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A Study on the Impact of Digital Management on Willingness to Transfer Knowledge in Whole-Process Engineering Consulting Projects

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Abstract: Against the background of the current development of China's engineering consulting industry, the technology acceptance model (TAM) is applied to construct a model of digital management influencing the willingness to transfer knowledge in whole-process engineering consulting projects. Digital management is used as the independent variable, perceived usefulness and perceived ease of use as the mediating variables, and the willingness to transfer knowledge as the dependent variable to investigate the influence relationship among the three. In this paper, 263 sample data are selected and structural equation modeling is used to analyze the data. The results show that digital management has a significant positive influence on the willingness to transfer knowledge; perceived usefulness and perceived ease of use play a mediating role in the relationship between digital management and the willingness to transfer knowledge. This paper enriches the research on knowledge transfer of engineering consulting. From the perspective of digital management, measures are made for improving the willingness of members to transfer knowledge and for lifting management efficiency in the whole process of the engineering consulting project.

Keywords: digital management; engineering consulting; willingness to transfer knowledge; structural equation model

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1. Introduction

With the in-depth implementation of digital development in the period of the "14th Five-Year Plan" and the relevant requirements of the state for deepening the reform of the investment and financing system, engineering consulting enterprises in China are facing better opportunities. At present, the investment body and construction unit has an increasingly strong demand for comprehensive, cross-stage, and integrated engineering consulting services. As a national direction and cultivation mode, the engineering consulting service for the whole construction progress is widely used in major engineering projects [1]. Building information modeling (BIM) and other digital management technologies have played an important role in construction projects, such as the Hong Kong-Zhuhai-Macao Bridge, Xiongan Station, and the Kunming Comprehensive Transportation International Hub [2]. In the Guidance on Promoting the Licensing of Whole Process Engineering Consulting Services, the National Development and Reform Commission, together with the Ministry of Housing and Construction, points out that information technology and information resources including big data and the internet of things should be fully developed and utilized, and that efforts should be made to improve the level of information management and application to provide guarantees for carrying out engineering consulting services for the whole construction process [3]. Therefore, the implementation of digital management is an inevitable trend and an effective management tool for the development of engineering consulting services.

Engineering consulting service is a high-end intelligent service based on knowledge [4]. The implementation of the engineering consulting project is the process of integrating and

applying knowledge in organization, management, economy, technology, and other related aspects [5]. Knowledge transfer is involved in the whole life cycle [6]. Whole-process engineering consulting refers to the intellectual service activity of providing partial or overall solutions involving organization, management, economy, and technology for the whole life cycle of investment decision, construction, and operation of construction projects [3]. In the knowledge transfer in the engineering consulting project involved in this paper, that is, in the process of engineering project management services and professional consulting services, all information such as data, documents, and communication information of each project stage and business are continuously transferred, accumulated, absorbed, and applied with the project construction process [7]. Based on the situation of the whole-process engineering consulting and the demand for digital development, this study proposes the knowledge transfer process of each business stage of the whole-process engineering consulting project with a digital management platform as the core, as shown in Figure 1. A digital management platform, as an important medium for knowledge transfer and an effective tool for the indirect transfer of project knowledge [8,9], can provide experiential learning opportunities and a platform for exchanges with experts for the participating units and project members in each business stage of the project. Multiple cycles of project knowledge utilization and innovation can be realized through knowledge search, knowledge matching, knowledge absorption, knowledge application, and knowledge feedback. For the tacit knowledge that is difficult to be expressed and disseminated or that requires in-depth communication and explanation to realize knowledge transfer and absorption, such as technical experience, construction techniques under specific situations, and technical processing methods, direct knowledge transfer is realized through experience-sharing sessions, face-to-face communication, online communication, and other channels to promote project members to acquire and absorb knowledge through learning, in-depth communication, perception, practice, internalization, and feedback.

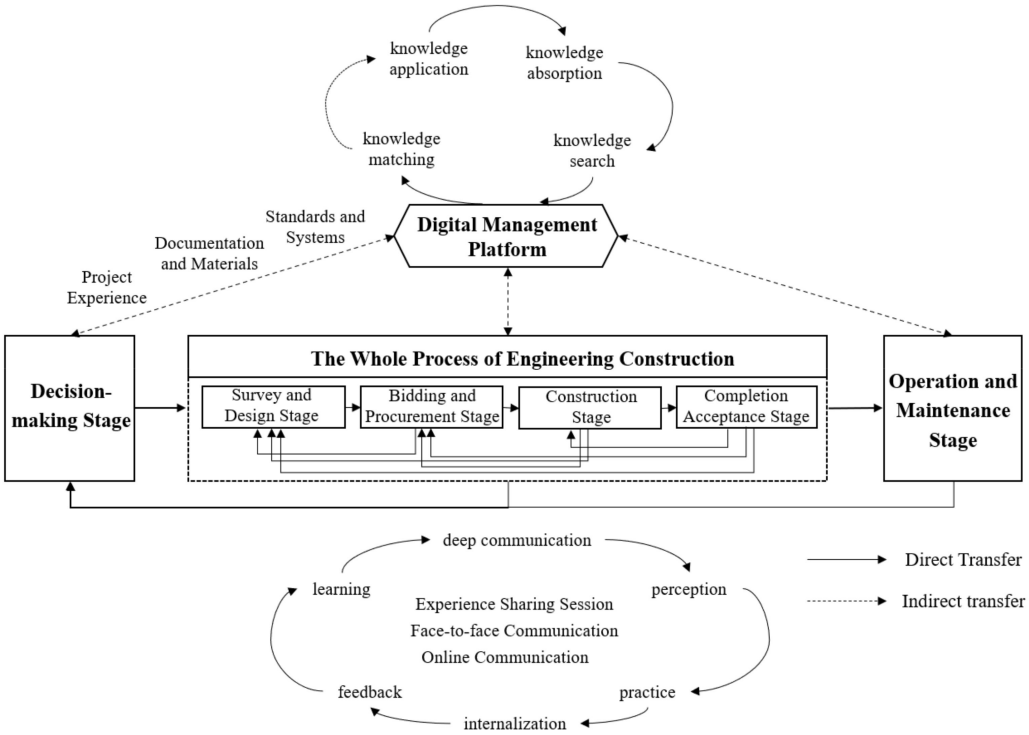


Figure 1. Knowledge transfer process of each business stage of the whole-process engineering consulting project with a digital management platform as the core.

Effective knowledge transfer can largely reduce the occurrence of serious knowledge loss, waste of resources, and low management efficiency among various business stages in

engineering consulting, which is an important guarantee to accumulate knowledge, project experience, and talents for the consulting team. Therefore, it is important to enhance project members' willingness to transfer knowledge and promote the occurrence of knowledge-transfer behavior to improve the efficiency of engineering consulting services [10]. However, the occurrence of knowledge-transfer behavior is usually not carried out spontaneously and is influenced by multiple factors [11]. As an important tool to open up the workflow, information flow, resource flow, and capital flow, digital management helps to realize optimal resource allocation, collaborative work, and the integration of the value chain [12], which can also provide an effective channel for project knowledge transfer. Therefore, the technology acceptance model (TAM) is employed as the theoretical framework. How digital management affects knowledge-transfer willingness through perceived usefulness and perceived ease of use in engineering consulting projects is constructed and tested empirically in this paper, thus providing the theoretical basis and practical guidance for accelerating the implementation of digital management and improving project management efficiency in engineering consulting projects.

2. Literature Review

2.1. Knowledge Transfer between Projects

With the increase in competitive pressure, the development of modern organizations needs to rely on and utilize knowledge to maintain long-term advantage, which puts higher demands on organizations to precisely understand the process of knowledge management [13,14]. In the knowledge management process, many research scholars have reflected a focus on knowledge transfer [15]. Teece [16] first proposed the concept of knowledge transfer, which was defined as one of the important means for enterprises to accumulate knowledge. Argote, L. et al. [17] defined knowledge transfer as the process of transferring experience from one organizational unit (e.g., a group, department, or division) to another. Newell believed that learning and exchanges between projects are essential to improve the performance of engineering projects. Meng [18] pointed out that increasing the willingness to transfer knowledge is an effective way for companies to innovate and enhance their competitive advantage. Manesh et al. [13] pointed out that the process of knowledge transfer is profoundly influenced by the fourth industrial revolution, in terms of machine interconnectivity, autonomous learning, and the ability to share data. Arias et al. [19] pointed out that digital strategies as a means of external embedding are important for acquiring and utilizing knowledge and can drive high-quality development of engineering consulting firms and industries [20].

Although there are existing academic studies on knowledge management and knowledge transfer in engineering projects in the digital age, there is little precedent for using the technology acceptance model (TAM) to analyze the impact of digital management on knowledge transfer willingness. The TAM, first proposed by Davis, consists of two specific beliefs related to technological innovation: perceived ease of use and perceived usefulness, both of which together determine willingness and behavioral intentions to accept information technology [21]. The TAM has been extremely useful not only in the study of user acceptance of new technologies and information systems but also in all major fields [22]. The TAM is an open and flexible model, and the external variables of the model can be adjusted appropriately according to the study [23]. Digital management can be used as an external variable to influence the willingness to transfer knowledge, and perceived usefulness and perceived ease of use are perceived factors influencing the willingness to transfer knowledge, i.e., the extent to which it is beneficial and convenient for project personnel to adopt digital management tools in whole-process engineering consulting projects.

2.2. The Impact of Digital Management on Knowledge Transfer from Three Perspectives

Digital management is gradually becoming an important enabler of the knowledge transfer process [13]. Inkinen et al. [5,24,25] considered the impact of digital management

on the willingness to transfer knowledge in three dimensions: technology, organization, and management process. Currently, many scholars have analyzed the supporting role played by digital management for knowledge transfer in the fields of industry, business, sports, and education [26,27]. Stoyanov T [28] believed that the main advantages of digital management tools in the knowledge transfer process were the acquisition of high-quality knowledge and the improvement of the efficiency of knowledge transfer. Wolf et al. [29] pointed out that the drivers of successful digital transformation included transforming the mindset of management, meeting the innovation potential of different departments, and stimulating knowledge transfer within the organization. Sarina [30] thought that digital transformation was mainly carried out from a technological perspective, emphasizing the role and impact of technological platforms and their integration of organizational change. Lu [12] believed that the implementation of digital management in the whole process of engineering consulting included a new site management work model, the application of project site wisdom technology, and the construction of a digital management platform in the management process. He and Xu [24,31] pointed out that driving digital management change relied on technological change and organizational change. Inkinen [25] argued that knowledge management is related to four main foci: people (people, culture, and leadership), organizations (organizational processes and structures), technology (infrastructure and applications), and management processes (strategy, goals, and measurement) related to knowledge management practices.

Zhang [32] argued that the application of digital technology for digital management and how to quickly gain knowledge through learning in the digital world became an urgent problem to solve. Stachová [33] pointed out that digital technologies, including digital interactive platforms, data analytics, and other forms, could bring a wealth of information to enterprises and help them make decisions based on hardware and soft data. Troise [34] pointed out that digital platforms contribute to knowledge transfer by making tacit knowledge such as the experience of project site personnel explicit. Aromaa [35] used to discuss the knowledge-sharing capability and interaction of platforms. Currently, BIM plays a significant role in the engineering construction process as one of the most common digital management tools [36]. For example, Xiongan Station, currently the largest railway station in Asia, applied intelligent construction technologies such as digital design and building information modeling (BIM) in the whole life-cycle stage of the project to achieve design coordination, construction monitoring, and operation simulation.

Alavi argued that effective knowledge transfer required not only digital technology and IT infrastructure, but that talent and organization also had a significant impact on the knowledge transfer process [37–39]. Bibaud et al. [40] pointed out that digital transformation also required the development of new competencies and skills, improved process management methods, and decision-making processes in the organizational domain. Ferraris et al. [41] highlighted that the use of big data required organizational capabilities. Organizational climate and incentives could increase the willingness of project teams to transfer knowledge [42]. Zbuchea et al. [43] pointed out that human factors such as communication mechanisms and organizational culture were key to maximizing the use of technology and digital platforms in the knowledge management process. Grant [44] pointed out that talent was an important source for organizations to gain competitive advantage and could lead to greater innovation in the digital management process [45]. In the organizational Industry 4.0 environment, human capital had a strong potential for organizational knowledge transfer through the exchange and integration of individual knowledge [13].

The management standard for engineering consulting services proposed that the corresponding organizational management, human resources, and IT environment should be ensured to meet the requirements of each stage, emphasizing that information management needs to run through the whole process of engineering consulting services and to provide digital management support for undertaking the comprehensive project management of construction projects and professional consulting service business [5]. Sher and Crossan et al. [46,47] pointed out that information sharing can facilitate learning among

employees and improve problem-solving skills by sharing past experiences, including explicit and tacit knowledge [15], thus facilitating faster responses to emerging problems. Mature digital management tools can promote the integration of knowledge into internal business processes, improve the ease of access to resources and the reliability of resource access channels for enterprises and employees [28,43,48], achieve immediate and adequate communication, and reduce the drawbacks caused by information asymmetry, and thus, strengthen the trust relationship among participants in the whole-process engineering consulting projects [42,49], facilitate the project participants to quickly obtain the required information and knowledge, and increase the motivation of each participant to communicate and bring creativity to the project [50].

3. Hypotheses and Research Model

Based on the recent literature review, the conceptual framework influencing the willingness to transfer knowledge is shown in Figure 2, and we hypothesized that the technology, organization, and management tools in digital management could influence perception and further affect the willingness to transfer knowledge. The establishment of the analytical model and hypotheses is discussed concretely in this part.

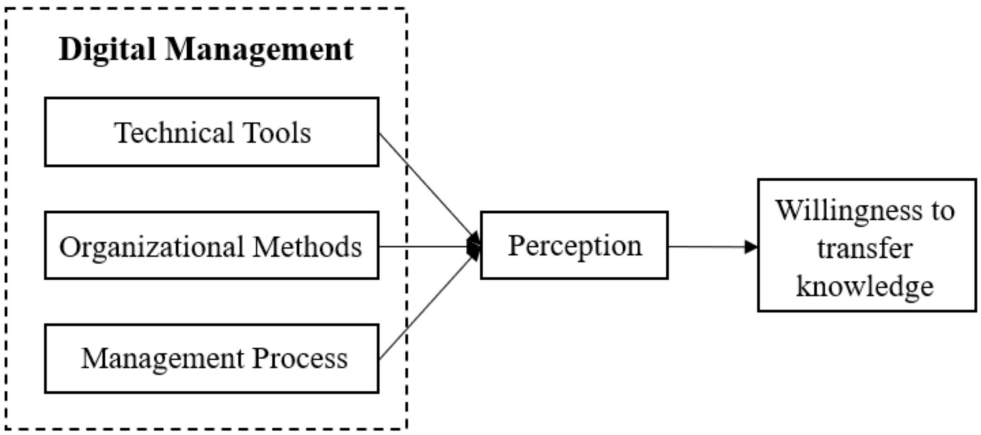


Figure 2. Research model of willingness to transfer knowledge factors within engineering consulting projects.

3.1. Technical Dimension

Digital technology is the cornerstone for carrying out digital management. In the context of digital transformation, the development process of digital technology has been accelerated, and technology has become an important guarantee to support the development of engineering consulting. Digital technology can improve the willingness to transfer the knowledge of project personnel through the convenience of perceived information transmission [34]. The application of digital technology can promote the exchange and reuse of construction knowledge between project managers and field engineers [51], which can effectively achieve the multiple objectives of engineering projects, making the participants willing to share information and promoting effective communication and knowledge-transfer activities [52,53].

In the technical dimension, the digital management of engineering consulting is mainly reflected in two aspects: digital infrastructure and digital innovation input [24]. Digital infrastructure is mainly composed of computer software, hardware, network, etc., which is mainly reflected in the whole-process engineering consulting project as a digital management (cloud) platform, data service layer construction, and IT management skills [54]. Digital management platforms are increasingly used by knowledge service providers to deliver their services [55]. As the main digital management technology and an important carrier for searching external knowledge [56,57], the digital management platform can provide technical channels for information communication and data resource flow

among multiple participants by improving the quality of perception of innovative technologies [58,59], which is an important means to realize the synergy, business integration, and integrated management of the whole-process engineering consulting [60]. Knowledge is transmitted from analog to digital, which greatly promotes acquisition, storage, transmission, and analysis of knowledge and makes knowledge used dynamically and promptly by employing digital media, and mobile devices, and converting the information flow, thereby effectively increasing the motivation for information exchange and sharing, as well as productivity [61].

At present, there are many digital technologies and tools used in the market, but highly matched and functional technologies that can meet the characteristics of integrated management and efficient collaboration of engineering consulting projects are still relatively lacking [62]. For strong medium and large enterprises, increasing the investment in capital, talents, operation, and maintenance and attaching importance to the research and development of digital platforms can greatly improve the construction efficiency of engineering consulting projects, enhancing the sense of the use of project managers, bringing lasting advantages to enterprises, and injecting vitality into the industry development. Therefore, the following hypotheses are proposed.

H1. *Digital infrastructure has a significant positive impact on perceived ease of use.*

H2. *Digital innovation input has a significant positive impact on perceived usefulness.*

3.2. Organizational Dimension

The willingness to transfer knowledge in engineering consulting projects can be influenced by organizational-level factors [42]. The main participants of digital project management are the project personnel in the whole process of engineering consulting, whose mastery of digital knowledge and application of digital technology can benefit the project from digital technology [63]. Through the form of knowledge coaching, such as organizational learning and the training of digital talents, knowledge is transferred from experts and experienced people to project personnel and system operators to realize the effective knowledge flow in the digital management platform [64].

Digital management can give birth to a new site management work mode, which can form a systematic and standardized standard work mechanism and a positive circulation mechanism by forming an efficient digital management organization, developing a post and management system for digital service projects, improving organizational learning, and doing a good job of data and information collection and resource integration in the whole process of engineering, thus improving the standardization of work and the ease of operation of project personnel, and providing an effective guarantee for knowledge transfer [12,65].

Currently, there is an increasing demand for digital talents in various fields such as the construction industry and manufacturing industry [66]. Digital talents are an important link to realizing the effective integration of digital management platforms and project resources. The cultivation of digital talents is crucial to the development of the engineering consulting service mode. As a result of improving the employees' awareness of digital technology applications by formulating digital talent cultivation mechanisms and increasing the investment in skills training, a group of professional talents is delivered to the development of the whole process of engineering consulting [67]. Therefore, digital awareness can always be implemented in the whole process of engineering projects, which is conducive to improving on-site project production efficiency and quality and strengthening the competitiveness of the consulting team. Therefore, the following hypotheses are proposed.

H3. *Digital organization construction has a significant positive impact on perceived ease of use.*

H4. *Digital management talents have a significant positive impact on perceived usefulness.*

3.3. Management Process Dimension

Knowledge transfer in engineering consulting projects is a dynamic flow and feedback process in which technology and organization fully integrate and play their roles [21]. Digital management of engineering consulting focuses on two aspects of information management and project management in the process of project construction [5]. Through the digital drive, the information of all-around production elements of the project can be mastered and controlled by the engineering consulting unit, thus automating business processes [68], optimizing working methods, and improving work efficiency.

Digital management implementation includes the collection and research of information [53]. Digital information management mainly focuses on the refinement and daily management of a large amount of basic data and information generated at each stage of the project, which ensures the effective transmission and integration of information, promotes collaborative information-sharing between project parties and management, construction, and service parties, and effectively reduces the changes and rework caused by information asymmetry [69]. The efficiency of information flow and the timeliness of information acquisition will promote multiple participants to maintain close contact, which is conducive to the participants maintaining a trusting cooperative relationship and greatly improves the rate and efficiency of knowledge transfer [42,70]. Combining digital project management processes and fully integrating with construction site work through digital technologies, such as BIM and information systems, digital project management effectively operates project data and resource information. Based on the digital management platform, data assets of engineering consulting projects are accumulated by forming digital consulting results such as databases, knowledge base, and benchmark projects, thus promoting the manifestation of a large amount of tacit knowledge [71], to provide a reference for subsequent construction of engineering consulting projects and reduce knowledge loss and resource waste. Therefore, the following hypotheses are proposed.

H5. *Digital information management has a significant positive impact on perceived ease of use.*

H6. *Digital information management has a significant positive impact on perceived usefulness.*

H7. *Digital project management has a significant positive impact on perceived ease of use.*

H8. *Digital project management has a significant positive impact on perceived usefulness.*

3.4. Mediating Role of Perceived Usefulness and Perceived Ease of Use

Perceived usefulness and perceived ease of use are based on the perceptual level, and factors in the technical, organizational, and managerial process dimensions are considered to influence the occurrence of knowledge transfer in engineering consulting projects and the ease of occurrence. Perceived usefulness and perceived ease of use are subjective-level influencing factors. Existing studies have demonstrated that perceived usefulness and perceived ease of use can significantly influence willingness [72]. When digital management is adopted in engineering consulting projects, project personnel can improve the willingness to communicate among project personnel and all participants by perceiving the convenience of digital technology for business activities and the important role of digital management for information collaboration and instant communication in business processes [73].

Perceived ease of use can also influence perceived usefulness when it affects willingness and behavior [72,74]. For the whole-process engineering consulting project, the key prerequisites are the mastery and application of digital management technology, talent training, and perfect management processes to implement digital management throughout the whole process and maximize its utility and value and to accelerate the efficiency of knowledge flow and transfer. The project personnel perceive the ease of operation of digital technology, the organization management process and talent team guarantee, the realization of technology, and the standardization of process, which make them more willing to cooperate with the implementation of digital management in the engineering consulting

project and to believe that digital management is an effective means to strengthen the sharing of project resources and the information of participants so that the willingness for knowledge transfer will be enhanced.

Therefore, the following hypothesis is proposed.

H9. *Perceived ease of use has a significant positive impact on perceived usefulness.*

H10. *Perceived usefulness has a significant positive impact on willingness to transfer knowledge.*

H11. *Perceived ease of use has a significant positive impact on willingness to transfer knowledge.*

Based on the theoretical framework of TAM and the above research hypothesis analysis, it was investigated how digital management affects the willingness to transfer knowledge through the variables at the perception level and, thus, construct a theoretical model of the impact of digital management on the willingness to transfer knowledge, as shown in Figure 3.

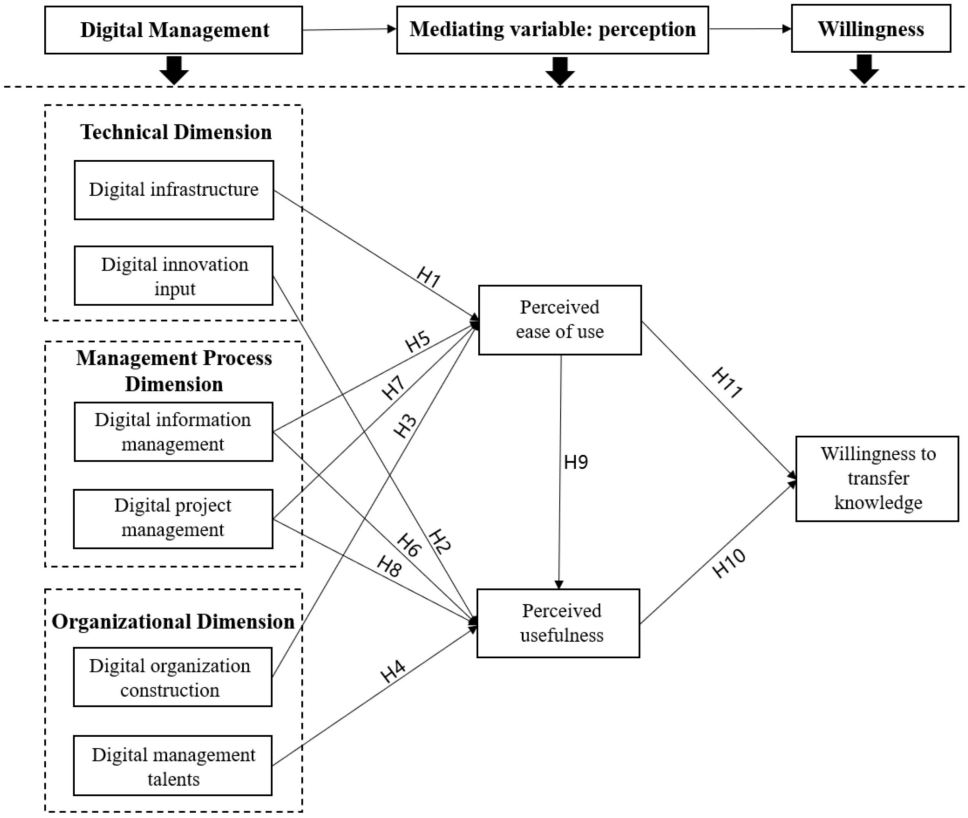


Figure 3. The Conceptual Model of the Impact of Digital Management on Willingness to Transfer Knowledge in Engineering Consulting Projects.

4. Methodology

4.1. Sample and Data Collection

The 40 first-batch pilot enterprises of the whole-process engineering consulting were identified by the Ministry of Housing and Construction in May 2017, and some universities were selected as the main research objects. The research focuses on TYLI, an enterprise with experience in the whole-process engineering consulting projects, and experts from universities in Hunan who conduct research on the whole-process engineering consulting. The network questionnaire was adopted in this survey by inviting project staff and university experts to fill it in by email and telephone, and the questionnaire can be found in Appendix A. Therefore, the sample is highly representative. A total of 286 questionnaires were finally collected, and 245 valid questionnaires were obtained by screening the questionnaires and eliminating invalid ones.

Descriptive statistical analysis was conducted on the above 245 questionnaires. As shown in Table 1, 54.69% of the questionnaire respondents are from design units, which meets the demand of transforming enterprise type. From the viewpoint of positions, middle management, and field technicians are the main ones, which correspond to the main objects of digital management implementation in the whole process of engineering consulting projects. In terms of working years, the distribution of sample data is reasonable. In view of the engineering consulting experience, most of the respondents have relevant project experience, while a few respondents without relevant experience come from universities and are not directly involved in the whole process of engineering consulting projects but have engaged in research on engineering consulting. Therefore, the relevant data are useful for reference in this study.

Table 1. Profiles of respondents and projects.

Respondents'	Classification	Frequency	Proportion
Unit Type	Design unit	134	54.69%
	Supervisory unit	3	1.22%
	Construction unit	37	15.11%
	Owner unit	23	9.39%
	Consulting unit	12	4.90%
	Government	4	1.63%
	Scientific research unit	30	12.24%
	Other	2	0.82%
Position	Senior management	11	4.49%
	Middle management	72	29.39%
	Site technicians	67	27.34%
	Site management	37	15.10%
	R&D staff	23	9.39%
	Other	35	14.29%
Years of experiences	<2 years	47	19.18%
	2–5 years	66	26.94%
	5–10 years	82	33.47%
	>10 years	50	20.41%
Whole-Process Engineering Consulting experience	0	31	12.65%
	1–3 times	122	49.80%
	4–6 times	57	23.26%
	≥7 times	35	14.29%

4.2. Measures

To test the above model, the questionnaire items were designed based on the variables and indicators derived from the literature and research. In this paper, the questionnaire items measuring digital management were mainly derived from the indicators in Table 2, containing 18 questionnaire items, which measured digital management in six dimensions: DI, DII, DOC, DMT, DIM, and DPM, respectively. The questionnaire items measuring perceived usefulness and perceived ease of use were mainly derived from He and Ca et al. [72,75] and contained six items. The items measuring the willingness to transfer knowledge were mainly derived from Ren et al. [76] and contained three items. The five-point Likert scale was used to express respondents' perceptions of each question, ranging from a score of 1 (fully disagree) to 5 (fully agree).

Table 2. Sources of measurement items.

Component Factors	Indicators	Source References
Digital infrastructure (DI)	Digital management platform (DI1) Data service layer construction (DI2) IT management skills (DI3)	[5,22,30,32]
Digital innovation input (DII)	Digital R&D capability (DII1) Financial investment (DII2) Digital operation and maintenance investment (DII3)	[5,22,30,32]
Digital organization construction (DOC)	Digital management organization (DOC1) Organizational mechanism construction (DOC2) Organizational learning atmosphere (DOC3)	[5,22,36–41]
Digital management talents (DMT)	Talent development mechanism (DMT1) Skill training input (DMT2) Digital application consciousness (DMT3)	[5,11,22,35,42,43]
Digital information management (DIM)	Timely information sharing (DIM1) Business process automation (DIM2) Trust relationship building (DIM3)	[5,40,44,45,47]
Digital project management (DPM)	Project management process (DPM1) Field technical application (DPM2) Digitalization of consulting results (DPM3)	[5,10,27,41]

4.3. Scale Validity and Reliability

The reliability and validity analysis of each variable was carried out by using SPSS22.0 and AMOS26.0. As illustrated in Table 3, in terms of reliability, the factor loading coefficients of the observed indicators of each variable are greater than 0.7. Cronbach's α, which indicates that the internal consistency of each variable, is high enough to meet the reliability requirements (range = 0.740–0.943 > 0.6). Construct reliability (CR) is greater than 0.6, indicating that the model has good reliability. The average variance extracted (AVE) of each variable is greater than 0.5, which indicates that the model has good convergent validity. The discriminant validity is shown in Table 4, and the correlation coefficients among the variables are all smaller than the square root of the AVE of the variable, indicating that the variables have good discriminant validity.

Table 3. Reliability and validity test of the measurement model.

Variables	Item	FL [1]	Variables	Item	FL [1]
DI: Cronbach's α = 0.864 CR = 0.853; AVE = 0.659	DI1 DI2 DI3	0.866 0.774 0.793	DPM: Cronbach's α = 0.891 CR = 0.842; AVE = 0.640	DPM1 DPM2 DPM3	0.807 0.814 0.778
DII: Cronbach's α = 0.740 CR = 0.783; AVE = 0.547	DII1 DII2 DII3	0.812 0.699 0.702	PU [2]: Cronbach's α = 0.943 CR = 0.912; AVE = 0.775	PU1 PU2 PU3	0.907 0.856 0.877
DOC: Cronbach's α = 0.880 CR = 0.887; AVE = 0.724	DOC1 DOC2 DOC3	0.853 0.845 0.855	PEOU [3]: Cronbach's α = 0.936 CR = 0.924; AVE = 0.803	PEOU1 PEOU2 PEOU3	0.913 0.876 0.899
DMT: Cronbach's α = 0.923 CR = 0.863; AVE = 0.677	DMT1 DMT2 DMT3	0.832 0.866 0.768	WTTK [4]: Cronbach's α = 0.929 CR = 0.931; AVE = 0.818	WTTK1 WTTK2 WTTK3	0.932 0.876 0.905
DIM: Cronbach's α = 0.840 CR = 0.828; AVE = 0.617	DIM1 DIM2 DIM3	0.834 0.780 0.739	-	- - -	- - -

[1] FL = factor loading; [2] PU = perceived usefulness; [3] PEOU= perceived ease of use; [4] WTTK = willingness to transfer knowledge.

Table 4. Correlations among major constructs.

Item	DI	DII	DOC	DMT	DIM	DPM	PU	PEOU	WTTK
DI	**0.812**								
DII	0.378	**0.740**							
DOC	0.322	0.290	**0.851**						
DMT	0.476	0.524	0.343	**0.823**					
DIM	0.387	0.466	0.299	0.508	**0.785**				
DPM	0.440	0.421	0.347	0.534	0.510	**0.800**			
PU	0.261	0.367	0.387	0.327	0.413	0.418	**0.880**		
PEOU	0.401	0.139	0.259	0.243	0.251	0.383	0.293	**0.896**	
WTTK	0.247	0.201	0.205	0.198	0.212	0.284	0.333	0.325	**0.904**

5. Results and Discussions

5.1. Goodness-of-Fit Analysis

To evaluate the fitness of the overall model, the model was analyzed according to the model fit test criteria proposed by Alzahrani and Emsley [77]. The test results demonstrate that the indices in each part of the model have complied with the recommended standards, as shown in Table 5.

Table 5. Test results of model fit.

Index	Fit Standard of Fitness	Value	Result
χ^2/df	<3, good fit	2.583	Yes
GFI	>0.90, good fit	0.904	Yes
AGFI	>0.80, good fit	0.812	Yes
NFI	>0.90, good fit	0.902	Yes
CFI	>0.90, good fit	0.901	Yes
RMSEA	<0.08, not bad fit; <0.05, good fit	0.072	Yes

5.2. Path Analysis among Latent Variables

Table 6 and Figure 4 illustrate the results of the SEM, according to the rule of significance judgment; all paths showed significant C.R. values greater than 1.96 and significant values p less than 0.05. Therefore, all of the 11 hypotheses were supported. As shown in Table 6, DI and DOC could influence perceived ease of use and further affect the willingness to transfer knowledge, and DI has a more significant impact on perceived ease of use. DII and DMT could influence perceived usefulness and, thus, positively and significantly influence the willingness to transfer knowledge, and DMT has a greater impact on perceived usefulness. Both DIM and DPM influence the willingness to transfer knowledge through perceived ease of use and perceived usefulness, and the mediating effect of perceived ease of use is more pronounced. In addition, the path coefficient between perceived ease of use and perceived usefulness, as well as the path coefficients of perceived ease of use, perceived usefulness, and the willingness to transfer knowledge, all reach significance levels.

Table 6. Result of path analysis.

Hypothesized Relationships		Path Coefficient	S.E.	C.R.	*p*	Interpretation
H1	DI→PEOU	0.297	0.077	4.448	*** [1]	Supported
H2	DII→PU	0.178	0.117	2.551	0.011	Supported
H3	DOC→PEOU	0.204	0.061	3.420	***	Supported
H4	DMT→PU	0.239	0.077	3.697	***	Supported
H5	DIM→PU	0.262	0.091	3.925	***	Supported
H6	DIM→PEOU	0.201	0.106	2.735	0.003	Supported
H7	DPM→PU	0.197	0.103	2.747	0.002	Supported
H8	DPM→PEOU	0.263	0.066	4.040	***	Supported
H9	PEOU→PU	0.237	0.073	3.149	***	Supported

[1] *** = $p < 0.001$.

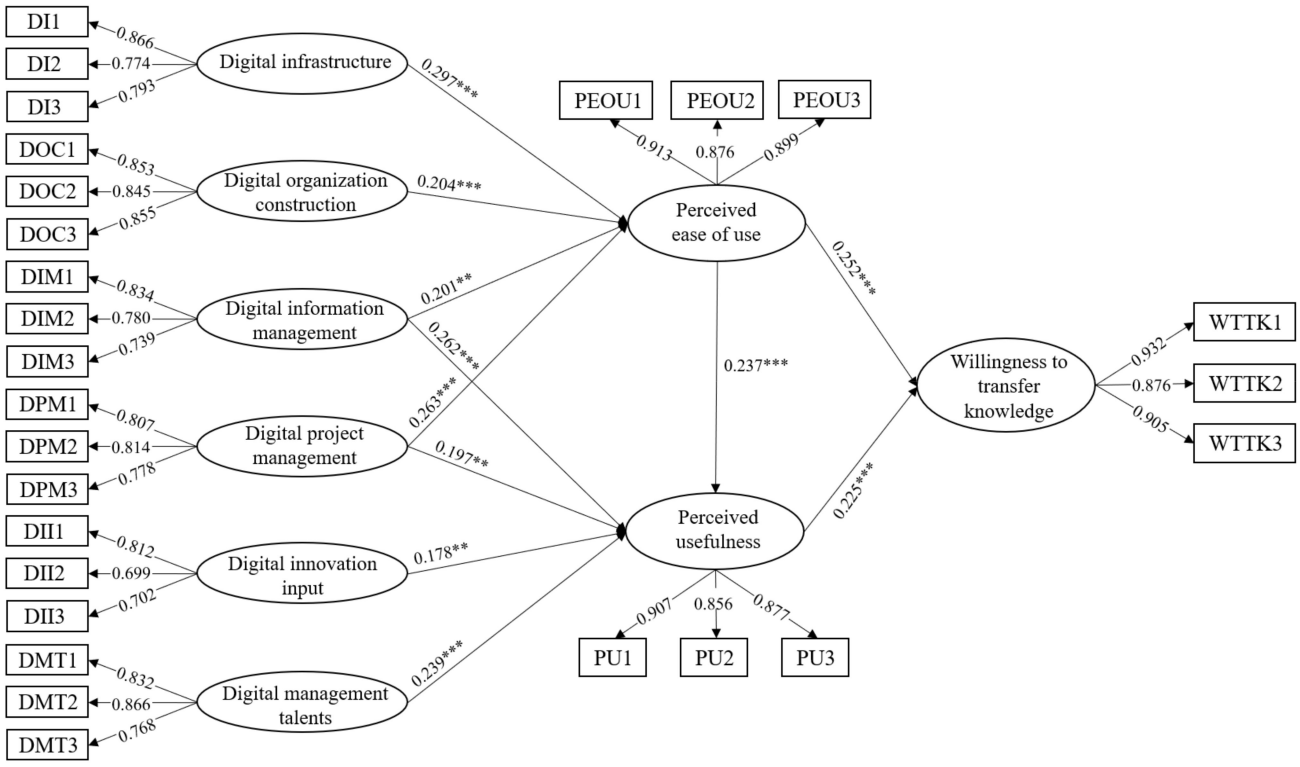


Figure 4. Projects Results of SEM Analysis. ** = $p < 0.01$; *** = $p < 0.001$.

5.3. Mediating Effect of Perceived Usefulness and Perceived Ease of Use

According to the research of Macho and Ledermann [78], causal effects are divided into the direct effect and the indirect effect. The indirect effect refers to the indirect effect of the cause variable on the outcome variable by affecting one or more intervening variables. If there is more than one intervening variable, the indirect effect is the sum of the product of the path coefficients for each cause variable through the intervening variables to affect the outcome variable. The nonparametric bootstrap procedure is used to measure the overall and specific indirect effects, and the results are shown in Table 7. There is a chain mediating effect in this model, i.e., not only can the cause variables affect the willingness to transfer knowledge through the mediating variables, perceived ease of use, and perceived usefulness, respectively, but perceived ease of use can also affect perceived usefulness.

Table 7. Results of mediating effect.

Causal Relationship	Influence Path	Influence Coefficient	Total Influence Coefficient
DI→WTTK	DI→(PEOU)→WTTK	0.075	0.091
	DI→(PEOU)→(PU)→WTTK	0.016	
DII→WTTK	DII→(PU)→WTTK	0.040	0.040
DOC→WTTK	DOC→(PEOU)→WTTK	0.051	0.062
	DOC→(PEOU)→(PU)→WTTK	0.011	
DMT→WTTK	DMT→(PU)→WTTK	0.054	0.054
DIM→WTTK	DIM→(PU)→WTTK	0.059	0.121
	DIM→(PEOU)→WTTK	0.051	
	DIM→(PEOU)→(PU)→WTTK	0.011	
DPM→WTTK	DPM→(PU)→WTTK	0.044	0.124
	DPM→(PEOU)→WTTK	0.066	
	DPM→(PEOU)→(PU)→WTTK	0.014	

The results indicate that DI and DOC have an indirect positive influence on the willingness to transfer knowledge through two paths, and DI (influence coefficient: 0.091) is more effective than DOC (influence coefficient: 0.062). As for DII and DMT, they have an indirect positive influence by the mediating effect of perceived usefulness on the willingness to transfer knowledge, with DMT having a greater impact (influence coefficient: 0.054). DIM and DPM have an indirect positive influence on the willingness to transfer knowledge through three paths, and their influence coefficient is 0.121 and 0.124, respectively. It is worth noting that DIM has a more significant effect on the willingness to transfer knowledge through perceived usefulness, while DPM has a greater effect on the willingness to transfer knowledge through perceived ease of use.

Overall, DPM and DIM have the most significant impact on the willingness to transfer knowledge, which may be related to the fact that the application of digital technology embedded in the information management process and project implementation process increases project members' perceptions of the value of digital management and the perceived ease of digital for information collection and project management, thus increasing project members' willingness to adopt digital in their business work. DII has the least impact on the willingness to transfer knowledge, which may be due to project members' insufficient mastery of digital management technologies and infrastructures and their lack of understanding of the intangible resources and inputs required for them.

Meanwhile, the influence coefficients of "independent variable → perceived ease of use → perceived usefulness → willingness to transfer knowledge" are much smaller than those of "independent variable → perceived ease of use → willingness to transfer knowledge" and "independent variable → perceived usefulness → willingness to transfer knowledge". This indicates that the chain-mediating effect of independent variables on willingness to transfer knowledge is smaller. This may be related to the fact that infrastructure, organizational development, human resources, input, digital project management, and digital information management can directly affect project members' perceptions of the efficiency, convenience, and value of digital management applications.

5.4. Theoretical Implications

Because of the increasing importance of knowledge management and digital management in the academic field, these results will have several theoretical implications.

First, based on the characteristics of business stages of whole-process engineering consulting and the demand for digital development, this study puts forward the knowledge transfer process model of each business stage of a whole-process engineering consulting project with a digital management platform as the core and analyzes the transfer mode of explicit and implicit knowledge of each business stage.

Second, this paper digs into the fact that the whole-process engineering consulting service is a high-end intelligent service based on knowledge, and practical knowledge transfer can largely reduce the occurrence of serious knowledge loss, resource waste,

and low management efficiency among the various business stages of whole-process engineering consulting. Digital management, as an important means to realize optimal resource allocation and collaboration and promote value chain integration, can provide an effective channel for project knowledge transfer, which further clarifies the important role of digital management applications for knowledge transfer.

Third, the connotation of digital management is defined and analyzed from three dimensions of technology, organization, and management with the specific context of whole-process engineering consulting and related scholars' research, which enriches the understanding of the digital management of whole-process engineering consulting projects and, at the same time, provides an important source and strong basis for variable measurement.

Fourth, technology acceptance theory (TAM theory) is applied to the field of engineering project knowledge transfer. A theoretical model is constructed from the perspective of digitization in which digital management influences the willingness to transfer knowledge of whole-process engineering consulting projects through perceptual factors, and thus influences knowledge-transfer behavior. Hypotheses are made on the role relationship between variables, and SPSS22.0 and AMOS26.0 are used to conduct reliability analysis, correlation analysis, goodness-of-fit analysis, mediation effect analysis, and hypothesis testing on questionnaire data. According to the empirical test results, digital management can have a significant positive effect on knowledge transfer willingness through perceived ease of use and perceived usefulness, among which digital project management and digital information management have the greatest effect on knowledge transfer willingness. This provides theoretical support for the application of digital management and knowledge transfer to improve the quality and efficiency of whole-process engineering consulting projects in the future.

5.5. Managerial Implications

Based on the above research results, digital management is an effective means to improve the willingness of knowledge transfer in the whole-process engineering consulting projects, and the application of digital management is conducive to improving the quality and efficiency of project business work, which meets the realistic needs of current development. At the same time, it also brings some practical values and inspirations for the implementation and digital management application of whole-process engineering consulting projects. First, improve the importance of digital information management and project management to actively promote the project's internal information and management, construction, service, and other multi-unit information interaction, to achieve participation in collaborative information sharing, and effectively reduce the changes and rework brought by information asymmetry through the refinement and daily management of project information to improve the project members' perception of the value of digital management application and the enthusiasm for active application.

Second, do a good job of guaranteeing infrastructure, organization construction, innovation investment, and talent training. Technology and organizational resources are an important foundation for project members' willingness to apply digital management. Develop and apply construction site wisdom technology, digital management platform, etc., make full use of BIM technology, internet of things, and other advanced information means to realize the digitization of jobs; set up an efficient and competent digital management organization; do a good job of collecting data and information of the whole process of the project; increase the absorption and training of digital talents; establish a sound digital talent management and guarantee system; and play the core benefit of talents. Finally, accelerate the promotion of whole-process engineering consulting.

Finally, accelerate the pilot of the digital management application of the whole-process engineering consulting project first. Digital management means will be gradually introduced into the project implementation process through platform construction and management process construction. Combine with the actual engineering observation and summarize the application results and value of digital management in the implementation

process of whole-process engineering consulting projects, dig out the technical and organizational problems arising in the application process, accumulate experience for digital application, realize the resourcefulness of engineering data results, and be able to provide effective guidance for the follow-up work.

6. Conclusions

This paper is aimed at providing a theoretical guide to improving the willingness to transfer knowledge of engineering consulting projects through digital management. First, it is known through the relevant literature research that digital management is an effective channel to promote project knowledge transfer. A combination of theoretical and empirical research was applied to analyze the relationships among DI, DII, DOC, DMT, DIM, and DPM, perceived ease of use, perceived usefulness, and the willingness to transfer knowledge. After various hypotheses and theoretical frameworks were proposed, questionnaire data were collected by web-based surveys, and an examination was conducted with SEM. Results indicated that DI and DOC provide technical and organizational guarantees for projects, and strong technical reserves and well-developed organization make project members realize that knowledge transfer is more convenient, thus enhancing their willingness to transfer knowledge. DII and DMT encourage the project team to pay attention to actual investment in digitization and the cultivation of digital talents. Popularize digital awareness and the willingness to transfer knowledge will increase. In addition, DIM and DPM are more complex. Timely information sharing in all project phases, automated business processes, and trust relationships can have a positive impact on the willingness to transfer knowledge. Moreover, the digital presentation of the project management process and project results can increase project members' awareness of digital applications and visualize the effectiveness of digital management. Thus, it plays a positive role in increasing the willingness to transfer knowledge.

Currently, this study has several limitations, and further research should be conducted to be more in-depth and practical on this issue. First, the SEM used in this paper simplifies the relationship between variables into a linear relationship, but the relationship may be much more complicated than the assumptions mentioned in the model. Therefore, system dynamics or other simulation analysis methods will be considered in the subsequent research to analyze the antecedents and outcomes. Second, this paper verified that digital management had a significant positive influence on the willingness to transfer knowledge in engineering consulting projects. If further research on mechanism design for knowledge transfer of engineering consulting projects can be conducted, it will be of great significance to the practice of engineering consulting service mode and project management efficiency improvement.

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Appendix A. Questionnaire

Variables	Item
Digital infrastructure	DI1: Digital management platform can improve project efficiency.
	DI2: The supporting technical management process can regulate the platform construction.
	DI3: We attach importance to professional software and database management in project construction.
Digital innovation input	DII1: We attach importance to the research and development of digital technology.
	DII2: We keep increasing the capital investment in digital equipment and operation and maintenance.
	DII3: We can pay attention to the upgrade and update of digital production equipment in time.
Digital organization construction	DOC1: Digital management organization and system help project sites to collect information well.
	DOC2: Our senior leaders value and support the implementation of digital management at project sites.
	DOC3: We have a good atmosphere for learning and applying digital technology.
Digital management talents	DMT1: Project sites need talents related to the implementation of digital technology and digital management.
	DMT2: We pay more and more attention to the training mechanism and skills training for digital talents.
	DMT3: The awareness of project site staff to apply digital technology management is getting stronger and stronger.
Digital information management	DIM1: Project information is available to multiple parties through the digital management platform in a timely manner.
	DIM2: Project matters, documents, and data can be automated through digital means.
	DIM3: Digital means can improve the efficiency of the project site and the communication efficiency of the participants.
Digital project management	DPM1: The digital project management process can regulate the digital work on the project site.
	DPM2: We are continuously strengthening the application of digital technologies in the project implementation process.
	DPM3: The formation of digital results such as knowledge base, database, and benchmarking projects is beneficial for the next project.
Perceived usefulness	PU1: The application of digital technology can greatly improve the efficiency of the project site.
	PU2: Organizational construction and talent training can enhance the enthusiasm for using digitalization on site.
	PU3: Digital management tools can improve the degree of management refinement and business decision-making efficiency.
Perceived ease of use	PEOU1: The application of digital technology makes business process approval and other work more convenient.
	PEOU2: Organizational construction and digital talents make it easier to apply digital technology on site.
	PEOU3: Information access and sharing is easier through digital management tools.
Willingness to transfer knowledge	WTTK1: I am willing to share my work documents and work experience with other members.
	WTTK2: When I need certain work document templates and related work experience, I am willing to get them anytime through the digital management platform.
	WTTK3: When project members are good at something, I am willing to let them teach me.

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