

Sustainable Digital Transformation Driven by GB/T 50500-2024 Valuation Standard: Influence of Technological Relative Advantage on Digital Adoption Intention in Cost Consulting Enterprises

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Abstract: The implementation of the Standard for Bills of Quantities and Valuation for Construction Works (GB/T 50500-2024) effectively phases out fixed quota pricing and imposes elevated digital capability requirements on cost consulting enterprises, which acts as a core policy driver for the sustainable digital transformation of the built environment industry. However, the sector faces a prominent paradox: the technical merits of digital tools are widely recognized, yet on-site implementation remains stagnant. Based on the Technology Acceptance Model (TAM), this study collected 600 valid questionnaires from practitioners of Chinese cost consulting enterprises and constructed a structural equation model to examine the influence mechanism of technological relative advantage and technological compatibility on digital technology adoption intention. In this study, digital technology referred to a broad set of cost-supporting tools including BIM, big data analysis, intelligent pricing algorithms and digital collaboration platforms. The empirical results showed that technological compatibility was the primary predictor of perceived ease of use ($\beta=0.307$). The direct effect of technological relative advantage on adoption intention was statistically insignificant, and its influence was fully mediated by perceived usefulness. This study clarified the cognitive transmission path from perceived technological advantages to adoption willingness, providing targeted countermeasures to advance the sustainable digital transition of cost management within the whole built environment industry.

Keywords: Sustainable digital transformation; GB/T 50500-2024 valuation standard; Digital technology adoption intention; Technological relative advantage; Perceived usefulness; Technology Acceptance Model (TAM)

Introduction

Against the backdrop of high-quality development in China's construction industry, digital transformation has become an inevitable path to promoting the sustainable development of the built environment, which is a core research theme covered by this journal. In November 2024, the Ministry of Housing and Urban-Rural Development of China issued the Standard for Bills of Quantities and Valuation for Construction Works (GB/T 50500-2024), which was formally implemented in September 2025 (Ministry of Housing

and Urban-Rural Development & State Administration for Market Regulation, 2024). The new standard effectively phases out the traditional fixed quota pricing mechanism. In the compilation of maximum tender prices, the valuation quota is replaced by engineering price information and self-accumulated cost data, forcing enterprises to rely on their own historical cost databases and market inquiry capabilities for independent bidding (Zhao & Zhang, 2025). This institutional reform puts forward rigid requirements for the digital application capability of cost consulting enterprises,

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and sustainable digital transition has become an indispensable part of the sustainable development agenda of the built environment. Digital transformation of cost consulting has become a critical component of sustainable built environment construction under national construction reform policies (Xiao et al., 2025).

As core market participants responsible for bill compilation and whole-process cost control, cost consulting enterprises determine the implementation effect of the new valuation rules to a large extent. The practical value of digital technologies such as Building Information Modelling (BIM) and big data analysis in built environment cost management has been widely verified: BIM technology enables automatic quantity takeoff and controls estimation errors within 3% (Alathamneh et al., 2024), and intelligent algorithms combined with historical databases can support data-driven market pricing decisions (Sepasgozar et al., 2022).

For the purposes of this survey, these tools—together with digital collaboration platforms and intelligent pricing systems—are grouped under the umbrella term “digital technology”. Respondents were asked to evaluate their overall perceptions and adoption intentions regarding this family of technologies as applied to GB/T 50500-2024 valuation tasks, rather than rating one specific software.

Nevertheless, the actual adoption of digital technologies in the industry is far below expectations. The sector generally faces a dilemma: the theoretical value of digital tools is highly recognized, but the actual landing and application progress is slow (Gu, 2020). This practical industry bottleneck deserves in-depth discussion in the field of built environment sustainability research.

Proposed by Davis, the Technology Acceptance Model (TAM) identifies perceived usefulness and perceived ease of use as two core cognitive variables that determine individual technology acceptance behavior (Davis, 1985). In the field of construction engineering, existing studies have validated the explanatory power of TAM for practitioners’ willingness to adopt BIM and other digital technologies (Zhao et al., 2023; Pang, 2018). However, most existing literature regards technological advantages as an inherent driving force of adoption, and pays insufficient attention to the transformation mechanism between perceived technical merits and individual adoption intention. Under the new quota-free pricing framework, the advantages of digital tools such as high calculation accuracy and efficient pricing have been widely verified, but practitioners do not necessarily generate adoption willingness accordingly. The internal transmission logic from technical advantages to adoption behavior remains to be further explored, filling a research gap in sustainable built environment service research.

Against the policy background of the GB/T 50500-2024 reform, this study takes frontline practitioners of cost consulting enterprises as research objects, and empirically examines how technological relative advantage affects digital technology adoption intention, with a focus on the mediating role of perceived usefulness. This research supplemented

theoretical evidence for the sustainable digital transformation of the cost-consulting industry and provided actionable countermeasures to break through the bottleneck of low digital adoption, thereby enriching empirical research on sustainable digital transition in built-environment service sectors.

Theoretical Background and Research Hypotheses

Technology acceptance model

The core logic of TAM holds that users’ willingness to adopt a new technology is jointly determined by two cognitive constructs: perceived usefulness and perceived ease of use, and perceived ease of use exerts a significant positive impact on perceived usefulness (Davis, 1985). Perceived usefulness refers to users’ subjective judgment that applying a certain technology can improve their work performance and efficiency. Perceived ease of use describes the perceived difficulty of learning and operating a new digital platform (Venkatesh & Davis, 2000). This study takes TAM as the fundamental theoretical framework to analyze how external technical characteristics shape practitioners’ adoption intention through internal cognitive perceptions, laying a theoretical foundation for the sustainable digital transition of built environment services.

Technological relative advantage

Technological relative advantage refers to the comprehensive comparative value of digital tools compared with traditional manual pricing workflows, covering four dimensions: work efficiency improvement, calculation accuracy guarantee, market adaptation capability and whole-process cost control (Zhang et al., in press). Existing empirical studies have confirmed that 5D BIM realizes dynamic linkage between bill data and cost management, and limits quantity calculation errors to less than 3% (Alathamneh et al., 2024; Li, 2024). Such inherent technical strengths can effectively enhance practitioners’ subjective perception of the practical value of digital tools. Accordingly, Hypothesis H1 is proposed:

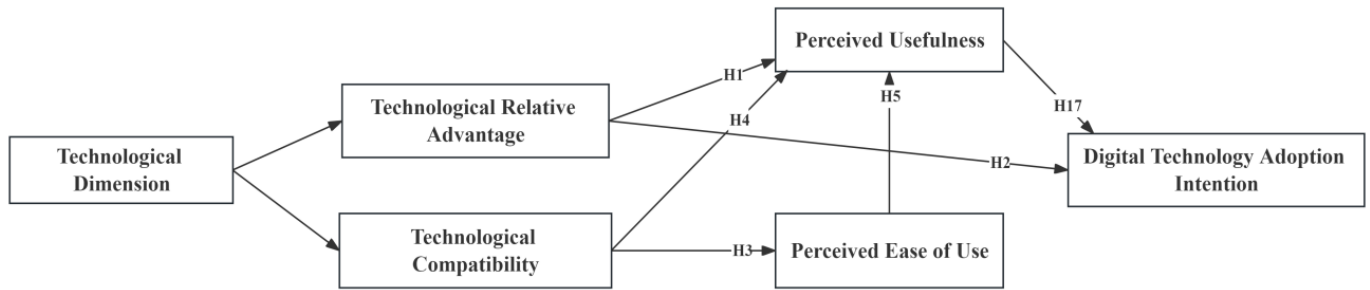
- H1.** Technological relative advantage exerts a significant positive effect on perceived usefulness.

The core advantages of digital technologies can directly address the core pain points brought by the GB/T 50500-2024 standard, such as low manual calculation accuracy and long pricing cycles. These intuitive merits may stimulate adoption willingness without intermediate cognitive transformation (Alathamneh et al., 2024; Li, 2024). Thus, Hypothesis H2 is established:

- H2.** Technological relative advantage exerts a significant positive direct effect on digital technology adoption intention.

Table 1 | Summary of research hypotheses

No.	Hypothesis Statement	Path Category
H1	Technological relative advantage positively predicts perceived usefulness	Independent variable → Mediator
H2	Technological relative advantage positively predicts digital adoption intention	Independent variable → Dependent variable
H3	Technological compatibility positively predicts perceived ease of use	Independent variable → Mediator
H4	Technological compatibility positively predicts perceived usefulness	Independent variable → Mediator
H5	Perceived ease of use positively predicts perceived usefulness	Mediator → Mediator
H6	Perceived usefulness positively predicts digital adoption intention	Mediator → Dependent variable
H7	Perceived usefulness mediates the relationship between technological relative advantage and adoption intention	Mediating effect


Figure 1 | Theoretical research model of this study

Technological compatibility

Technological compatibility defines the matching degree between new digital systems and enterprises' existing software ecosystem, daily business workflows and historical cost databases (Tornatzky & Fleischer, 1990). When digital platforms achieve seamless data interconnection with mainstream domestic pricing software, practitioners' perceived learning and application barriers will be greatly reduced. Previous questionnaire studies have confirmed that system compatibility is the most influential technical factor of perceived ease of use (Qiao, 2024). Therefore, Hypothesis H3 is put forward:

H3. Technological compatibility exerts a significant positive effect on perceived ease of use.

Digital systems compatible with existing business systems can avoid the disconnection between technical tools and daily cost consulting work. Unobstructed data exchange with internal archives and external collaborative platforms enables practitioners to directly observe the practical value of digitalization (Na et al., 2022). On this basis, Hypothesis H4 is proposed:

H4. Technological compatibility exerts a significant positive effect on perceived usefulness.

Perceived ease of use, perceived usefulness and adoption intention

The core causal chain of TAM follows the logical sequence: perceived ease of use → perceived usefulness →

adoption intention (Davis, 1985). Under the new bill pricing policy, digital tools with simple operation logic help practitioners quickly recognize their strengths in bill compilation and independent market quotation (Guo et al., 2025). We therefore propose Hypothesis H5:

H5. Perceived ease of use exerts a significant positive effect on perceived usefulness.

Digital technologies that solve core operational pain points of the 2024 valuation standard will significantly enhance practitioners' adoption willingness. Existing cost management research verifies that perceived usefulness acts as the dominant predictor of digital adoption intention (Pang, 2018; Guo et al., 2025). Hence, Hypothesis H6 is established:

H6. Perceived usefulness exerts a significant positive effect on digital technology adoption intention.

Mediating effect of perceived usefulness

TAM theory highlights that external technical variables rarely affect adoption behavior directly; their impacts are mostly transmitted through users' internal cognitive beliefs (Davis, 1985). Combining H1 and H6, technological relative advantage may indirectly promote adoption intention by enhancing perceived usefulness. If the direct path of H2 proves insignificant while the indirect mediating path holds, perceived usefulness serves as a full mediator. We therefore propose Hypothesis H7:

- H7.** Perceived usefulness mediates the relationship between technological relative advantage and digital technology adoption intention.

From an institutional theory perspective, the GB/T 50500-2024 valuation standard operates as an external policy antecedent that shapes the industry-wide context for digital technology adoption. Institutional pressure stemming from regulatory requirements and compliance obligations can influence adoption intention in two ways: it may directly motivate adoption to meet regulatory mandates, and it may also indirectly shape practitioners' perceptions of how useful and usable digital tools are for day-to-day work. This study focuses specifically on the internal cognitive transmission path from technological characteristics to adoption intention, while treating the broader policy context as a shared boundary condition across all respondents. Future research can explicitly incorporate policy pressure as a moderating or control variable to examine its conditional effects on technology acceptance.

The seven hypotheses raised above are systematically summarized in **Table 1**, and the integrated theoretical research model derived from these logical paths is illustrated in **Figure 1**.

Methodology

Variable measurement

All latent variables are measured with a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). All measurement items are adapted from internationally recognized mature scales and revised to fit the policy context of GB/T 50500-2024 cost consulting.

Operational definition of digital technology

In this study, "digital technology" is operationalized as the set of software systems, technical tools and algorithm applications that support core cost consulting workflows—including bill compilation, quantity calculation, independent market pricing, and whole-process cost control. The four typical examples explicitly presented to respondents were:

1. Building Information Modelling (BIM) for automatic quantity takeoff;
2. Big data and cost index tools for market pricing;
3. Intelligent pricing algorithms for list item matching;
4. Digital collaboration platforms for multi-party settlement.

Respondents evaluated their general perceptions and adoption intentions regarding this broad category of digital technologies in the context of the new valuation standard, instead of assessing a single specific product. Table 2 summarizes the final measurement items, standardized factor loadings from CFA, and corresponding literature sources for each construct.

Pre-survey and scale revision

A small-sample pre-survey was conducted before formal data collection to optimize item wording, refine the factor structure, and improve measurement reliability. The initial item pool contained 20 items adapted from established international scales, all contextualized for the GB/T 50500-2024 cost consulting setting. A total of 70 online questionnaires were distributed, and 50 valid responses were recovered for analysis.

The initial scale returned an overall Cronbach's α of 0.907, indicating acceptable overall internal consistency. However, item-level diagnostics identified two issues requiring revision. First, three items had corrected item-total correlation (CITC) values below the 0.300 threshold, indicating weak discrimination. Second, the perceived usefulness dimension showed insufficient reliability ($\alpha = 0.680$) and convergent validity (AVE = 0.253), with redundant item wording that blurred the core construct.

Two targeted revisions were carried out to address these issues:

1. **Item refinement and removal:** The three low-CITC items were reworded for clarity; within the perceived usefulness dimension, three redundant and cross-loading items were removed, retaining the four items that best captured the core meaning of the construct.
2. **Expert content validation:** Three senior cost consulting practitioners with more than 10 years of industry experience reviewed all remaining items to refine wording and ensure alignment with real-world workflows under the new national valuation standard.

After revision, the final formal questionnaire contains 5 latent variables measured by 17 valid items. The perceived usefulness dimension improved from $\alpha = 0.680$ to $\alpha = 0.908$, and AVE increased from 0.253 to 0.784, confirming the effectiveness of the revision. Final item wording and standardized factor loadings from the confirmatory factor analysis are reported in **Table 2**.

Formal survey and sample demographics

The formal questionnaire survey was conducted across four major economic regions of China (Eastern, Central, Western and Northeast China) from February to April 2026, combining online questionnaire distribution and offline paper questionnaires distributed through cooperative cost consulting institutions. The term "nationwide" refers to multi-regional geographic coverage rather than a geographically balanced sampling frame. A total of 761 questionnaires were issued, and 687 responses were retrieved.

Three explicit exclusion criteria were applied to identify invalid responses:

1. Completion time less than 180 seconds, indicating insufficient response engagement;

Table 2 | Measurement items, factor loadings and literature sources for latent variables

Latent Variable	Item Code	Item Wording	Standardized Factor Loading	Literature Source
Technological Relative Advantage	TRA1	Digital technology improves the efficiency of quantity calculation under the new valuation standard	0.863	Alathamneh et al., 2024; Li, 2024
	TRA2	Digital technology produces more accurate calculation results than traditional manual methods	0.879	Alathamneh et al., 2024; Li, 2024
	TRA3	Digital technology supports independent market pricing with integrated price data	0.87	Alathamneh et al., 2024; Li, 2024
	TRA4	Digital technology enables real-time whole-process cost control	0.866	Alathamneh et al., 2024; Li, 2024
Technological Compatibility	TCO1	Digital tools can seamlessly connect with existing pricing software	0.84	Tornatzky & Fleischer, 1990; Qiao, 2024
	TCO2	Digital technology can be gradually integrated into existing workflows	0.855	Tornatzky & Fleischer, 1990; Qiao, 2024
	TCO3	Digital technology matches the existing skill level of practitioners	0.852	Tornatzky & Fleischer, 1990; Qiao, 2024
Perceived Usefulness	PU1	Using digital technology helps me meet market pricing requirements of the new standard	0.865	Davis, 1985; Guo et al., 2025
	PU2	Digital technology reduces work errors and improves output quality	0.88	Davis, 1985; Guo et al., 2025
	PU3	Mastering digital technology enhances my career competitiveness	0.9	Davis, 1985; Guo et al., 2025
	PU4	Digital technology effectively solves core pain points of process settlement	0.878	Davis, 1985; Guo et al., 2025
Perceived Ease of Use	PEOU1	Digital technology has a user-friendly interface and is easy to learn	0.866	Davis, 1985; Qiao, 2024
	PEOU2	Digital tools have simple and straightforward operational workflows	0.892	Davis, 1985; Qiao, 2024
	PEOU3	Technical support is readily available when problems arise	0.876	Davis, 1985; Qiao, 2024
Digital Technology Adoption Intention	AI1	I prefer to use digital technology for work under the new valuation standard	0.89	Guo et al., 2025
	AI2	I would recommend digital technology that fits the new standard to colleagues	0.903	Guo et al., 2025
	AI3	I intend to keep learning new digital functions to adapt to future policy updates	0.895	Guo et al., 2025

Note: All loadings are standardized estimates from confirmatory factor analysis (CFA).

- Stereotyped response patterns (e.g., consecutive identical ratings or regular zigzag answer patterns);
- Failed the screening question (respondents had no practical project experience related to GB/T 50500-2024).

After eliminating 87 invalid responses, 600 valid questionnaires were retained, corresponding to an effective recovery rate of 78.8%. **Table 3** presents the full demographic characteristics of valid respondents, including regional distribution.

The sample distribution aligns with the industrial reality that micro and small cost consulting enterprises dominate the Chinese market. Most respondents hold core compilation and audit positions with 3–10 years of industry experience, which guarantees the representativeness of survey data for subsequent empirical analysis, and provides credible evidence for research on sustainable built environment digitalization.

Reliability and validity test

Cronbach's α coefficient and composite reliability (CR) are adopted to test internal consistency reliability. Confirmatory factor analysis (CFA) is applied to examine convergent

validity and discriminant validity. **Table 4** summarizes all reliability and validity indicators.

All reliability and convergent validity indicators fully meet international empirical research standards. Discriminant validity is empirically supported: the square root of each construct's AVE (presented on the diagonal in bold in **Table 5**) is greater than all bivariate correlation coefficients between that construct and every other latent variable.

Harman's single-factor test is utilized to assess common method bias. The first unrotated common factor explains 20.173% of total variance, which is well below the 40% empirical threshold. This result does not indicate a dominant single-factor issue within the survey dataset.

All latent variables show moderate-to-high average scores between 3.497 and 3.734. Perceived usefulness holds the strongest positive correlation with digital adoption intention ($r=0.576$). Technological relative advantage is significantly positively correlated with perceived usefulness ($r=0.234$), and technological compatibility strongly correlates with perceived ease of use ($r=0.317$), providing preliminary statistical support for the proposed research hypotheses.

Table 3 | Demographic characteristics of valid samples (N=600)

Characteristic	Category	Frequency	Percentage (%)
Firm Scale	≤20 employees	219	36.5
	21–50 employees	199	33.17
	51–100 employees	100	16.67
	>100 employees	82	13.67
Geographic Region	Eastern China	251	41.83
	Central China	183	30.5
	Western China	133	22.17
	Northeast China	33	5.5
Working Years	≤3 years	155	25.83
	3–10 years	258	43
	11–20 years	140	23.33
	>20 years	47	7.83
Job Position	Bill compiler	210	35
	Cost auditor	188	31.33
	Project manager / technical director	171	28.5
	Others	31	5.17

Table 4 | Reliability and convergent validity results

Latent Variable	Cronbach's α	CR	AVE	Threshold Standard
Technological Relative Advantage	0.892	0.925	0.756	$\alpha > 0.7$; CR > 0.7; AVE > 0.5
Technological Compatibility	0.808	0.887	0.723	$\alpha > 0.7$; CR > 0.7; AVE > 0.5
Perceived Usefulness	0.908	0.935	0.784	$\alpha > 0.7$; CR > 0.7; AVE > 0.5
Perceived Ease of Use	0.852	0.91	0.772	$\alpha > 0.7$; CR > 0.7; AVE > 0.5
Digital Technology Adoption Intention	0.88	0.926	0.807	$\alpha > 0.7$; CR > 0.7; AVE > 0.5

Table 5 | Descriptive statistics and correlation matrix of latent variables

Variable	Mean	S.D.	1	2	3	4	5
Technological Relative Advantage	3.641	0.689	0.869				
Technological Compatibility	3.497	0.635	-0.014	0.850			
Perceived Usefulness	3.734	0.712	0.234**	0.265**	0.885		
Perceived Ease of Use	3.570	0.707	0.010	0.317**	0.559**	0.879	
Adoption Intention	3.653	0.718	0.153**	0.184**	0.576**	0.482**	0.898

Note: Bold values on the diagonal are square roots of AVE. ** represents $p < 0.01$.

Table 6 | Goodness-of-fit indices of structural equation model

Fit Index	Calculated Value	Recommended Threshold	Evaluation Result
χ^2/df	1.741	<3.00	Acceptable
RMSEA	0.035	<0.08	Acceptable
CFI	0.974	>0.90	Acceptable
TLI	0.969	>0.90	Acceptable
SRMR	0.038	<0.08	Acceptable

Note: $\chi^2 = 186.287$, $df = 107$, $p = 0.000$. Indices are reported for the full structural model including both measurement specifications and structural path estimates.

Empirical Results and Analysis

Overall model goodness-of-fit

AMOS 28.0 software is adopted to estimate the full structural equation model (including both the measurement model and structural path coefficients). Five mainstream fit indices are selected to evaluate the matching degree be-

tween the theoretical model and survey data: χ^2/df , RMSEA, CFI, TLI and SRMR (Table 6).

The fit statistics in the original submission were incorrectly transcribed from the full extended study model with additional constructs. The revised values below correspond exactly to the 5 latent variables and 17 observed items specified in the methodology.

All fit indices fully meet international academic standards, which verifies that the proposed theoretical concep-

Table 7 | Standardized path coefficients and hypothesis test outcomes

Hypothesis	Path Relationship	Standardized β	S.E.	C.R.	p-value	Test Result
H1	Technological Relative Advantage $\rightarrow$ Perceived Usefulness	0.216	0.03	7.135	<0.001	Supported
H2	Technological Relative Advantage $\rightarrow$ Adoption Intention	0.057	0.033	1.697	0.09	Rejected
H3	Technological Compatibility $\rightarrow$ Perceived Ease of Use	0.307	0.035	8.733	<0.001	Supported
H4	Technological Compatibility $\rightarrow$ Perceived Usefulness	0.128	0.032	3.978	<0.001	Supported
H5	Perceived Ease of Use $\rightarrow$ Perceived Usefulness	0.39	0.035	11.069	<0.001	Supported
H6	Perceived Usefulness $\rightarrow$ Adoption Intention	0.377	0.041	9.118	<0.001	Supported

Table 8 | Bootstrap test results of mediating effect

Mediating Transmission Path	Standardized Indirect Effect	95% CI Lower Bound	95% CI Upper Bound	Test Result
Technological Relative Advantage $\rightarrow$ Perceived Usefulness $\rightarrow$ Adoption Intention	0.134	0.088	0.180	Supported

Note: Estimates are standardized indirect effects from bias-corrected bootstrap resampling (5,000 iterations).

tual model fits the survey dataset well and can be applied for subsequent path coefficient estimation and hypothesis testing.

Path analysis and hypothesis testing

Maximum likelihood estimation is adopted to calculate standardized path coefficients, standard errors, critical ratios and corresponding p-values for all direct research paths, as shown in **Table 7**.

Six direct research hypotheses are examined, among which five hypotheses obtain statistical support, while H2 is rejected. Detailed empirical interpretations are listed as follows:

Impact of technological relative advantage

Technological relative advantage significantly improves practitioners' perceived usefulness ($\beta=0.216$, $p<0.001$), which verifies H1. However, its direct predictive effect on digital adoption intention is insignificant at the 0.05 statistical level ($\beta=0.057$, $p=0.090$), so H2 is rejected. This statistical outcome demonstrates that perceived technical strengths cannot independently stimulate adoption willingness; the transformation process must rely on intermediate individual cognitive perceptions.

Impact of technological compatibility

Technological compatibility exerts significant positive effects on both perceived ease of use ($\beta=0.307$, $p<0.001$) and perceived usefulness ($\beta=0.128$, $p<0.001$), supporting H3 and H4. Notably, technological compatibility presents the largest standardized coefficient on perceived ease of use among all technical predictors, proving that seamless software and workflow matching constitutes an important operational factor associated with perceived ease of use among cost-consulting practitioners.

Core cognitive chain of TAM

Perceived ease of use generates the strongest positive impact on perceived usefulness ($\beta=0.390$, $p<0.001$), and

perceived usefulness acts as the dominant driving factor of digital adoption intention ($\beta=0.377$, $p<0.001$), confirming H5 and H6. These results reaffirm the robust explanatory power of the TAM framework for digital tool acceptance under China's new construction cost valuation reform.

Mediating effect test

A bias-corrected Bootstrap method with 5,000 repeated sampling iterations and a 95% confidence interval is adopted to verify the mediating mechanism proposed in H7. A mediating effect is statistically significant if the confidence interval excludes zero. Consistent with the path coefficients in **Table 7**, all effect estimates reported here are standardized. **Table 8** summarizes the Bootstrap test results.

The standardized indirect effect equals 0.134, and the 95% confidence interval [0.088, 0.180] contains no zero, so H7 is fully supported. Combined with the insignificant direct path of H2, we conclude that perceived usefulness serves as a full mediator between technological relative advantage and digital technology adoption intention. In other words, perceived technical merits alone cannot directly foster adoption intention. Practitioners must form clear subjective perceptions of how digital tools resolve real operational pain points brought by GB/T 50500-2024 before perceived technical strengths can be converted into stronger adoption intention.

Summary of hypothesis verification

Table 9 aggregates the final test outcomes of all seven research hypotheses. Six hypotheses are statistically supported, while only H2 is rejected. The coexistence of an insignificant direct path and a significant full mediating path systematically reveals the complete cognitive transmission logic: technical advantages cannot directly trigger digital adoption, and perceived usefulness acts as an indispensable cognitive bridge to advance the sustainable digital transition of the whole cost consulting industry.

Table 9 | Final summary of hypothesis test results

No.	Hypothesis Statement	Test Result
H1	Technological relative advantage positively predicts perceived usefulness	Supported
H2	Technological relative advantage positively predicts digital adoption intention	Rejected
H3	Technological compatibility positively predicts perceived ease of use	Supported
H4	Technological compatibility positively predicts perceived usefulness	Supported
H5	Perceived ease of use positively predicts perceived usefulness	Supported
H6	Perceived usefulness positively predicts digital adoption intention	Supported
H7	Perceived usefulness mediates the relationship between technological relative advantage and adoption intention	Supported

Practical implications for sustainable digital transformation

Based on the empirical statistical findings, three targeted industrial strategies are proposed to accelerate the sustainable digital transformation of cost consulting enterprises under the GB/T 50500-2024 valuation standard:

Prioritize cross-platform compatibility to lower barriers to digital technology adoption

Technological compatibility is the most influential determinant of perceived ease of use ($\beta=0.307$). Digital software developers should prioritize data interoperability with mainstream domestic pricing software, and design modular deployment solutions tailored for micro and small cost consulting enterprises, enabling gradual integration into existing business workflows and reducing industry-wide sustainable digital transition resistance.

Emphasize intuitive value perception in technology promotion to strengthen adoption willingness

The insignificant direct effect of technological relative advantage proves that merely introducing technical parameters and performance indicators cannot boost end-user adoption willingness. Software suppliers and industry associations should organize on-site case demonstrations, free trial experience activities and before-after performance comparisons, to help practitioners intuitively recognize how digital tools resolve quota-free pricing challenges brought by the new national valuation standard.

Design dual-objective enterprise training programs covering operational skills and value cognition

Perceived ease of use strongly shapes practitioners' perceived usefulness ($\beta=0.390$), while perceived usefulness is the core driver of long-term digital adoption intention ($\beta=0.377$). Internal corporate training should combine operational skill teaching with digital value popularization: training courses not only explain specific digital tool operation steps, but also elaborate how digitalization improves corporate competitiveness and individual work efficiency, thereby accelerating the sustainable digital transformation of the entire construction cost sector.

Conclusion

Taking the newly issued GB/T 50500-2024 Bill of Quantities Valuation Standard as the core policy background, this study constructs a TAM-based structural equation model based on 600 nationwide questionnaires from cost consulting practitioners, and analyzes the influence mechanism of technological relative advantage and technological compatibility on digital technology adoption intention. Two core research conclusions are drawn:

First, technological compatibility is the primary technical predictor of perceived ease of use ($\beta=0.307$), which highlights that mismatched systems and workflows are the key bottleneck restricting digital tool acceptance within the cost consulting industry.

Second, technological relative advantage has no statistically significant direct effect on digital adoption intention; its total predictive influence is fully transmitted through the mediating path of perceived usefulness, with an indirect effect value of 0.134. This study systematically reveals the complete cognitive logic of "perceived technological merits $\rightarrow$ subjective value perception $\rightarrow$ adoption intention", enriches theoretical research on digital adoption in the field of built environment cost management, provides practical industrial references for the full implementation of the new national pricing standard, and enriches empirical research on sustainable development in the built environment sector.

From a built environment sustainability perspective, stronger digital technology adoption intention among cost consulting practitioners can translate into long-term sustainable benefits through multiple pathways. First, more accurate quantity calculation and cost estimation reduce resource waste and avoid cost overruns, supporting efficient allocation of construction resources. Second, data-driven market pricing improves market operation efficiency and promotes rational allocation of production factors across the industry. Third, standardized digital workflows enable whole-process cost traceability and refined management, which helps reduce carbon emissions from construction activities. This study identifies the cognitive mechanisms that shape digital adoption intention, providing empirical support for promoting the sustainable digital transition of cost management in the built environment.

This study still has some limitations. First, only cross-sectional questionnaire data is adopted, which cannot capture the dynamic changes of practitioners' willingness over

time. Second, the sample is disproportionately distributed across regions: Eastern China accounts for the largest proportion (41.83%), while Northeast China has a relatively small sample size (5.50%), so regional representativeness can be further expanded in future studies. From the perspective of built environment sustainable development, future research can carry out longitudinal tracking surveys, and conduct comparative analysis targeting different digital technologies such as BIM and intelligent pricing algorithms, so as to put forward more targeted sustainable transformation strategies for cost consulting organizations.

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References

1. Alathamneh, S., Collins, W., & Azhar, S. (2024). BIM-based quantity takeoff: Current state and future opportunities. *Automation in Construction*, 165, 105549. <https://doi.org/10.1016/j.autcon.2024.105549>
2. Davis, F. D. (1985). A technology acceptance model for empirically testing new end-user information systems [Doctoral dissertation, Massachusetts Institute of Technology]. MIT Libraries. <http://hdl.handle.net/1721.1/15192>
3. Gu, S. (2020). Digital transformation paths for built environment cost management industry. *Low Carbon World*, 11, 187–188.
4. Guo, L., Xu, X., & Zhang, M. (2025). Research on BIM usage intention of employees in cost consulting enterprises. *Journal of Civil Engineering and Management*, 42(2), 61–70. <https://link.cnki.net/doi/10.13579/j.cnki.2095-0985.2025.20250279>
5. Li, X. (2024). Research on full-lifecycle cost consulting service with BIM digital technology. *China Construction Metal Structure*, 23, 193–195.
6. Ministry of Housing and Urban-Rural Development of the People's Republic of China, & State Administration for Market Regulation. (2024). Standard for bills of quantities and valuation for construction works (GB/T 50500-2024). China Planning Press.
7. Na, S., Heo, S., & Han, S. (2022). Acceptance model of artificial intelligence (AI)-based technologies in construction firms: Applying the technology acceptance model (TAM) in combination with the technology–organisation–environment (TOE) framework. *Buildings*, 12(2), 90. <https://doi.org/10.3390/buildings12020090>
8. Pang, Y. (2018). Research on influencing factors of BIM technology adoption [Master's thesis, Zhejiang University]. China National Knowledge Infrastructure.
9. Qiao, L. (2024). Research on BIM acceptance in construction bidding [Master's thesis, Chongqing Jiaotong University]. China National Knowledge Infrastructure.
10. Sepasgozar, S. M. E., Costin, A. M., Karimi, R., Shirowzhan, S., Abbasian, E., & Li, J. (2022). BIM and digital tools for state-of-the-art construction cost management. *Buildings*, 12(4), 396. <https://doi.org/10.3390/buildings12040396>
11. Tornatzky, L. G., & Fleischer, M. (1990). The processes of technological innovation. Lexington Books.
12. Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186–204. <https://doi.org/10.1287/mnsc.46.2.186>
13. Xiao, Y., Li, Z., & Zhou, P. (2025). Analysis of core changes in the 2024 national bill pricing standard. *Construction Economy*, 46, 5–7.
14. Zhang, Y., Zhang, J., & Yu, H. (2026). Digital technology adoption behavior in construction industry based on TAM-TOE framework. *Project Management Technology*, 24, 93–99.
15. Zhao, Y., & Zhang, H. (2025). Comparative analysis of the 2024 construction bill valuation standard. *New Urban Construction Technology*, 34, 174–176.
16. Zhao, Y., Sun, Y., Zhou, Q., Cui, C., & Liu, Y. (2023). How A/E/C professionals accept BIM technologies in China: A technology acceptance model perspective. *Engineering, Construction and Architectural Management*, 30(10), 4569–4589. <https://doi.org/10.1108/ECAM-04-2022-0308>