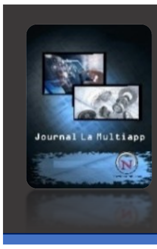

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Technology Readiness and Acceptance as Predictors of Bim Adoption Intention: A Tram Study an a Project Management Consultancy

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Abstract

Building Information Modeling (BIM) is a critical digital innovation for improving coordination and decision-making in construction project management; however, its adoption among project management consultancies in Indonesia remains limited. This study examines how technology readiness and technology acceptance influence BIM adoption intention in a pre-adoption consultancy context using the Technology Readiness and Acceptance Model (TRAM). A confirmatory survey was conducted at a state-owned project management consultancy involving 85 respondents from management and project site teams. Data were analyzed using the Relative Importance Index (RII) and Structural Equation Modeling–Partial Least Squares (SEM-PLS). The results show that BIM adoption intention is mainly driven by perceived usefulness ($\beta = 0.531$, $p < 0.001$), followed by perceived ease of use ($\beta = 0.263$, $p = 0.037$). The TRAM model explains 55.7% of the variance in adoption intention ($R^2 = 0.557$). Innovativeness plays an important enabling role by positively influencing perceived usefulness ($\beta = 0.387$, $p = 0.002$) and perceived ease of use ($\beta = 0.481$, $p = 0.001$), while optimism and insecurity do not show significant effects. Descriptive analysis further indicates that BIM is highly valued for its long-term organizational benefits (RII = 0.925) and early problem detection capability (RII = 0.915). No significant perceptual differences are found between management and project site teams. These findings suggest that BIM adoption intention in project management consultancies is primarily shaped by performance-related and usability perceptions, underscoring the importance of targeted training, infrastructure readiness, and organizational support to translate intention into effective implementation.

Introduction

The construction industry is undergoing a profound transformation driven by digital technologies associated with the Industry 4.0 paradigm (Huang et al., 2023; Zizic et al., 2022; Elghaish et al., 2022). Digitalization has reshaped how construction projects are planned, executed, and controlled by enabling higher levels of integration, automation, and data-driven decision-making across the project life cycle (Eastman et al., 2011). Within this transformation, Building Information Modeling (BIM) has emerged as a core digital innovation that integrates geometric, informational, and functional data throughout the design, construction, and operational phases (Succar, 2009; Sarigul & Gunaydin, 2025; Sepasgozar

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et al., 2023). Beyond its role as a three-dimensional modeling tool, BIM functions as a comprehensive information management approach that facilitates collaboration among project stakeholders, enhances visualization, supports early problem detection, and improves control over cost, schedule, and quality performance (Azhar, 2011; Kobi, 2024; Rane, 2023). Numerous empirical studies have demonstrated that BIM implementation can reduce design errors, minimize rework, and enhance overall project performance and productivity (Hardin, 2009; Sacks et al., 2010; Bryde et al., 2013). Despite these well-documented benefits, BIM adoption remains uneven across regions and organizational contexts, suggesting that technological advantages alone do not guarantee successful implementation. In many developed countries, BIM has become a standard or mandatory requirement for public infrastructure projects (Wong et al., 2018), supported by comprehensive regulatory frameworks and institutional readiness (British Standards Institution, 2014; ISO 19650-1, 2018).

BIM adoption in developing countries, including Indonesia, remains fragmented and uneven (Lembangan & Nurdiah, 20235; Chatsuwan et al., 2024; Mashinini et al., 2025). Existing evidence indicates that BIM implementation is largely concentrated within contractors and design consultants, while other key actors in the project delivery system particularly project management consultancies and supervision-oriented organizations often lag behind (Fundra et al., 2021; Hosseini et al., 2018). This gap is particularly critical given the strategic role of project management consultancies in project governance, coordination, quality assurance, and owner representation. Unlike design consultants or contractors, consultancy-based organizations derive BIM's value primarily from its capacity to support decision-making, coordination, monitoring, and information integration rather than from model authoring or production. As a result, BIM adoption in consultancy and supervision contexts is closely tied to perceptions of practical utility, workflow compatibility, and ease of use. However, these behavioral and perceptual dimensions have received comparatively limited attention in BIM adoption research (Cao et al., 2022; Wang et al., 2024; Faisal Shehzad et al., 2022).

Previous studies on BIM adoption have predominantly emphasized technical, organizational, and regulatory determinants, such as software capability, interoperability, contractual arrangements, and institutional mandates (Succar, 2010; Jung & Joo, 2011; Oesterreich & Teuteberg, 2016). While these factors are essential, growing evidence suggests that the success of digital transformation initiatives also depends heavily on individual users who interact with the technology in their daily work routines (Thomas et al., 2024; Koca et al., 2025; From a behavioral perspective, technology adoption has been widely examined using the Technology Acceptance Model (TAM), which identifies perceived usefulness and perceived ease of use as primary determinants of user acceptance (Davis, 1989). Nevertheless, TAM has been criticized for its limited ability to capture individuals' psychological predispositions and readiness to embrace new technologies, particularly in organizational change and pre-adoption contexts. To address this limitation, Parasuraman (2000) introduced the Technology Readiness Index (TRI), which conceptualizes individual readiness through four dimensions: optimism, innovativeness, discomfort, and insecurity.

The integration of TRI and TAM into the Technology Readiness and Acceptance Model (TRAM) provides a more comprehensive framework that simultaneously captures readiness-related attitudes and acceptance-related perceptions (Lin et al., 2007). Recent studies have applied TRAM to investigate BIM adoption behavior in the construction sector (Wang & Lin, 2019; Lai & Lee, 2020). However, most of this research has focused on post-adoption contexts or organizations where BIM has already been implemented, thereby overlooking the critical pre-adoption stage in which perceptions, expectations, and behavioral intentions are formed.

This limitation is particularly evident in the context of project management consultancies in developing countries, where BIM adoption is often still exploratory and not yet embedded in routine supervisory practices. Consultancy-based organizations typically operate within complex, multidisciplinary project environments and face practical constraints related to infrastructure readiness, skill availability, and role clarity in BIM-enabled workflows. Understanding technology readiness and acceptance at this early stage is therefore essential, as initial behavioral perceptions strongly influence subsequent adoption decisions and implementation outcomes. Against this background, this study aims to analyze technology readiness and individual acceptance toward BIM adoption in consultancy-based project organizations using the Technology Readiness and Acceptance Model (TRAM), with empirical evidence drawn from the Indonesian construction consultancy context. Specifically, this study seeks to (1) evaluate individual technology readiness toward BIM in a pre-adoption setting, (2) examine the effects of technology acceptance factors on BIM adoption intention, and (3) identify managerial implications to support effective and sustainable BIM implementation within project management consultancy and supervision-oriented organizations. Based on the TRAM framework, this study hypothesizes that technology readiness dimensions function as enabling and inhibiting factors that shape technology acceptance perceptions, which in turn influence the intention to adopt BIM in a pre-adoption consultancy context.

Methods

Research Design and Context

This study adopts a confirmatory quantitative approach using a case study design to examine individual technology readiness and acceptance toward Building Information Modeling (BIM) adoption in consultancy-based project organizations. The case study design allows for an in-depth investigation of organizational conditions, work practices, and behavioral perceptions within a pre-adoption setting, which is particularly relevant for understanding early-stage BIM adoption dynamics in supervision-oriented contexts. The empirical investigation was conducted within a project management consultancy operating in Indonesia, representing a typical consultancy-based organization involved in infrastructure delivery. The organization provides project management and supervision services for power plant and transmission infrastructure projects and, at the time of the study, had not formally integrated BIM into its supervisory practices. This condition allows respondents to be characterized as non-users or potential users of BIM, making the context suitable for examining technology readiness and adoption intention prior to implementation. The organization manages multidisciplinary projects involving civil, mechanical, electrical, and instrumentation works, where effective coordination, information accuracy, and decision support are critical to project performance. These characteristics reflect common operational conditions faced by project management consultancies and supervision services in Indonesia, thereby enabling the findings of this study to offer insights relevant to similar consultancy-based project environments beyond the specific empirical setting.

Research Model

The hypothesized research model, illustrated in Figure 1, integrates the Technology Readiness Index (TRI) and the Technology Acceptance Model (TAM) within the TRAM framework. Four TRI constructs optimism (OPT), innovativeness (INN), discomfort (DIS), and insecurity (INS) are modeled as exogenous variables influencing perceived usefulness (PU) and perceived ease of use (PEOU). These acceptance constructs act as mediators leading to the

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endogenous variable, intention to use BIM (IU). In line with TAM, a direct relationship from PEOU to PU is also specified.

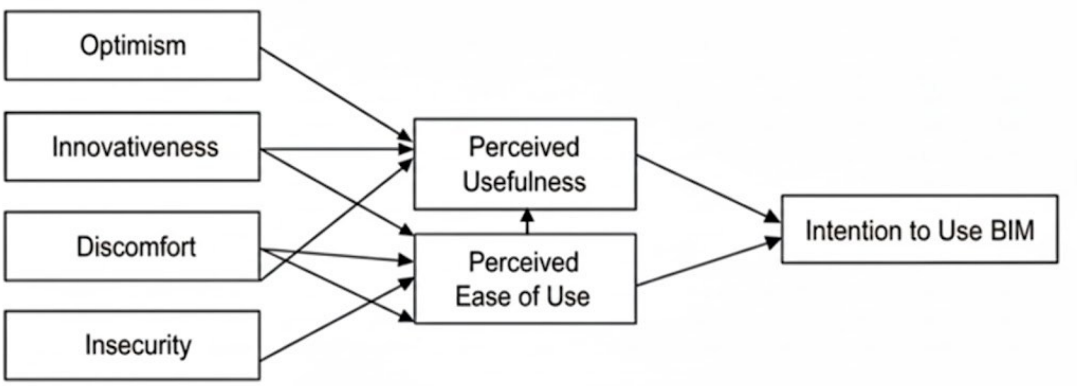

Figure 1. Research Model of BIM Adoption Based on the TRAM

Sample and Data Collection

The study population consisted of employees involved in project management and construction supervision activities, including both management personnel and project site teams. A purposive sampling technique was applied to ensure that respondents possessed adequate professional experience and familiarity with construction processes. Data were collected using a structured questionnaire distributed both online and in person to accommodate respondents working at different project locations. A total of 85 complete and valid responses were obtained and included in the analysis. This sample size is considered adequate for Partial Least Squares–Structural Equation Modeling (PLS-SEM), which is appropriate for prediction-oriented analysis with relatively small samples.

Research Instrument

Data were collected using a structured questionnaire developed from established Technology Readiness Index (TRI) (Parasuraman, 2000) and Technology Acceptance Model (TAM) (Davis, 1989) instruments, adapted to the BIM context. The questionnaire comprised seven latent constructs: optimism, innovativeness, discomfort, insecurity, perceived usefulness, perceived ease of use, and intention to use BIM. All items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Prior to distribution, the instrument was reviewed to ensure clarity, relevance, and contextual suitability.

Table 1. Model Variables and Questionnaire Indicators

No	Code	Construct	Questionnaire Indicators
1.	OPT1	Optimism (OPT)	Belief in technology benefits
2.	OPT2		Belief in improved work quality
3.	OPT3		Confidence in long-term organizational benefits
4.	INN1	Innovativeness (INN)	Interest in new technology
5.	INN2		Exploration of new methods
6.	INN3		Openness to technological innovation
7.	INN4		Organizational openness to BIM innovation
8.	DIS1	Discomfort (DIS)	Discomfort due to lack of facilities
9.	DIS2		Anxiety regarding workflow changes
10.	DIS3		Difficulty in adaptation
11.	DIS4		Lack of adequate training

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12.	DIS5		Administrative complexity concerns
13.	INS1	Insecurity (INS)	Uncertainty of BIM benefits
14.	INS2		Implementation concerns
15.	INS3		System compatibility issues
16.	INS4		Difficulty in understanding BIM
17.	INS5		Data input accuracy concern
18.	PU1	Perceived Usefulness (PU)	Early issue identification
19.	PU2		Reporting accuracy
20.	PU3		Communication efficiency
21.	PU4		Faster and better decision-making
22.	PEOU1	Perceived Ease of Use (PEOU)	Ease of daily use
23.	PEOU2		Ease of information access
24.	PEOU3		Ease of interface
25.	IU1	Intention to Use (IU)	Intention to adopt BIM
26.	IU2		Recommendation to others
27.	IU3		Commitment to active use

Source: Author's development on Parasuraman (2000) and Davis (1989), 2025

Data Analysis

Data analysis was conducted in several stages. Descriptive statistics were first used to summarize respondent characteristics and overall perception trends. The Relative Importance Index (RII) was applied to identify dominant factors influencing BIM adoption perceptions. Group comparison tests were then performed to examine potential perceptual differences between management and project site teams, while Spearman's rank correlation analysis provided an initial assessment of relationships among constructs. PLS-SEM was employed as the primary analytical technique to evaluate the TRAM framework. The measurement model was assessed for reliability and validity using outer loadings, Average Variance Extracted (AVE), Composite Reliability (CR), and the Heterotrait–Monotrait (HTMT) ratio, following established guidelines (Hair et al., 2019). The structural model was subsequently evaluated to assess explanatory power using the coefficient of determination (R^2) and to test hypothesized relationships through a bootstrapping procedure. Mediation analysis was also conducted to examine indirect effects and to provide deeper insight into the mechanisms through which technology readiness influences BIM adoption intention.

Results and Discussion

Respondent Characteristics

The respondents involved in this study represent key organizational actors in construction supervision and project management activities. A total of 85 respondents participated, comprising management personnel (21.18%, n = 18) and project site team members (78.82%, n = 67), ensuring representation of both strategic and operational perspectives. Respondents are also almost evenly distributed across power plant projects (48.24%, n = 41) and transmission projects (51.76%, n = 44), reflecting the organization's core consultancy domains. As shown in Table 2, the respondent profile is dominated by experienced practitioners. Overall, more than 74% of respondents have over 12 years of project experience, consisting of 61.18% with 12–15 years and 12.94% with more than 16 years of experience. All management respondents possess more than 12 years of experience, while the majority of project site team members also fall within the same experience range. This composition indicates that perceptions of BIM adoption captured in this study are grounded in substantial professional experience, strengthening the credibility and contextual relevance of the findings.

Table 2. Respondent Characteristics

Project Experience	Project Site Team		Management		Total	
	%	n	%	n	%	n
4-7 years	2.99	2	-	-	2.35	2
8-11 years	29.85	20	-	-	23.53	20
12-15 years	61.19	41	61.11	11	61.18	52
>16 years	5.97	4	38.89	7	12.94	11
Total	100	67	100	18	100	85

Descriptive Results of Technology Readiness and Acceptance

The descriptive analysis indicates an overall positive perception of BIM adoption across both technology readiness and acceptance dimensions. Among acceptance-related constructs, perceived usefulness records the highest mean values, suggesting that respondents primarily evaluate BIM based on its expected contribution to work performance, coordination efficiency, and problem-solving capability. This pattern reflects the professional and performance-oriented nature of consultancy-based organizations, where technology adoption decisions are driven mainly by functional value. Within the technology readiness dimensions, innovativeness shows consistently high scores, indicating a strong openness to adopting new digital tools and work methods. Optimism toward technology is also generally positive, suggesting that respondents believe digital solutions can enhance job effectiveness. In contrast, discomfort and insecurity exhibit relatively lower scores, highlighting concerns related to limited infrastructure, insufficient training, and uncertainty regarding data accuracy. These findings suggest that while respondents conceptually support BIM adoption, practical readiness constraints remain evident in the pre-adoption context.

Relative Importance Index (RII) Results

The Relative Importance Index (RII) analysis further clarifies the relative weight of specific factors influencing BIM adoption perceptions. As summarized in Table 3, the highest-ranked indicator is confidence in BIM's long-term organizational benefits (OPT3; RII = 0.925), indicating that BIM is perceived as a strategic investment rather than a short-term technological upgrade. High rankings for openness to innovation (INN3; RII = 0.920) and early problem detection capability (PU1; RII = 0.915) reinforce the view that respondents recognize BIM's strategic and operational value in supporting supervision and control functions. Conversely, lower RII values are observed for indicators related to lack of facilities (DIS1; RII = 0.499) and insufficient training (DIS4; RII = 0.515), identifying infrastructure and competency gaps as key barriers. Concerns regarding data accuracy (INS5; RII = 0.551) further indicate lingering apprehension toward BIM reliability. The coexistence of high perceived benefits and notable implementation barriers reflects a typical pre-adoption condition, where strategic awareness is strong but operational readiness remains limited.

Table 3. Key RII Results of BIM Adoption Factors

Rank	Indicators	Variables	RII	Interpretation
1	OPT3	Optimism	0.925	Long-term organizational benefit
2	INN3	Innovativeness	0.920	Openness to innovation
3	PU1	Perceived Usefulness	0.915	Early issue identification

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25	INS5	Insecurity	0.551	Data accuracy concern
26	DIS4	Discomfort	0.515	Lack of adequate training
27	DIS1	Discomfort	0.499	lack of facilities

Comparison of Perceptions Between Management and Project Site Teams

To assess perceptual consistency across organizational levels, independent sample t-tests and Mann–Whitney U tests were conducted to compare management personnel and project site team members across all TRAM constructs. The results show no statistically significant differences between the two groups (all $p > 0.05$), including optimism, innovativeness, discomfort, insecurity, perceived usefulness, perceived ease of use, and intention to use BIM. These findings indicate that perceptions of BIM readiness and acceptance are relatively homogeneous across the organization, regardless of hierarchical position or functional role. From an organizational change perspective, this alignment between strategic and operational levels represents a favorable condition for BIM implementation, as perceptual gaps between decision-makers and end users often contribute to resistance during technology adoption initiatives. The absence of such gaps suggests that both management and project site teams share similar expectations, concerns, and intentions toward BIM, thereby reducing the risk of internal resistance and supporting coordinated, organization-wide adoption strategies.

Measurement and Structural Model Results

Model Evaluation

The measurement model results, illustrated in Figure 2, indicate that all constructs meet the required standards of reliability and validity. All indicator loadings exceed the recommended threshold of 0.70, demonstrating strong associations between indicators and their respective latent constructs. Convergent validity is confirmed, as the Average Variance Extracted (AVE) values for all constructs are above 0.50. Internal consistency is also satisfactory, with Composite Reliability (CR) and Cronbach's Alpha values exceeding 0.70 across all constructs. Discriminant validity is established using both the Heterotrait–Monotrait (HTMT) ratio and the Fornell–Larcker criterion, confirming that each construct is empirically distinct. In addition, all Variance Inflation Factor (VIF) values remain below the threshold of 5, indicating the absence of multicollinearity issues (Hair et al., 2019). Overall, these results confirm that the measurement model provides a reliable and valid basis for subsequent structural analysis.

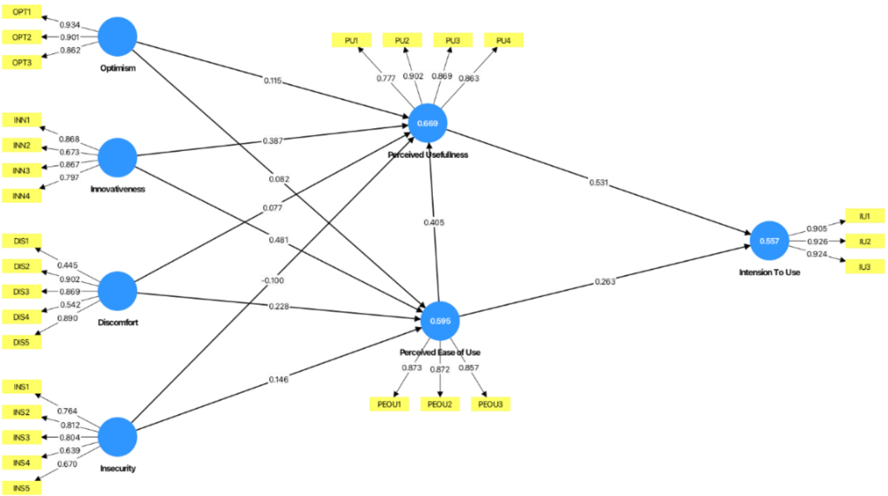

Figure 2. TRAM Measurement Model Results

Structural Model and Hypothesis Testing

Following the validation of the measurement model, the structural model was assessed to examine the hypothesized relationships and the model's explanatory power. As summarized in Table 4, the TRAM framework explains a substantial proportion of variance in the key endogenous constructs, accounting for 55.7% of the variance in Intention to Use BIM ($R^2 = 0.557$), 66.9% in Perceived Usefulness, and 59.5% in Perceived Ease of Use. These results indicate a strong explanatory capability of the TRAM model within a pre-adoption project management consultancy context, highlighting its robustness in capturing behavioral determinants of BIM adoption intention.

Table 4. R-Square Values of the Research Model

Variabel Endogen	R-Square	R-Square Adjusted
Intention to Use	0.557	0.547
Perceived Ease of Use	0.595	0.575
Perceived Usefulness	0.669	0.648

Model fit indices, including SRMR, d_ULS, d_G, and NFI, all meet the recommended thresholds, indicating good alignment between the theoretical TRAM framework and the empirical data. The results of direct hypothesis testing are presented in Table 5. Of the eleven proposed relationships, six are statistically supported ($p < 0.05$). Perceived Usefulness exhibits the strongest direct effect on Intention to Use BIM ($\beta = 0.531$, $p < 0.001$), followed by Perceived Ease of Use ($\beta = 0.263$, $p < 0.05$). In addition, Perceived Ease of Use significantly influences Perceived Usefulness ($\beta = 0.405$, $p < 0.001$), highlighting its dual role as both a direct and indirect driver of adoption intention. Among the technology readiness dimensions, Innovativeness significantly affects both Perceived Usefulness ($\beta = 0.387$, $p = 0.002$) and Perceived Ease of Use ($\beta = 0.481$, $p = 0.001$), whereas Optimism and Insecurity do not show significant direct effects.

Table 5. Results of Direct Effect Hypothesis Test

Hypothesis	Path	Original Sample (O) / β	SD	*t* Value	*p* Values	Decision
H1	OPT → PU	0.115	0.127	0.902	0.367	Not Supported
H2	OPT → PEOU	0.082	0.129	0.635	0.526	Not Supported
H3	INN → PU	0.387	0.124	3.116	0.002	Supported
H4	INN→ PEOU	0.481	0.140	3.428	0.001	Supported
H5	DIS → PU	0.077	0.109	0.704	0.482	Not Supported
H6	DIS → PEOU	0.228	0.104	2.189	0.029	Supported
H7	INS → PU	0.100	0.086	1.155	0.248	Not Supported
H8	INS → PEOU	0.146	0.095	1.546	0.122	Not Supported
H9	PU → IU	0.531	0.108	4.916	0.000	Supported
H10	PEOU → IU	0.263	0.126	2.089	0.037	Supported
H11	PEOU → PU	0.405	0.107	3.803	0.000	Supported

Mediation Effects

Mediation analysis was conducted to further examine the indirect mechanisms underlying BIM adoption intention, with results summarized in Table 6. The findings indicate that Perceived Usefulness plays a central mediating role within the TRAM framework. Innovativeness exerts a significant indirect effect on adoption intention through Perceived

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Ease of Use and Perceived Usefulness (β = 0.103, p = 0.014), suggesting that innovative individuals are more likely to perceive BIM as easy to use and useful, which subsequently strengthens their intention to adopt it. Perceived Ease of Use also significantly mediates the relationship between Perceived Usefulness and Intention to Use (β = 0.215, p < 0.001), reinforcing the core assumption of the Technology Acceptance Model that usability enhances adoption intention by amplifying perceived performance benefits. Although Discomfort does not show a significant direct effect, it demonstrates a significant sequential mediation through Perceived Ease of Use and Perceived Usefulness (β = 0.049, p = 0.045), indicating that usability improvements can partially mitigate discomfort-related barriers in a pre-adoption context. In contrast, mediation paths involving Optimism and Insecurity are not statistically significant, suggesting that general technological attitudes and risk perceptions play a limited role when functional utility and usability considerations are absent.

Table 6. Results of Mediation Effect Analysis

Mediation Path	**Original Sample (O) / β**	**SD**	***t* Values**	***p* Values**	**Decision**
DIS→ PEOU → PU	0.092	0.048	1.910	0.056	Not Significant
OPT → PU → IU	0.061	0.073	0.838	0.402	Not Significant
INN → PEOU → PU	0.195	0.077	2.528	0.011	Significant
OPT → PEOU → IU	0.022	0.038	0.575	0.565	Not Significant
PEOU → PU → IU	0.215	0.061	3.545	0.000	Significant
INN → PEOU → PU	0.059	0.041	1.431	0.152	Not Significant
OPT → PEOU → PU	0.033	0.052	0.643	0.520	Not Significant
INN → PEOU → PU → IU	0.103	0.042	2.449	0.014	Significant
DIS → PEOU → PU → IU	0.049	0.024	2.006	0.045	Significant
INN → PEOU → PU → IU	0.031	0.022	1.454	0.146	Not Significant
OPT → PEOU → PU → IU	0.018	0.028	0.635	0.525	Not Significant
DIS → PU → IU	0.041	0.060	0.677	0.498	Not Significant
DIS → PEOU → IU	0.060	0.046	1.317	0.188	Not Significant
INN → PU → IU	0.205	0.079	2.596	0.009	Significant
INN → PEOU → IU	0.127	0.074	1.719	0.086	Not Significant
INS → PU → IU	0.053	0.046	1.141	0.254	Not Significant

INS → PEOU → IU	0.039	0.034	1.131	0.258	Not Significant

limitation and Managerial Implications

The findings indicate that BIM adoption intention in consultancy-based project organizations is primarily driven by technology acceptance factors particularly perceived usefulness and perceived ease of use rather than by general technology readiness attitudes. This pattern aligns closely with the practical realities of project management consultancy and construction supervision practices in Indonesia. In many consultancy and supervision settings, BIM is not positioned as a model production platform but as a supporting tool for coordination, monitoring, reporting, and decision-making. Consequently, adoption decisions tend to be pragmatic and performance-oriented, focusing on whether BIM can demonstrably improve daily supervisory tasks, enhance information reliability, and reduce coordination complexity, rather than on general enthusiasm toward digital technologies.

Consistent with the Technology Readiness and Acceptance Model (TRAM), technology readiness dimensions function mainly as enabling or constraining conditions that shape perceptions of usefulness and ease of use, rather than exerting a direct influence on adoption intention. This reflects common organizational conditions in Indonesian consultancy and supervision practices, where professionals are typically experienced practitioners operating within established workflows, substantial administrative demands, and tight project schedules. In such environments, positive technological attitudes (optimism) or concerns about technological risks (insecurity) alone are insufficient to motivate adoption unless BIM clearly delivers operational value in terms of efficiency, accuracy, and workload reduction. This explains why perceived usefulness emerges as the dominant predictor of adoption intention, while optimism and insecurity do not exhibit significant direct effects.

The significant role of innovativeness highlights that individuals who are more open to new working methods are better positioned to recognize BIM's potential benefits and usability. However, the predominantly indirect influence of innovativeness suggests that openness alone is not sufficient; it must be supported by tangible system characteristics, such as intuitive interfaces, supervision-relevant BIM use cases, and alignment with existing work processes. This finding resonates with the Indonesian consultancy context, where organizations often face practical constraints, including limited BIM-ready infrastructure, uneven access to licensed software, and insufficient role-specific training. These constraints are reflected in the role of discomfort, which does not directly suppress adoption intention but influences it indirectly through perceived ease of use and usefulness. From a practical standpoint, this implies that usability enhancements and targeted capacity-building initiatives can partially mitigate discomfort-related barriers in supervision-oriented organizations.

The absence of perceptual differences between management and project site teams further reflects a characteristic feature of consultancy-based organizations in Indonesia, where strategic and operational actors often share similar assessments of BIM's potential benefits and limitations. This alignment suggests that resistance to BIM adoption is not primarily driven by hierarchical disagreement, but rather by organizational readiness and implementation capacity. Accordingly, the main challenge for consultancy organizations lies not in changing individual attitudes, but in translating shared expectations into operationally viable BIM practices that are embedded within routine supervisory workflows.

Research Limitation

This study focuses on a consultancy-based organizational context and captures adoption intention at a pre-adoption stage. While this approach provides valuable insights into early-stage BIM adoption dynamics in supervision-oriented settings, future studies may extend the analysis by examining multiple consultancy organizations and exploring adoption behavior over time to capture post-adoption usage and institutionalization processes.

Managerial Implications

From a managerial perspective, the findings suggest that BIM adoption strategies in Indonesian project management consultancies should be explicitly positioned around performance enhancement rather than technological novelty. BIM applications should initially focus on supervision-relevant functions, such as visual-based coordination review, progress monitoring, clash-related issue tracking, and reporting support, before expanding to more advanced dimensions such as 4D and 5D BIM. Improving perceived ease of use through adequate infrastructure, simplified workflows, and role-specific training is critical to reducing discomfort and increasing acceptance. Finally, technological initiatives should be supported by structured change management measures, including pilot projects, internal BIM champions, and clear implementation roadmaps, to ensure that BIM adoption is not merely symbolic but becomes embedded in routine consultancy and supervision practices in Indonesia.

Conclusion

This study examined individual technology readiness and acceptance toward Building Information Modeling (BIM) adoption in consultancy-based project organizations using the Technology Readiness and Acceptance Model (TRAM). The findings indicate that, in a pre-adoption consultancy and supervision context, BIM adoption intention is primarily driven by technology acceptance factors rather than by general readiness attitudes. Perceived usefulness emerges as the strongest determinant, followed by perceived ease of use, suggesting that adoption decisions are largely motivated by expectations of tangible performance improvements in coordination, information accuracy, and decision-making. These results reflect the practical realities of project management consultancy and construction supervision practices in Indonesia, where BIM is typically positioned as a supporting tool for monitoring, coordination, reporting, and decision support rather than as a model production platform. In such environments, experienced consultants and supervisors tend to adopt digital technologies when clear operational value and workflow efficiency gains are evident. Accordingly, technology readiness dimensions play differentiated roles: innovativeness acts as an enabling factor by strengthening acceptance perceptions, while optimism and insecurity do not significantly influence adoption intention in the absence of clearly perceived functional benefits. Practical constraints related to infrastructure readiness and role-specific training are reflected in the influence of discomfort. The absence of perceptual differences between management and project site teams further suggests strong organizational alignment, indicating that barriers to BIM adoption are primarily operational rather than attitudinal.

From a managerial perspective, these findings imply that BIM adoption strategies in consultancy-based project organizations should prioritize applications that directly support supervisory and decision-making functions, such as coordination review, progress monitoring, and early issue identification. These strategies should be supported by investments in user-friendly systems, adequate technological infrastructure, targeted training programs, and structured change management initiatives including pilot projects and internal BIM champions to ensure that BIM adoption is effectively institutionalized within routine project management and supervision practices. This study captures BIM adoption intention at an early stage within a consultancy-based context and provides empirically grounded insights into pre-adoption dynamics. Future research may extend this work by examining multiple consultancy and supervision organizations, adopting longitudinal designs to track post-adoption usage, and incorporating organizational or regulatory factors to further enrich understanding of BIM adoption in consultancy-oriented project environments.

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References

Azhar, S. (2011). Building Information Modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry. Leadership and Management in Engineering.

British Standards Institution. (2014). PAS 1192-2:2013 Specification for information management for the capital/delivery phase of construction projects using building information modelling*. BSI.

Bryde, D., Broquetas, M., & Volm, J. M. (2013). The project benefits of building information modelling (BIM). International Journal of Project Management, 31(7), 971–980. https://doi.org/10.1016/j.ijproman.2012.12.001

Cao, D., Shao, S., Huang, B., & Wang, G. (2022). Multidimensional behavioral responses to the implementation of BIM in construction projects: an empirical study in China. *Engineering, Construction and Architectural Management*, *29*(2), 819-841. https://doi.org/10.1108/ECAM-09-2020-0735

Chatsuwan, M., Manajitt, B., Ichinose, M., & Alkhalaf, H. (2024). A Review of BIM Maturity in Standards and Guidelines Across Asia. In *Proceedings of the 41st International Conference of CIB W* (Vol. 78).

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.

Eastman, C. M., Teicholz, P., Sacks, R., & Liston, K. (2011). BIM Handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors (2nd ed.).

Elghaish, F., Matarneh, S. T., Edwards, D. J., Pour Rahimian, F., El-Gohary, H., & Ejohwomu, O. (2022). Applications of Industry 4.0 digital technologies towards a construction circular economy: gap analysis and conceptual framework. *Construction Innovation*, *22*(3), 647-670. https://doi.org/10.1108/CI-03-2022-0062

Faisal Shehzad, H. M., Binti Ibrahim, R., Yusof, A. F., Mohamed khaidzir, K. A., Shawkat, S., & Ahmad, S. (2022). Recent developments of BIM adoption based on categorization, identification and factors: a systematic literature review. *International Journal of Construction Management*, *22*(15), 3001-3013. https://doi.org/10.1080/15623599.2020.1837719

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Fundra, I. W., Susanto, A., & Widjaja, A. (2021). Analisis faktor-faktor yang mempengaruhi implementasi BIM pada proyek konstruksi di Indonesia. Jurnal Teknik Sipil, 28(1), 45-58.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2-24.

Hardin, B. (2009). BIM and construction management: proven tools, methods, and workflows.

Hosseini, M. R., Maghrebi, M., Akbarnezhad, A., Martek, I., & Arashpour, M. (2018). Analysis of citation networks in building information modeling research. Journal of Construction Engineering and Management.

Huang, J. (2023). Digital engineering transformation with trustworthy AI towards industry 4.0: emerging paradigm shifts. *Journal of Integrated Design and Process Science*, *26*(3-4), 267-290. https://doi.org/10.3233/JID-229010

Jung, Y., & Joo, M. (2011). Building information modelling (BIM) framework for practical implementation. Automation in Construction.

Kobi, J. (2024). Developing dashboard analytics and visualization tools for effective performance management and continuous process improvement. *International Journal of Innovative Science and Research Technology (IJISRT)*, *9*(10.38124).

Koca, D., & van Deursen, A. (2025). Exploring labor market dynamics in digital transformations: The perspective of Dutch SMEs. *Journal of the International Council for Small Business*, 1-36. https://doi.org/10.1080/26437015.2025.2538182

Lembangan, M. O., & Nurdiah, E. A. (2025). A Review of BIM Implementation in Indonesia's Smart Cities: Challenges and Opportunities. *Advances in Civil Engineering and Sustainable Architecture*, *7*(1), 46-59. https://doi.org/10.9744/acesa.v7i1.14569

Lin, C. H., Shih, H. Y., & Sher, P. J. (2007). Integrating technology readiness into technology acceptance: The TRAM model. Psychology & Marketing, 24(7), 641–657.

Mashinini, P. C., Mahachi, J., Gumbo, T., & Mphambukeli, T. N. (2025). A critical review of BIM adoption in public infrastructure projects: global trends and lessons for South Africa. *Frontiers in Built Environment*, *11*, 1685353. https://doi.org/10.3389/fbuil.2025.1685353

Oesterreich, T. D., & Teuteberg, F. (2016). Understanding the implications of digitization and automation in the construction industry: A systematic literature review. Computers in Industry, 83, 121–139. https://doi.org/10.1016/j.compind.2016.09.006

Parasuraman, A. (2000). Technology readiness index (TRI): A multiple-item scale to measure readiness to embrace new technologies. Journal of Service Research, 2(4), 307–320.

Rane, N. (2023). Integrating building information modelling (BIM) and artificial intelligence (AI) for smart construction schedule, cost, quality, and safety management: challenges and opportunities. *Cost, Quality, and Safety Management: Challenges and Opportunities (September 16, 2023)*.

Sacks, R., Radosavljevic, M., & Barak, R. (2010). Requirements for building information modeling based lean production management systems for construction. Automation in Construction, 19(5), 641–655.

Sarigul, F. H., & Gunaydin, H. M. (2025). Integrated BIM, GIS and interoperable digital technologies in lifecycle management of building construction projects: systematic literature review. *Smart and Sustainable Built Environment*. https://doi.org/10.1108/SASBE-08-2024-0312

Sepasgozar, S. M., Khan, A. A., Smith, K., Romero, J. G., Shen, X., Shirowzhan, S., ... & Tahmasebinia, F. (2023). BIM and digital twin for developing convergence technologies as future of digital construction. *Buildings*, *13*(2), 441. https://doi.org/10.3390/buildings13020441

Succar, B. (2009). Building information modelling framework: A research and delivery foundation for industry stakeholders. Automation in Construction, 18(3), 357–375.

Succar, B. (2010). The five components of BIM performance measurement. In CIB World Congress 2010. CIB.

Thomas, A. (2024). Digitally transforming the organization through knowledge management: A socio-technical system (STS) perspective. *European Journal of Innovation Management*, *27*(9), 437-460. https://doi.org/10.1108/EJIM-02-2024-0114

Wang, K., Guo, M., Di Sarno, L., & Sun, Y. (2024). Decoding BIM adoption: a meta-analysis of 10 years of research—exploring the influence of sample size, economic level, and national culture. *Buildings*, *14*(4), 920. https://doi.org/10.3390/buildings14040920

Wang, X., & Lin, J. (2019). Applying the technology readiness and acceptance model to investigate the determinants of BIM adoption in Taiwan's construction industry. Construction Management and Economics, 37(7), 359-377.

Wong, K.D. and Fan, Q. (2013) Building Information Modelling (BIM) for Sustainable Building Design. Facilities, 31, 138-157. http://dx.doi.org/10.1108/02632771311299412

Zizic, M. C., Mladineo, M., Gjeldum, N., & Celent, L. (2022). From industry 4.0 towards industry 5.0: A review and analysis of paradigm shift for the people, organization and technology. *Energies*, *15*(14), 5221. https://doi.org/10.3390/en15145221