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Perception BIM Expert Towards Transition Risk to Implement BIM in IBS Projects

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ABSTRACT

The integration of Building Information Modeling (BIM) with the Industrialized Building System (IBS) has strong potential to improve productivity, coordination, and efficiency in the Malaysian construction industry. However, the transition from traditional practices to BIM-based IBS implementation involves various risks that may hinder successful adoption. This study investigates key transition risks and evaluates organizational readiness for BIM implementation in IBS projects using the Technology Readiness Index (TRI) as the guiding framework. A qualitative approach was employed through semi-structured interviews with five BIM experts from academia and industry who possess extensive experience in BIM and IBS projects. The findings reveal that financial risk is the most significant barrier, driven by high costs of BIM software, hardware, training, and specialist expertise. Management risks, particularly resistance to change and a shortage of skilled personnel, also affect adoption. Based on TRI, organizational readiness is mainly influenced by optimism and discomfort with technology, with optimism acting as a driver and discomfort as an inhibitor. Overall, the transition risk level is perceived as moderate, indicating that BIM–IBS implementation is achievable when key risks are effectively managed. This study offers practical insights to support strategic planning for BIM adoption in IBS projects and aligns with SDG 9 Industry, Innovation, and Infrastructure.

Keywords: Transition risk, Building Information Modeling, Industrialized Building System.

1. INTRODUCTION

The construction industry is evolving rapidly, with Industrialized Building System (IBS) and Building Information Modeling (BIM) playing key roles in improving productivity and efficiency. Introduced in Malaysia in the 1960s, IBS streamlines construction through off-site manufacturing, reducing time and cost [1]. BIM provides a digital model that enhances integration, visualization, and simulation across the project lifecycle [2, 3]. Integrating BIM with IBS is a strategic approach to reduce errors and improve project outcomes by enabling better coordination and more accurate data [2, 3].

However, BIM–IBS integration faces challenges, including technical, management, financial, and legal issues [2, 3], as well as high training and technology costs, weak intellectual property protection, and insufficient BIM standards [2]. Malaysia's construction industry also struggles with low productivity, poor communication, and fragmented processes, hindering adoption [4, 5]. Despite challenges, case studies show BIM–IBS integration can reduce waste and improve efficiency [1], although users report technical and financial constraints [2, 3]. Government initiatives such as CITP and RMK12 promote BIM adoption for projects valued at more than RM10

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million [1]. Addressing transition risks and organizational readiness is therefore critical for successful implementation [6-9].

2. LITERATURE REVIEW

2.1 Building Information Modeling (BIM)

BIM is widely used in the construction industry to create and manage digital representations of a building's physical and functional characteristics [10]. While BIM is well established in countries such as the UK, USA, Singapore, and Canada, Malaysia has experienced slower adoption [11]. Nevertheless, the Malaysian government actively promotes BIM through CIDB and PWD. CIDB issues national BIM guidelines and provides training to enhance industry capability [12,13], while PWD integrates BIM requirements into public project delivery frameworks [14], reflecting strong government commitment.

BIM supports decision-making through virtual construction, reducing uncertainty, improving safety, enabling clash detection, and integrating data across the project lifecycle [15-17]. BIM also evolves across multiple dimensions, including 3D, 4D, 5D, 6D, and 7D [18].

In Malaysia, BIM development is supported by CITP [19], the establishment of the Malaysia BIM Association in 2023 [20], and CIDB training through the myBIM Center [19-21]. Additionally, BIM is mandated for projects valued at RM10 million or more, starting 1 July 2025, under Pekeliling Perbendaharaan PK 1.15 [22].

2.2 Industrialized Building System (IBS)

The construction industry has shifted from traditional site-based methods to industrialized and off-site construction systems [23]. This transition has led to varying definitions of industrialized construction across countries due to different experiences and interpretations [24]. According to CIB, industrialization in construction involves the use of mechanical tools, automation, mass production, and standardization [25]. Globally, it is referred to as Modular Construction (Canada), Modern Method of Construction (MMC) (UK), and Industrialized Building System (IBS) (Malaysia) [26].

In Malaysia, the CIDB classification is widely adopted by both researchers and practitioners. Terms such as Prefabricated Construction, MMC, and Off-Site Construction are commonly used to describe IBS, where components are manufactured off-site and assembled on-site [27]. IBS systems are classified into five categories as shown in Table 1 [28, 29].

According to [30] and supported by [31], this study selected the precast concrete system because it is the most widely used IBS in Malaysia. It is officially recognized by CIDB as a core IBS category. It is commonly applied in public and government-funded projects to achieve required IBS scores [30]. Its adoption is supported by national policies and clear benefits, including better quality control through off-site production, faster construction, less on-site labor, and reduced material waste [30]. These benefits align with Malaysia's IBS objectives. In addition, key IBS attributes such as standardization, constructability, productivity, and efficiency are well represented by precast concrete systems [31]. The widespread use of precast concrete and the availability of industry data further justify its suitability as the focus of this study [31].

Table 1: Type of IBS system.

Type of IBS System	Description
Precast Concrete System	The most common IBS products are precast concrete elements, including columns, beams, slabs, walls, and 3D components such as balconies, staircases, toilets, lift chambers, and refuse chambers, as well as lightweight precast concrete and permanent concrete formwork.
Steel Formwork System	This system is one of the least prefabricated IBS types because most work is cast on-site. However, it provides good quality finishes, faster construction, and requires less labor and materials. It is suitable for large residential projects with repetitive designs.
Steel Framing System	Commonly used with precast concrete slabs, steel columns, and beams, especially for the fast construction of high-rise buildings. Recent IBS developments include the use of lightweight steel trusses and steel portal frames, which are more cost-effective than traditional heavy steel sections.
Prefabricated Timber Framing System	This system uses timber frames and timber roof trusses. Timber roof trusses are more common, while timber frames are used for niche projects that need attractive designs, such as resort chalets.
Blockwork System	Traditional brick construction has improved with interlocking concrete blocks and lightweight concrete blocks, making building faster and easier than conventional bricklaying.
Innovative or Hybrid Systems	These systems combine different IBS methods, such as precast concrete, steel framing, and modular construction, to use the strengths of each and suit specific project needs.

2.3 Technology Readiness Index (TRI)

The Technology Readiness Index (TRI), developed by [32], measures people's readiness to accept and use new technologies. It focuses on users' beliefs and attitudes rather than technical features, explaining why some adopt new technologies easily while others resist them. TRI shows that readiness depends on a mix of positive drivers and negative inhibitors [32, 33]. Tables 2 and 3 present TRI's main dimensions and classify users into five technology readiness segments.

Table 2: Basic Dimensions of Technology Readiness Index (TRI) [32].

TRI Dimension	Category	Simple Explanation
Optimism	Driver	Belief that technology improves work efficiency and performance
Innovativeness	Driver	Willingness to try and adopt new technology earlier than others
Discomfort	Inhibitor	Feeling overwhelmed or lacking confidence when using technology
Insecurity	Inhibitor	Distrust of technology due to concerns about reliability and safety

Table 3: Technology readiness segments (TRI User Types) [33].

TRI Segment	Technology Attitude	Characteristics
Explorers	Very positive	High optimism and innovativeness; low resistance to technology
Pioneers	Positive but cautious	See the benefits of technology but have some insecurity or discomfort
Skeptics	Neutral	Doubt the benefits of technology; low motivation to adopt
Paranoids	Mixed	Interested in technology but highly concerned about risks and security
Laggards	Negative	Strong resistance to technology; prefer traditional methods

Based on Table 2, Optimism and Innovativeness encourage adoption of technology, while Discomfort and Insecurity act as barriers that may slow or prevent adoption [33]. Based on Table

3, the four TRI dimensions classify users into five technology readiness segments [33]. TRI is widely used in adoption research to explain the human factors that affect acceptance or resistance. In digital transformation like BIM implementation, TRI helps identify readiness gaps, mindset barriers, and transition risks [32, 33].

2.4 Transition Risk in Implementation of BIM for IBS

According to [34, 35], a transition is a change from one form to another, and a risk is something bad that might happen. Transition risk is the possibility of an adverse event during a change [36]. While often used in investing, it applies to any situation with potential loss, where the benefits may outweigh the risks [36]. In BIM implementation for IBS projects, transition risk refers to potential challenges, uncertainties, and disruptions when moving from traditional construction to BIM within IBS, due to the complexity of integrating BIM into existing workflows and prefabricated or modular construction methods [24]. Table 4 presents the types of transition risk identified in previous studies for BIM–IBS implementation.

Table 4: Transition risk factors in the implementation of BIM in IBS projects.

Type of Transition Risk	Authors	Number of Authors
Management		
Negative attitude towards data sharing	Dossick and Neff (2010); Azhar (2011); Rezgui et al. (2013); Won et al. (2013); Stanley and Thurnell (2014); Liu and Liu (2015); Zhang et al. (2018); Tan et al. (2019); Tsai and Peniel (2021)	9
Negative attitude towards working collaboratively	Dossick and Neff (2010); Ku and Taiebat (2011); Arayici et al. (2012); Stanley and Thurnell, (2014); Ozorhon and Karahan (2016); Jin et al. (2017); Tan et al. (2019); Tabatabaee et al. (2021); Tsai and Peniel (2021); Ali et al. (2022)	10
Lack of a well-established BIM-based workflow	Eastman et al. (2011); He et al. (2012); Panuwatwanich and Peansupap (2013); Zhang et al. (2013); Jin et al. (2017); Ya'acob et al., (2018); Tan et al. (2019); Woo and Peniel Ang Soon Ern (2021)	8
Need to hire new workers who have skills and knowledge of BIM	Ibrahim et al. (2022)	1
Misunderstanding of BIM	Khosrowshahi and Arayici (2012); Panuwatwanich and Peansupap (2013); Zhang et al. (2013); Lee et al. (2014); Chien et al. (2014); Xu et al. (2014); Zhang et al. (2018); Tan et al. (2019); Ibrahim et al. (2022)	9
Poor understanding and incompetence skill in the supervision of the IBS construction	Massofia et al. (2018); Nur Atiqah Jamalludin et al. (2022)	2
Immature dispute resolution mechanisms for BIM implementation	Pan and Zhao (2012); He et al., (2012); Rezgui et al. (2013); Liu and Liu (2015); Xu and Kong (2016); Tan et al. (2019); Woo and Peniel Ang Soon Ern (2021)	7
Ineffective communication between the project team and stakeholders	Riaz Ahmed (2017); Ya'acob et al., (2018); Nur Atiqah Jamalludin et al. (2022)	3
Lack of top management support and commitment to BIM adoption	Ya'acob et al., (2018)	1
Resistance to change	Yan and Damian (2008); Gu and London (2010); Eastman et al. (2011); Arayici et al. (2011); Panuwatwanich and Peansupap (2013); Zhang et al. (2013); Stanley and Thurnell	14

	(2014); Xu et al. (2014); Liu and Liu (2015); Xu and Kong (2016); Mehran (2016); Ya'acob et al., (2018); Tan et al. (2019); Ibrahim et al. (2022)	
Financial		
High prices of material, labour costs and machinery costs	Kai Chen (2019); Nur Atiqah Jamalludin et al. (2022);	2
New contractors or small companies need to bear the risk of cost and structured finance	Massofia et al. (2018); Nur Atiqah Jamalludin et al. (2022); Ibrahim et al. (2022)	3
BIM training cost and time required	Abd. Hamid et al. (2008); Tse et al. (2005); Yan and Damian, (2008); Suermann and Issa (2009); Liu et al. (2010); Zhang et al. (2013); Eadie et al. (2014); Xu et al. (2014); Rogers et al. (2015); Ozorhon and Karahan (2016); Jin et al. (2017); Ya'acob et al. (2018); Tan et al. (2019); Peniel Ang Soon Ern et al. (2022); Ibrahim et al. (2022); Jamalluddin et al. (2022); Woo and Peniel Ang Soon Ern (2021); Collinge and Osorio (2024)	16
BIM experts and tool expenditure	Suermann and Issa (2009); Khosrowshahi and Arayici (2012); Pan and Zhao (2012); Zhang et al. (2013); Xu et al. (2014); Liu and Liu (2015); Xu and Kong (2016); Ya'acob et al. (2018); Tan et al. (2019); Peniel Ang Soon Ern et al. (2022); Ibrahim et al. (2022); Woo and Peniel Ang Soon Ern (2021)	12
Increased design costs	Tse et al. (2005); Liu et al. (2010); Azhar (2011); Eastman et al. (2011); Pan and Zhao (2012); Lu et al. (2014); Liu and Liu (2015); Tan et al. (2019); Woo and Peniel Ang Soon Ern (2021)	9
Ambiguous economic benefits	Barlish and Sullivan, (2012); Xu and Kong, (2016); Jin et al., (2017); Papadonikolaki and Aibinu (2017); Zhang et al. (2018); Tan et al. (2019); Woo and Peniel Ang Soon Ern (2021)	7
Large investments in updating software and hardware	Ibrahim et al. (2022)	1
Potential for budget overruns due to learning curve with new technologies	Kjartansdóttir et al. (2017); Ya'acob et al. (2018)	2
Technology		
High cost for new technology and only large organisation can afford to own the technology	Ibrahim et al. (2022)	1
Regularly requires hardware upgrades	Ibrahim et al. (2022)	1
A requirement for detailed and precise models to fix the issue of interoperability	Azhar (2011); Pan and Zhao (2012); Zhang et al. (2013); Liu and Liu (2015); Zhang et al. (2018); Tan et al. (2019); Ibrahim et al. (2022); Tan et al. (2019); Woo and Peniel Ang Soon Ern (2021)	9
BIM coordination is difficult to adapt in complex design	Yan and Damian, (2008); Lu and Korman (2010); He et al. (2012); Rezgui et al. (2013); Zhang et al. (2013); Elmualim and Gilder (2014); Rogers et al., (2015); Xu and Kong, (2016); Jin et al. (2017); Ibrahim et al. (2022); Woo and Peniel Ang Soon Ern (2021)	11
Interoperability between applications and software	Ya'acob et al. (2018); Ibrahim et al. (2022)	2
Difficulty in adapting to the BIM technology and process	Yan and Damian (2008); Lu and Korman (2010); He et al. (2012); Rezgui et al. (2013f); Zhang et al. (2013); Elmualim	12

	and Gilder (2014); Rogers et al. (2015); Xu and Kong (2016); Jin et al. (2017); Tan et al. (2019); Woo and Peniel Ang Soon Ern (2021); Tabatabaee et al. (2021)	
Lack of domestic- oriented BIM tools	Tse et al. (2005); Pan and Zhao (2012); He et al. (2012); Zhang et al. (2013); Xu and Kong (2016); Bui et al. (2016); Zhang et al. (2016); Tan et al. (2019); Woo and Peniel Ang Soon Ern (2021)	9
Legal		
Lack of BIM standards in IBS design	Yan and Demian (2008); Pan and Zhao (2012); He et al. (2012); Zhang et al. (2013); Chien et al. (2014); Stanley and Thurnell (2014); Zhang et al. (2014); Azhar et al. (2015); Liu and Liu (2015); Xu and Kong (2016); Jin et al. (2017); Tan et al. (2019); Tabatabaee (2019); Tabatabaee et al. (2021); Peniel Ang Soon Ern et al. (2022); Tsai and Peniel (2021); Woo and Peniel Ang Soon Ern (2021)	17
Lack of insurance coverage for BIM deployment in IBS	Yan and Demian (2008); Pan and Zhao (2012); Eadie et al. (2014); Azhar et al. (2015); Liu and Liu (2015); Ghaffarianhoseini et al. (2017); Tan et al. (2019); Peniel Ang Soon Ern et al. (2022); Woo and Peniel Ang Soon Ern (2021)	9
Intellectual property rights are not adequately protected	Dossick and Neff (2010); Ku and Taiebat (2011); Azhar (2011); He et al. (2012); Pan and Zhao (2012); Rezgui et al. (2013); Zhang et al. (2013); Fan (2013); Azhar et al. (2015); Liu and Liu (2015); Hsu et al. (2015); Ozorhon and Karahan (2016); Tan et al. (2019); Peniel Ang Soon Ern et al. (2022); Ibrahim et al. (2022); Woo and Peniel Ang Soon Ern (2021)	16
Lack of a standard form of contract for BIM implementation	Nawari (2012); Zhang et al. (2013); Stanley and Thurnell (2014); Chien et al. (2014); Liu and Liu (2015); Hsu et al. (2015); Bui et al. (2016); Xu and Kong (2016); Tan et al. (2019); Woo and Peniel Ang Soon Ern (2021)	10
Incompatibility of procurement systems with BIM	Ibrahim et al. (2022)	1
Greatest risk for file errors and loss of data	Ibrahim et al. (2022)	1

*NOTE: The colors above are 3 major indicators for each transition risk factor.

Based on Table 4, the major transition risks are: Management risk – resistance to change (14), negative attitude towards working collaboratively (10), misunderstanding of BIM (9), and negative attitude towards data sharing (9); Financial risk – BIM training cost and time required (16), BIM experts and tools expenditure (12), and increased design costs (9); Technology risk – difficulty adapting to BIM technology and process (12), BIM coordination in complex design (11), need for detailed and precise models to fix interoperability issues (9), and lack of domestic-oriented BIM tools (9); Legal risk – lack of BIM standards in IBS design (17), insufficient protection of intellectual property rights (16), and lack of standard contract for BIM implementation (10).

3. METHODOLOGY

This study used semi-structured interviews conducted virtually via Google Meet. Participants were selected based on these criteria: a) registered members of a construction-related organization (CIDB, BEM, etc.); b) involved in IBS projects; c) familiar with BIM; d) willing to join the interview; and e) over 5 years of construction experience. Although qualitative studies typically suggest about 15 participants, only five BIM specialists were chosen for their expertise in academia, industry, and projects. Participants were informed about the study and assured of confidentiality. The “information power” concept states that focused studies with expert participants can yield sufficient data even with a few interviews [37]. Similar expertise allows key themes to emerge after five to twelve interviews [38, 39]. Thus, five participants provided meaningful insights. Table 5 presents the demographics of the BIM experts.

Table 5: Demographics of BIM experts.

Type	Description	Number of Panels	Percentage (%)
Gender	Female	1	25
	Male	4	75
Position	Professional Engineers	2	40
	Senior Engineer	1	20
	Assistant Engineer	2	40
Working Experience	5-10 years	1	20
	11-15 years	-	-
	16-20 years	3	60
	More than 20 years	1	20

Table 5 shows the demographics of 5 BIM experts: 75% male, 25% female; positions – 40% professional engineers, 20% senior engineers, 40% assistant engineers; experience – 20% with 5–10 years, 60% with 16–20 years, and 20% over 20 years, none with 11–15 years. The group is predominantly male and highly experienced, making the data valid for further analysis.

4. RESULTS AND DISCUSSION

During the semi-structured interview, there are five (5) main questions that need to be answered by the participants. The table below summarizes all the questions and answers based on the interview session outputs.

Table 6: Questions for important factors before successful BIM integration in an IBS project.

Question 1	What factors are important before successful BIM integration in an IBS project?
Panels	**Answers**
P1	**Financial**: Expensive software and hardware.
P2	**Management**: Need BIM experts and staff training.
P3	**Financial**: High cost for software/hardware, training, and upgrades. **Management**: Lack of clear BIM guidelines.
P4	**Financial**: Cost to hire BIM experts. **Technology**: Lack of BIM standards.
P5	**Technology**: Need BIM software (Revit, Tekla, AutoCAD) and hardware upgrade. **Financial**: Need sufficient budget allocation.
Summary Question	Financial readiness (software, hardware, and training costs) and management readiness (BIM experts and clear guidelines) are key to successful BIM–IBS integration.

Successful BIM integration depends on resources and technical alignment. Based on Table 6, P1 stated, *"Solve issue BIM software and hardware that is so expensive nowadays"* (Financial), echoed by P3 – *"Strong financial & cost money to get software & model, provide training for the staff, technology must always be updated like upgrading ROM & RAM."* P4 – *"The contractor must have an expert BIM Modeler so that the project can be completed quickly. Specification measurements in BIM software need to tally with project site measurements."* P5 – *"The company must have BIM software like Revit, AutoCAD, or Tekla. The company must allocate the money to implement BIM in IBS projects."* P2 added, *"BIM technology requires expert manpower to integrate with IBS. The government needs to provide BIM training for Malaysians. The company needs a manpower expert* *in BIM software and provides BIM training to the staff."* P3 also noted, *"standard guidelines from BIM usage to avoid any problem for others to find the data in the software."*

In summary, the main problems are high costs (Financial) and management needs (Management). P2 emphasized BIM experts and training, P3 highlighted financial and management requirements, P4 stressed hiring experts (Financial) and accurate measurements (Technology), and P5 noted software needs (Technology) and budget (Financial). All panels agreed that financial investment and management readiness are foundational. P2, P3, and P4 highlighted the need for BIM experts and training. High costs align with financial risk [40], BIM experts and training align with management risk [41, 42], and standardized measurement confirms technology risk [43].

Table 7: Questions for readiness of an organization to transit from current practices to BIM in an IBS project.

Question 2	**How do you measure the readiness of an organization to change from current practices to BIM in their IBS project?**
Panels	**Answers**
P1	**Optimism**: positive attitude towards technology.
P2	**Optimism**: positive attitude towards technology.
P3	**Optimism**: positive attitude towards technology.
P4	**Discomfort**: some resistance to learning new systems.
P5	**Optimism**: positive attitude towards technology.
Summary Question	Most see optimism and a positive mindset as readiness signs, though some stakeholders still show discomfort and resistance.

This section examines organizational readiness for BIM in IBS projects. Based on Table 7, readiness is seen through staff attitudes. P1 stated, *"Optimism, positive toward the technology because BIM really helps save time for projects to be completed quickly, especially IBS projects, compared to the traditional method of manual CAD Drawing."* P2 added, *"Optimism and a positive attitude towards technology because BIM can help facilitate work on project sites, especially IBS projects."* P3 noted, *"Optimism, positive towards the technology because BIM provides a more comfortable user experience,"* and emphasized, *"There is a need to check the staff's ability to use BIM software and always upgrade software and hardware and also update the team if there are any changes or anything new in BIM software."* P4 expressed resistance: *"Discomfort because why does it need to change? Because you are using old things, you need to learn something new, which is BIM."* P5 stated, *"Optimism, positive toward the technology."*

Overall, readiness is assessed through optimism (P1, P2, P3, P5) and discomfort (P4). Staff attitude is central, balancing positive drivers and negative inhibitors, consistent with TRI dimensions for evaluating willingness to adopt new technology [32].

This section (Table 8) discusses the main risks preventing BIM adoption in IBS projects, including financial, management, technology, and time-related risks. P1 stated, *"Possible risk besides the key major risk above is a reluctance mindset to change the method, for example, the old days of using CAD changed to using BIM software. Another risk is causing delays in the project due to a lack of understanding of BIM software data and a new learning curve for newbies."* P2 added, *"The company will lose out due to not using BIM in IBS projects because it is very helpful in speeding up the data acquisition to manage facilities in the building."* P3 noted, *"The company must have a good team relationship with each other. The company must have strong finances to implement BIM with software and hardware. Staff mindset reluctance to change to BIM in IBS projects."* P4 stated, *"Mindset reluctance to change for the company. The company needs software to purchase, but the price is too high. It must also have strong hardware like ROM, RAM, & graphic card upgrades."* P5 said, *"The organization must allocate the budget to implement BIM in IBS projects. The company must allocate more time to prepare BIM software."*

Overall, the main risks are financial (high investment and budget), management (resistance to change), technology (software/hardware needs), and time (preparation and training). These findings align with the literature: financial risk is dominant [40], management risks involve negative attitudes toward collaboration and change [42, 44], and time-related risks contribute to implementation delays [45, 46].

Table 8: Question about the most common risks preventing the transition from current practices to BIM for IBS projects.

Question 3	What are the most common risks preventing the change from current practices to BIM for IBS projects?
Panels	**Answers**
P1	**Management**: Reluctance to change. **Financial**: Cost of software/hardware. **Time**: Delays due to a lack of understanding.
P2	**Financial**: Cost of training & limited financial support.
P3	**Management**: Lack of leadership and cooperation. **Financial**: High cost of tools (software and hardware).
P4	**Management**: Reluctance to change. **Financial**: High software cost. **Technology**: Hardware upgrade needs.
P5	**Financial**: High cost of software/hardware. **Time**: Time-consuming training and preparation.
Summary Question	Key risks include financial burden, management reluctance, and technology challenges (software/hardware limitations, training delays).

This section (Table 9) presents transition risks in BIM–IBS adoption. P1 stated, *"Lack of knowledge about BIM among IBS project industry players. The main risks that hinder change are costs such as software and hardware, as well as expensive training. The specifications of each project are not the same, causing difficulties in synchronizing the BIM process."* P2 added, *"The management's reluctance to change to BIM-IBS. The management needs more cost to invest in BIM and budget transparency."* P3 noted, *"The company must appoint a supervisor, like a BIM expert, to monitor the staff to use BIM software in the right way. Same data sharing management with concerns about the risk of data loss or system failures during BIM adaptation for IBS projects."* P4 said, *"New standard because of new things, because it perceives the absence of standardized BIM protocols for IBS, resulting in compatibility issues among project stakeholders. Miscommunication among stakeholders due to different BIM standards when using BIM in IBS projects, with concerns about the potential for increased miscommunication during the transition to BIM-IBS projects, resulting in longer project delays. Lack of a BIM expert in the company."* P5 stated, *"It takes more time to adapt to BIM in IBS projects, which can delay a project. It needs to propose a BIM standard guideline for IBS projects."*

Overall, transition risks involve management (lack of knowledge, experts, management reluctance; P1, P2, P4) [40], technology (missing BIM standards, data loss; P3, P4, P5) [44, 45], and time-related risks (slow adaptation causing delays; P1, P4, P5) [45, 46]. Miscommunication (P4) is a new time risk affecting coordination and timing.

Table 9: Questions for examples of possible risks encountered in moving towards BIM-IBS technology.

Question 4	Examples of possible risks encountered in moving towards BIM-IBS technology.
Panels	**Answers**
P1	**Management**: Lack of BIM knowledge. **Financial**: High software/training cost. **Time**: Synchronization difficulties.
P2	**Management**: Reluctance to change. **Financial:** High investment and transparency issues.
P3	**Management**: Need BIM leadership. **Technology**: Risk of data loss/system failures.
P4	**Technology**: Different BIM standards causing miscommunication. **Management**: Lack of experts. **Time**: Project delays.
P5	**Time**: Delays due to adaptation. **Technology**: Need a standardized BIM guideline.
Summary Question	Common risks include a lack of BIM expertise, high investment costs, miscommunication, and the absence of standard BIM protocols for IBS.

This section (Table 10) examines the perceived risks of transitioning to BIM for IBS projects. P1 stated, "Moderate the level of risk to change from current practice to BIM for their IBS projects because of financial, knowledge of BIM, and management decision reluctance to change to BIM-IBS." P2 noted, "Moderate the level of risk…because of the cost & effort for the company to change to BIM-IBS technology; budget transparency and data transfer become easier when using BIM in IBS projects." P3 said, "Moderate the level of risk to change from current practice to BIM for their IBS projects." P4 added, "Moderate the level of risk…because of miscommunication among construction players." P5 considered it "Low level of risk to change from current practice to BIM for their IBS projects."

Overall, most panels (P1–P4) assessed the transition risk as moderate, with P5 rating it low. This shows that, according to experts, the BIM–IBS transition is generally manageable when risks are identified and addressed.

Table 10: Question for the level of risk for planning to transit from current practice to BIM for IBS projects.

Question 5	Level of risk (high, low, moderate) for those planning to change from current practices to BIM for their IBS projects.
Panels	**Answers**
P1	Moderate
P2	Moderate
P3	Moderate
P4	Moderate
P5	Low
Summary Question	Most assess the risk as moderate, with one panel rating it low, showing manageable yet significant transition challenges.

Table 11 shows a summary of the major factors of transition risks by the following questions:

Table 11: Summary of the major factors of transition risks by the questions.

Factors / Question	Major Factor of Transition Risk
Q1	Financial risk
Q3	Financial risk
Q4	Management risk

From Table 11, key transition risks are financial (questions 1 and 3) and management (question 4). Overall, the risk of a BIM–IBS transition is moderate (question 5), with one respondent rating it low. Organizational readiness is mostly optimism toward technology, except for P4, which shows discomfort (question 2).

5. CONCLUSION

In summary, this study shows that in BIM–IBS adoption in Malaysia, financial readiness is the main challenge, while organizational optimism and moderate risk perception indicate growing confidence, marking a shift from risk awareness to strategic readiness in construction digitalization. Management-related challenges, including resistance to organizational change and a lack of skilled personnel, further hinder successful implementation. Based on the Technology Readiness Index (TRI), organizational readiness is significantly influenced by optimism and discomfort toward technology: optimism promotes adoption, while discomfort acts as a constraint. Overall, the moderate level of transition risk suggests that BIM–IBS integration is feasible provided that critical risks are proactively managed.

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