward, effective multi-stakeholder collaboration along with continuous policy refinement will be essential to ensure that BIM achieves its full potential in driving sustainable and competitive construction practices nationwide.

2.2 BIM Adoption, Barriers, and Enablers in Malaysia

Building Information Modelling (BIM) is progressively transforming the Malaysian construction industry by enhancing collaboration and efficiency. Despite national initiatives like the Construction Industry Transformation Programme (CITP) and the CIDB BIM Roadmap, BIM adoption remains inconsistent across regions and public and private sectors [4].

Among the most cited barriers is the lack of education and training. Many construction professionals still rely on traditional methods and lack formal exposure to BIM. Wong and Gray [26] reported that only 2 out of 43 surveyed professionals had received firm-provided BIM training, while 58% had no BIM knowledge at all. This reflects the insufficiency of BIM-focused curricula in Malaysian tertiary institutions and highlights the high training costs, especially for smaller firms. The absence of skilled personnel and reluctance to embrace new methods further compounds this issue [22].

Another issue is regarding legislative uncertainty surrounding BIM implementation. Concerns such as unclear data ownership, copyright protection, and the lack of formal BIM contract documents were seen as major legislative barriers. Without standardized legal frameworks, firms are hesitant to adopt BIM in large-scale projects [25].

In addition, technological fragmentation and software interoperability remain unresolved. BIM relies on seamless data exchange among stakeholders, yet differing software ecosystems, file

formats, and a fragmented construction culture hinder effective collaboration [19,26]. The absence of standardized data structures and collaborative protocols has led to reduced confidence in BIM's reliability during project execution.

Beyond technical and behavioural barriers, existing studies highlight deeper structural challenges related to institutional capacity, financial constraints, and overall industry readiness for BIM adoption. Several studies indicate that institutional readiness within public agencies and industry organisations remains uneven, with limited availability of dedicated BIM units, insufficient internal expertise, and fragmented governance structures constraining effective implementation [4,26]. Budget constraints further exacerbate these institutional limitations. High initial costs associated with software acquisition, training, and system integration disproportionately affect small and medium-sized enterprises, reducing their ability to comply with BIM requirements without external support [9,25]. As a result, BIM adoption often occurs only when mandated, rather than as an internally driven transformation. These institutional and financial pressures contribute directly to low industry readiness, where organisations may demonstrate awareness of BIM but lack the organisational maturity, resources, and strategic alignment necessary for effective implementation. This suggests that readiness challenges in Malaysia are not solely technological, but are rooted in broader capacity and governance constraints that limit the industry's ability to transition from awareness to sustained BIM practice [4,19].

Despite these challenges, significant enablers have also emerged. Government-led programs, awareness campaigns, and pilot projects play a critical role in educating industry players and raising BIM visibility [4]. Strategic leadership, top-down support, and organizational readiness have been repeatedly emphasized as key success factors in driving BIM integration [13]. In their study, Wong and Gray [26] found that while adoption remains low, most professionals generally agree on BIM's long-term value and potential, provided that adequate incentives and frameworks are introduced.

To fully harness BIM's transformative potential, Malaysia must invest more in education and certification, develop robust legislative standards, and promote interdisciplinary collaboration across the construction value chain. Only through such holistic and coordinated efforts can BIM move from isolated pilot use to mainstream adoption.

2.3 Sarawak Adoption Status

The adoption of Building Information Modeling (BIM) in Sarawak's construction industry remains in its infancy, with multiple studies highlighting low levels of awareness, readiness, and actual implementation across the state. According to Tamjehi *et al.,* [24], while the concept of BIM is gaining momentum, the implementation of BIM-related software and technologies in Sarawak is still considerably low. A survey involving 133 stakeholders revealed that awareness is primarily limited to knowledge of BIM concepts and software, indicating that the industry lacks in-depth familiarity and practical application. The same study identified two main components influencing awareness, knowledge and software familiarity, both of which are underdeveloped in Sarawak's context.

Zaini *et al.,* [29] further emphasize that although stakeholders increasingly recognize BIM's potential to enhance collaboration and efficiency, the Sarawak construction industry continues to face significant challenges, such as high initial costs, inadequate training, and a shortage of skilled professionals. Only 14% of surveyed respondents had actual experience with BIM-related projects, and although 63% were aware of BIM, just 46% had attended seminars or programs [17]. These findings show that although practitioners are aware of BIM, many are still not prepared to use it in practice. This issue is made worse by their low confidence in applying BIM on real projects.

Efforts have been made at the project level to address these issues. The Pan Borneo Highway in Sarawak stands out as a benchmark infrastructure project demonstrating BIM integration through the use of Malaysia's first Highway Information Modelling (HIM), which merges Geographic Information Systems (GIS) and BIM [2,3]. This project showcases the value of BIM in managing large-scale, complex infrastructure and has set a precedent for future adoption in the state. Nonetheless, while the project illustrates the potential of BIM in Sarawak, it is an exception rather than the norm.

Government initiatives, such as the Construction Industry Transformation Programme (CITP) and CIDB's BIM Roadmap, are aligned with the national agenda to promote BIM, but their influence in Sarawak appears limited. As Zaini *et al.,* [28] argue that the transition from awareness to implementation requires more than policy mandates, it demands strategic action, industry-wide training, financial incentives, and integration into institutional curricula.

In summary, BIM adoption in Sarawak is progressing at a slow pace. Despite increasing awareness and isolated success stories like the Pan Borneo's project, the industry at large continues to struggle with practical adoption due to cost, skills shortages, and limited institutional support. There is an urgent need for coordinated action among stakeholders to create an enabling environment for BIM to thrive in Sarawak's construction sector.

3. Methodology

This study adopted a systematic literature review (SLR) approach, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) framework. The objective was to identify and synthesise government initiatives aimed at increasing BIM adoption in Sarawak, drawing evidence from both peer-reviewed academic literature and grey literature sources. The dual focus on academic and non-academic material was necessary because academic studies on BIM initiatives in Sarawak are limited in number. While grey literature, particularly industry reports and news articles, provides more up-to-date and locally relevant insights.

For academic sources, two major databases were selected: Scopus and ScienceDirect. The search was restricted to the period 2007–2025, since BIM was first introduced in Malaysia by PWD in 2007. The search terms applied were constructed using Boolean operators: (BIM OR "building information modeling" OR "building information modelling") AND (initiative OR measure OR strategy OR strategies). The initial search yielded 58 documents. A multi-stage filtering process was then applied. In the first stage, documents were screened by title relevance, which reduced the pool to 16 documents. Next, only open access publications were retained, and their abstracts were reviewed for relevance to the study objectives, resulting in 15 documents. Following a full-text assessment of these articles, 11 journal papers were finally selected for inclusion in the review. These papers provided a limited but credible academic foundation for analysing BIM adoption policies and initiatives in Malaysia.

Given the limited number of academic studies focused directly on Sarawak, grey literature was included as a complementary evidence base. Priority was given to official publications and local news sources to capture state-level initiatives. The Malaysia BIM Report 2021, published by CIDB, was selected as the most up-to-date national benchmark document. For Sarawak-specific developments, searches were conducted in two major regional news portals: DayakDaily and Borneo Post. These outlets were chosen because of their consistent reporting on construction, infrastructure, and state policy issues. The keywords used were: "building information modeling" OR "building information modelling". The search returned 259 articles. These were initially filtered by title relevance and publication date (2019–2025), leaving 30 articles. To ensure reliability, repetitive articles were removed, resulting in a final selection of 26 articles. These news items covered government

announcements, state agency activities, pilot projects, and stakeholder engagement events relevant to BIM adoption in Sarawak.

In both streams of literature, the inclusion criteria required that documents (i) were published between 2019 and 2025, (ii) explicitly addressed BIM adoption in Malaysia with particular reference to government initiatives, measures, or strategies, (iii) for academic sources, were peer-reviewed journal articles or conference papers accessed through Scopus and ScienceDirect, (iv) were available in open access to allow full-text review, and (v) for grey literature, originated from credible government or industry reports such as PWD and CIDB, or from reputable local news outlets such as DayakDaily and Borneo Post. Excluded were documents that (i) lacked sufficient focus on government initiatives for BIM adoption, (ii) addressed BIM adoption in Malaysia but focused only on technical modelling or software use without policy relevance, and (iii) lack of sufficient detail on the initiative's scope, implementation, or outcomes to enable systematic analysis.

The final dataset comprised 11 peer-reviewed journal articles and 27 grey literature sources, which include the Malaysia BIM Report 2021 and 26 news reports. Data from these documents were coded and synthesised thematically into categories of regulatory and policy measures, capacity-building and skills development, financial and market incentives, research and innovation, and pilot and demonstration projects. This approach ensured that information from both academic and grey sources was combined into a well-structured analysis of BIM adoption in Sarawak.

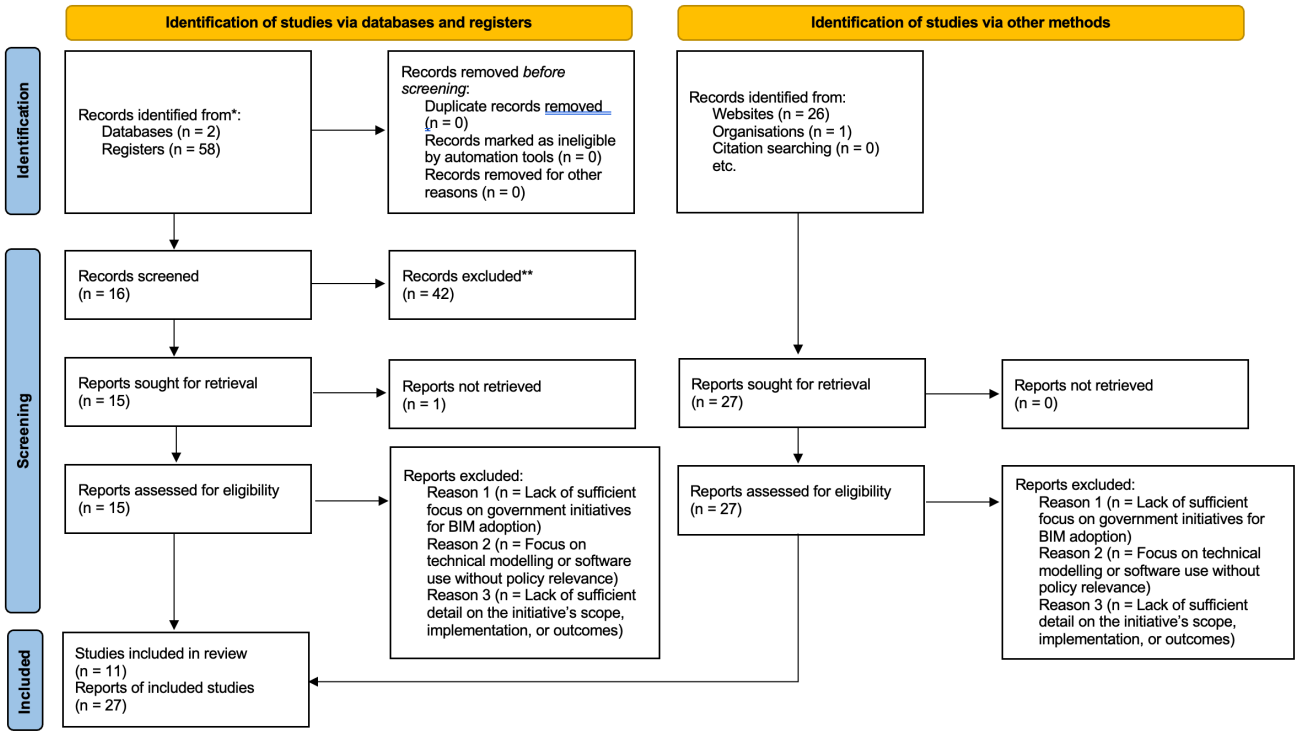

Fig. 1. PR1SMA flow diagram of government initiatives to promote BIM adoption in Sarawak

4. Findings and Discussion

These initiatives were synthesised and categorised into five thematic areas: regulatory and policy measures, capacity-building and skills development, financial and market incentives, research and innovation, and pilot and demonstration projects.

The overall findings indicate that Sarawak is promoting BIM adoption through a multi-layered set of initiatives that span regulation, training, financial incentives, research, and pilot projects. Regulatory and policy interventions are the strongest, providing clear requirements for adoption and long-term direction. Training and awareness programmes are also significant, though in need of deeper process integration. Financial incentives remain limited and represent a gap that could constrain compliance with the 2030 mandate. Research and innovation efforts are present but fragmented, while pilot projects demonstrate practical benefits but lack systematic evaluation.

To consolidate these findings, Table 2 summarises the government initiatives identified, categorised thematically. In addition, the initiatives are distinguished as either federal-initiated or state-initiated.

Table 2
Government initiatives to promote BIM adoption in Sarawak based on thematic areas

Category	Initiatives	Federal	State
Regulatory and policy measures	• Develop BIM adoption guidelines.	/	
	• Develop a digital transformation strategy for BIM.	/	
	• Develop BIM standards.	/	/
	• Develop BIM-related contractual frameworks.	/	
	• Mandate BIM adoption for government or private projects.	/	/
	• Mandate BIM adoption across all government departments and agencies.	/	
Capacity-building and skills development	• Establish BIM institutes to support young and fresh graduates.	/	
	• Organise training and awareness programmes (workshops, lectures, conferences, roadshows).	/	
	• Establish centres such as myBIM Centre to strengthen BIM competencies.	/	
	• Engage with more experts to impart knowledge of advanced BIM.	/	
	• Recognise and support BIM experts.	/	
	• Promote BIM through digital platforms.	/	
	• Facilitate partnerships with organisations to deliver BIM training and courses.		/
	• Prioritise BIM training and upskilling for the PWD workforce.		/
	• Encourage PWD officers to participate in international awards to showcase proactive BIM adoption.		/
	• Propose the establishment of a BIM Centre in Miri.		/
	• Launch the Malaysia Public Works Strategic Collaboration Programme 2025 to strengthen technical human capital.	/	
	• Provide financial incentives for BIM adoption, including subsidies, rebates, and tax benefits.	/	

Financial and market incentives	• Implement targeted programmes such as Program Prihatin CIDB.	/	
Research and innovation	• Publish BIM reports to track progress and provide guidance.	/	
	• Increase research on BIM.	/	
Pilot and demonstration projects	• Initiate BIM pilot projects.	/	/
	• Apply BIM in government projects to showcase implementation and benefits.	/	/

A comparative assessment of the thematic categories reveals clear differences in the depth and robustness of government intervention. Regulatory and policy measures emerge as the most established theme, supported by formal mandates, national strategic plans, and institutional directives that provide long-term direction. Capacity-building initiatives are also relatively well-evidenced, particularly through recurring training programmes and skills development efforts, although their effectiveness remains uneven across practitioner groups. In contrast, financial and market incentives represent the weakest theme, with limited evidence of structured or sustained support mechanisms at the state level. Research and innovation initiatives appear fragmented, with minimal coordination under a unified government framework, while pilot and demonstration projects, although increasingly visible, lack systematic post-project evaluation to inform wider policy learning. This imbalance suggests that BIM adoption in Sarawak is driven more by regulatory compliance and awareness-building than by integrated financial, research, and performance feedback mechanisms.

4.1 Regulatory and Policy Measures

Previous studies consistently shows that government leadership and clear guidelines are central to advancing BIM adoption in Malaysia. Kong *et al.,* [14] report that the Public Works Department (PWD) initiated BIM adoption as early as 2007, establishing a BIM Committee tasked with identifying appropriate BIM platforms and preparing implementation guidelines for public projects. Additional federal actions are summarised by Latiffi *et al.,* [16], which record the development of the PWD BIM Standard Manual, the issuance of BIM Guidelines, the creation of BIM Unit Projects under PROKOM and the formulation of a BIM Roadmap to formalise BIM practice within public-sector delivery. The same source highlights CIDB's responsibility in developing a BIM Portal and creating a national BIM Steering Committee, intended to strengthen national coordination and provide implementation guidance for industry practitioners. The importance of regulatory clarity is also supported by Wong and Gray [26] which identify legal uncertainty as one of the major barriers to BIM implementation, demonstrating the need for more comprehensive policy and governance structures.

In the context of Sarawak, study revealed that BIM adoption has remained low due to the absence of state-level policy support. A study by Lee *et al.,* [17] quantifies this issue, reporting that only 14% of respondents in Sarawak have hands-on BIM experience and identifying the "lack of clear policies that support BIM implementation" as one of the major barriers. This finding shows that Sarawak's slow progress is linked to a shortage of formalised regulatory structures.

Taken together, the evidence indicates that regulatory and policy measures constitute the strongest and most mature dimension of government intervention for BIM adoption. National-level instruments such as the Construction 4.0 Strategic Plan and Malaysia BIM Report 2021 provide formal direction, targets, and implementation frameworks. Compared to other thematic areas, regulatory

initiatives demonstrate greater clarity, continuity, and institutional authority, which explains their relatively stronger influence on BIM uptake. This finding aligns with academic studies that identify the absence of clear policies and mandates as a major barrier in Sarawak, suggesting that recent regulatory developments directly address one of the most persistent structural constraints to BIM implementation [16,17,26].

4.2 Capacity-Building and Skills Development

Previous studies highlight that capacity-building and workforce development are critical to supporting BIM adoption in Malaysia. Sinoh *et al.,* [23] identify limited technical expertise, insufficient training, and low levels of BIM awareness as major barriers that constrain implementation efforts nationwide. Similar findings are reported by Akob *et al.,* [2], who note that the lack of practitioner competency continues to hinder BIM uptake and reinforces the need for structured training interventions. Federal initiatives reflect these requirements. Latiffi *et al.,* [16] document CIDB's role in providing BIM-related training and guidance, including seminars and workshops delivered through national programmes. These efforts illustrate the federal emphasis on strengthening human capital as a prerequisite for digital transformation.

In Sarawak, study shows that capability gaps are more noticeable. Zaini *et al.,* [29] report that BIM implementation in the state remains minimal, with limited practitioner exposure and low hands-on experience. Lee *et al.,* [17] quantifies this, stating that only 14% of Sarawak respondents have worked directly with BIM and identifying "lack of expertise" as among the most significant barriers. These findings underscore the need for targeted capacity-building initiatives within the state.

Capacity-building initiatives represent a moderately developed but uneven component of the government-led BIM adoption strategy. At the national level, recurring training programmes, workshops, and institutional support such as the myBIM Centre demonstrate sustained commitment to workforce upskilling. However, evidence from Sarawak indicates that these initiatives have not yet translated into widespread practical competency, as hands-on BIM experience among practitioners remains limited despite increasing awareness. This gap suggests that existing programmes are more effective in raising awareness than in embedding BIM capability at the project delivery level. Academic studies consistently identify lack of expertise and insufficient practical exposure as persistent barriers in Sarawak, indicating that while capacity-building initiatives are present, their depth and reach remain constrained compared to the strength of regulatory measures [17,23,29].

4.3 Financial and Market Incentives

Studies consistently show that financial constraints are one of the most significant barriers to BIM adoption in Malaysia. Wong and Gray [26] reports that the high cost of BIM software and the substantial initial capital investment required are major obstacles, with 56% of surveyed professionals agreeing that software cost poses a difficulty to adoption. Similar findings appear in another study, where SMEs are identified as being particularly affected due to limited financial capacity and the need to outsource BIM-related tasks when internal systems are unavailable. A study by Al-Ashmori *et al.,* [4] indicates that local SMEs are often unable to invest in BIM systems due to high upfront costs, forcing them to rely on third-party consultants when BIM is requested by clients. These studies demonstrate that financial barriers are not marginal but form a core challenge for BIM readiness.

A study also highlights that uncertainty in standards and workflows can reduce incentives for firms to make long-term financial commitments. As Wong and Gray [26] notes, the absence of formal

BIM standards and contract documents creates low incentives for firms to invest, as the return on such investment appears uncertain. This suggests that financial and institutional factors are closely linked, as unclear standards make the financial risk appear greater, especially for smaller organisations

Initiatives identified in this review, such as the Malaysia BIM Report 2021's calls for subsidies, rebates, and tax-related incentives, align directly with the financial barriers highlighted in academic studies. CIDB's Program Prihatin, designed to reduce cost-related entry barriers, also reflects these concerns. In Sarawak, similar issues have been raised, with reports noting discussions about supporting SMEs and local contractors to meet the state's 2030 BIM mandate. However, existing evidence indicates that although financial incentives are frequently acknowledged at the national level, their practical implementation remains limited, particularly at the state level. Persistent barriers such as high software costs and initial investment requirements continue to affect SMEs and local contractors, suggesting that financial support mechanisms have not been institutionalised to the same extent as regulatory or training initiatives (Wong and Gray, [26]; Al-Ashmori et al., [4]; CIDB, [8]).

4.4 Research and Innovation

Research and innovation initiatives appear less prominent in the literature compared to regulatory and training measures, but they continue to play an important supporting role in advancing BIM adoption. Several studies highlight the importance of systematic evaluation and continuous knowledge development in strengthening BIM maturity across Malaysia. Wong and Gray [26] emphasises that limited understanding of BIM processes contribute to fragmented adoption, highlighting the need for ongoing research to support evidence-based practice. The Malaysia BIM Report 2021, functions as a federal-level mechanism for tracking adoption trends and guiding practice through structured reporting.

In Sarawak, reports of collaborative initiatives demonstrate how research is being positioned as a link between academia and industry. One example is the Memorandum of Agreement signed in 2020 between Swinburne University of Technology Sarawak and Project and Programme Matters Sdn. Bhd., which focuses on applied research, knowledge transfer, and strengthening practical BIM implementation. While this partnership supports the state's digitalisation agenda, it is not considered part of the government-led initiatives examined in this review because it was not initiated by PWD or CIDB.

A study emphasises the importance of structured research collaboration in developing effective BIM adoption models. Zaini *et al.,* [28] identify limited engagement between academic and practitioner as a barrier to BIM progress, and emphasise the need for coordinated research efforts to support practical implementation. In comparative terms, research and innovation represent one of the least developed dimensions of government-led BIM adoption efforts. While individual studies and isolated collaborations highlight the value of research in supporting BIM maturity, there is limited evidence of a coordinated, government-driven research framework dedicated to BIM implementation. Existing initiatives appear fragmented, with weak institutional linkage between policy formulation, academic research, and industry application. Academic studies emphasise that insufficient research coordination and limited engagement between academia and practitioners constrain knowledge transfer and slow the progression from conceptual understanding to effective implementation. This suggests that, unlike regulatory and training initiatives, research and innovation efforts currently play a supportive rather than a driving role in BIM adoption in Sarawak [26,28].

4.5 Pilot and Demonstration Projects

Studies highlight that pilot and demonstration projects play an important role in supporting BIM adoption. Latiffi *et al.,* [16] document several early federal-level pilot projects supervised by PWD, including the National Cancer Institute, Healthcare Centre Type 5, and the SPRM Administration Complex, where BIM was used for visualisation, clash detection, 4D simulation, and design review. These projects were intended to familiarise project teams with BIM workflows and provide reference cases for future implementation. At the infrastructure level, Akob *et al.,* [3] describe the application of BIM in the Pan Borneo Highway, demonstrating how large-scale infrastructure project provided opportunities for practitioners to engage directly with BIM processes. Zaini *et al.,* [29] similarly note that limited hands-on exposure remains a central barrier in Sarawak, reinforcing the importance of pilot projects as a means of developing practical capability. Together, these studies show that pilot projects serve as practical testing grounds through which organisations gain experience, assess benefits, and refine implementation strategies.

Grey literature shows that numbers of pilot projects have been initiated in Sarawak. Reports highlight the use of BIM in several state-led projects, including educational facilities such as SMK Saribas and SMK Agama Igan, the Premier's office complex known as Kompleks Satria Pertiwi, and major infrastructure projects such as the Pan Borneo Highway Sarawak and the Sarawak-Sabah Link Road. These examples indicate that pilot projects are being used both to introduce BIM and to showcase its potential benefits to stakeholders.

Pilot and demonstration projects constitute a visible but unevenly leveraged mechanism for promoting BIM adoption. Evidence from both academic and grey literature shows that pilot projects have been effective in demonstrating the technical feasibility and operational benefits of BIM, particularly in large-scale infrastructure and selected public building projects. However, the strength of evidence suggests that these projects function primarily as isolated exemplars rather than as systematically evaluated learning instruments. Academic studies highlight that limited hands-on exposure remains a key barrier in Sarawak, yet the absence of structured post-project assessment and knowledge dissemination constrains the ability of pilot projects to inform wider policy refinement and industry learning. Consequently, while pilot projects contribute positively to awareness and confidence-building, their impact on sustained and scalable BIM adoption remains weaker than their potential suggests [3,16,29].

5. Conclusion

This study set out to identify the government initiatives designed to promote BIM adoption in Sarawak. By applying a systematic literature review approach across both academic and grey sources, the analysis mapped a wide range of actions taken at both the federal and state levels. These initiatives were categorised into five thematic areas: regulatory and policy measures, capacity-building and skills development, financial and market incentives, research and innovation, and pilot and demonstration projects.

The findings show that Sarawak has established a regulatory framework anchored in national strategies such as the Construction 4.0 Strategic Plan 2021–2025 and complemented by the PWD Sarawak 2030 directive. Capacity-building programmes are also being advanced through workshops, curriculum integration, and targeted training for government officers, supported by proposed facilities such as the BIM Centre in Miri. Financial incentives have been identified as a priority in national reporting, but state-specific schemes remain limited, leaving a gap for SMEs and local contractors facing high entry costs. Research and innovation activities are evident through academic–

industry partnerships and government reports, although they lack integration under a state-led framework. Pilot and demonstration projects have been carried out across both building and infrastructure sectors, yet there is limited evidence of systematic post-project evaluation.

Overall, the review demonstrates that government intervention in Sarawak has created a layered ecosystem of initiatives aimed at fostering BIM adoption. The initiatives provide regulatory direction, raise awareness, and create opportunities for knowledge transfer, but challenges remain in financing, coordination of research, and institutionalisation of lessons from pilot projects. Addressing these gaps will be essential if Sarawak is to meet its 2030 mandate and ensure that BIM adoption extends beyond compliance towards integrated and sustainable use across the local construction industry.

This study also acknowledges several methodological limitations. First, although peer-reviewed academic journals formed the core scholarly foundation of the review, the limited number of academic studies focusing specifically on government-led BIM initiatives in Sarawak necessitated the inclusion of grey literature, such as government reports and reputable local news sources. While this approach enhances contextual relevance and captures current policy developments, it may introduce variability in the depth and consistency of evidence compared to purely academic sources. Second, the initiatives identified in this review were synthesised based on documented policies, programmes, and reported implementation activities, and have not yet been empirically verified through direct stakeholder validation. Previous studies have demonstrated the value of validating government initiatives and policy effectiveness through engagement with industry practitioners and stakeholders to assess implementation outcomes and practical impact. Accordingly, future research should complement literature-based analysis with empirical methods, such as surveys or interviews with industry stakeholders, to validate the effectiveness and maturity of BIM initiatives identified in this study [4,15].

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Table 1
Government initiatives to promote BIM adoption in Sarawak

No	Initiatives	Abdulqader et al., [1]	Baharuddin et al., [6]	Haron et al., [10]	Harun et al., [11]	Ibrahim et al., [12]	Kong et al., [14]	Latiffi et al., [15]	Latiffi et al., [16]	Manzoor et al., [18]	Sinoh et al., [23]	Zaini et al., [28]	Malaysia BIM Report 2021	Borneo Post	Dayak Daily
1	Establish a BIM-related committees	/					/	/	/						
2	Develop BIM adoption guidelines		/					/				/	/		
3	Develop a digital transformation strategy for BIM				/								/		
4	Release BIM Report												/		
5	Create BIM institutes for young/fresh graduates												/		
6	Provide financial incentives									/	/		/	/	
7	Develop programs (workshops, lectures, conference, roadshows) to increase BIM awareness							/	/	/	/	/	/		
8	Develop BIM standards							/	/				/		
9	Develop BIM-related contractual frameworks												/		

10	Initiate pilot projects			/				/	/				/		/
11	Mandate BIM adoption					/						/	/	/	/
12	Develop programs/center (myBIMcentre) to improve BIM competencies		/		/			/			/	/	/	/	/
13	Engage with more experts to impart knowledge of advanced BIM												/		
14	Mandate all departments in government to use BIM												/		
15	Incorporate all the related government agencies using BIM												/		
16	Increase research on BIM									/		/			
17	Acknowledge and support BIM experts									/		/			
18	Promote BIM through digital means							/			/				
19	Propose establishment of BIM Centre in Miri													/	
20	Partnership with various organisations to													/	/

	provide BIM training/courses														
21	Utilise BIM in government projects					/		/						/	/
22	Prioritise BIM training and upskilling for PWD workforce.							/						/	
23	Encourage PWD officers to participate in prestigious international awards to showcase proactive approach in adopting BIM														/