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The impact of information technology application on project performance: The mediating role of knowledge management

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A B S T R A C T

The present study evaluated the relationships between IT application and KM practice adoption, and project performance. KM practice adoption as a mediator in the relationship between IT application and project performance, was ascertained. A research model was constructed and validated utilizing structural equation modeling (SEM). Results of analyses demonstrated a positive relationship between IT application levels and knowledge management levels of projects. Also, high-level knowledge management contributes to project outcomes. Full mediation of KM practice adoption on the effects of IT application on project performance was affirmed.

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1. Introduction

Information technology (IT) is now everywhere, permeating all sectors and industries. Time and time again, IT has been proven to increase operational efficiencies of firms (Huang, 2009; Al-Sorihi et al., 2025). Meanwhile, firms are facing the increased need to be more cost effective in their operations in order to increase their operational efficiency, compelling them to consistently look for ways to be more efficient in their operations in terms of cost and timeliness. Hence, many firms, including those in the construction industry, have resorted to utilizing IT to increase their performance. With the erratic environment today owing to globalization, firms have to have the capability to react fast, to adapt. Firms in the construction sector frequently use project teams as a way of responding to these changes and achieve their objectives, but, during a project, managing several knowledge sources and types is a difficult undertaking. In project management, knowledge management is considered a major strategic issue (Liu et al., 2004; Arefazar et al., 2022; Priyanka & Siraj, 2024).

Knowledge management (KM) could lead to improved organizational performance, but the direct effect of its practices on the performance of capital facility projects needs to be explored more deeply (Simmons, 1994; Alade et al., 2022). Relevant to the context of this study; there were studies examining the effect of KM on the relationships involving the use of IT and KM in the field of construction. However, the effect of these relationships on project performance has not been explored. The methods used when evaluating the effect of technology on performance indicators may explain why investment in technology has not been related to better corporate success. As a result, a specific mechanism must be developed to demonstrate the advantages of using technology and implementing knowledge management practices.

The present study attempted to achieve two main objectives: to validate a model that evaluates the relationships between IT application and KM practice adoption, and project success represented by project performance and project advantages; and to

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ascertain KM practice adoption as mediator in the relationship between IT application and project performance. Between April and November 2024, data on IT application and the levels of practice of KM, as well as their links with project performance, were collected through a survey of 85 project responses in the Jordanian construction industry. The data were project-specific because they represented the degrees of IT and KM employed on projects.

2. Literature Review and Research Hypotheses

Many studies have examined technology adoption and use in the project management and construction industry, and many of these studies were looking into the factors that affect technology implementation and the expected benefits from technology usage. As reported in studies in architecture, engineering, and construction industries, changes resulting from the developments in information and communication technology or ICT, seem to go together with the changes to the processes of management. In other words, these changes are not purely technical. Also, past studies were demonstrating the benefits of using information technology, in addition to automation and four-dimensional CAD (4D CAD). In the construction industry, the role of technology is crucial.

There were studies examining the factors that impact adoption of technologies. Goodrum and Gangwar (2004) evaluated the link between changes in equipment technology and those occurring in salaries paid in the construction field. The authors accordingly examined the modifications using five aspects that lead to change in equipment technology. These aspects are: energy, control, functionality, ergonomics, and information processing. In another related study, Mitropoulos and Tatum discovered that hesitation towards technology adoption may be factored by ambiguous competitive advantage from the use of new technologies. The lack of information about the benefits of using technology could also cause hesitation. As such, for construction companies or projects, technology use is increasingly critical these days (Kolasani, 2023).

Within the construction industry, the benefits of technology usage have been investigated. For instance, the impacts of the use of various technologies on project performance has been examined, utilizing several indicators of project performance, including cost, schedule, and safety success. Indeed, for project stakeholders, these indicators are their main interests (Kudyba & D Cruz, 2023). Somehow, the construction industry has been suffering from poor efficiency and performance, resulting from ineffective investment decisions and ineffective communication and information exchange. Not only that, the construction projects are often fragmented and temporary, in addition to the use of unique working practices and resources. Additionally, construction companies often have different organizational objectives as opposed to organizations in other industries. All these factors have impeded the projected utilization of inter-organizational information technology.

Knowledge management (KM) perceives employee knowledge as the most prized resource in an organization. In fact, the concept of KM has been explored by numerous scholars, and many were looking into the expected benefits with KM usage in organizations. Within the context of the construction industry; studies have found that the use of formal managerial procedures in the management of knowledge is fairly low. In the sector of architecture, engineering, and construction (AEC), interoperability is currently a problem because of the various heterogeneous applications and systems that are often utilized by various players, in addition to the dynamics and the required adaptability for operation within this sector. As such, project-based industries need new knowledge tools to ease the many adverse power effects from bureaucratic knowledge practices.

Indeed, tools of project management knowledge are increasingly vital in the construction industry. Meanwhile, the factors affecting the interpersonal trust and readiness of the involved parties in sharing their knowledge in project teams cannot be overlooked. Relevantly, the management skill and knowledge deemed most important include leadership, communication, decision making, health and safety, motivation of others, and forecasting and planning. Furthermore, lucrative projects are often those with tacit and explicit knowledge being effectively managed, and so, knowledge transfer framework is necessary in projects. This framework would facilitate construction companies in knowledge transfer between projects.

Past findings have demonstrated the vital role of KM in the construction industry. KM clearly benefits both construction companies and projects. The benefits of IT usage in the construction industry have also been reported in earlier studies because in addition to mutual knowledge sharing, IT may also offer construction companies the mechanisms for accountability and control. The vital role of IT in KM is undeniable (Pillania, 2008). Moreover, the utilization of IT allows construction companies to integrate, share and manage data more efficiently (Hayes et al., 2022). Appositely, the inter-organizational knowledge can be created through high-level information pooling and physical interaction through interpersonal governance (Berente et al., 2010).

Clearly, IT could improve KM activities, and thus, the use of IT may have a positive impact on KM. In this study, the impacts of IT tools on project KM were scrutinized, and thus:

H_1: *IT application positively influences knowledge management in projects.*

Technology is vital in the construction domain. For example, multiple studies (Isikdag & Underwood, 2010; Ika & Pinto, 2022) found that technology adoption was a crucial influence in project success. The present study examined the effect of IT tools on project performance, taking into account previous findings. Consequently, the hypothesis below was postulated:

H_2: *The application of information technology has a positive impact on project performance.*

Many studies found significant benefits of information technology in knowledge management, and significant effect of knowledge management on the performance of organizations or projects. Effective management throughout the life of built facilities must be supported by effective knowledge management throughout the life of the facilities (Kolasani, 2023). Furthermore, the potential mediating role of knowledge management in the link between information technology and performance outcomes can be envisioned. Accordingly, in this study, the links involving IT usage and KM, and success of capital facility project were projected, as expressed in the following hypothesis:

H_3: *Knowledge management has a positive impact on project performance.*

H_4: *The relationship between IT applications and project performance is mediated through knowledge management*.

3. Research Methodology

The targeted study population comprised those with experience in capital facility projects, with a specific focus on senior individuals. In selecting the study respondents, a convenient sampling method was applied. As explained by Ramírez-Anormaliza et al. (2016), choosing the study respondents using this sampling method involves the use of basic screening criteria. In this study, a total of 50 respondents (n = 50) was selected. All of the respondents were from Jordan.

The study data were gathered using a survey questionnaire which comprised items representing the constructs of IT application, Knowledge management, and project performance. The items representing the aforementioned constructs were measured using a seven-point Likert scale, where the scale of 1¼ means "Strongly Disagree," the scale of 4 1⁄4 means "Strongly Disagree," and the scale of 7 means "Strongly Agree." The items measuring the construct of IT application were adapted from Olson (1982), Bakos and Treacy (1986) and Boynton and Zmud (1987), while items representing the construct of knowledge management on projects were adapted from Chen and Huang (2009) and Kiessling et al. (2009), whereas items representing the construct of project performance were based on Müller and Turner (2010) and Westerveld (2003). Overall, there were 411 completed returned surveys that were fit for analyses, and the demographic characteristics of the study respondents are provided in the ensuing Table 1. Table 1 shows that females made up more than half of the study respondents at 53.5%, while the remaining 46.5% represented the male respondents. Most respondents were in the age group of 25-34 years old representing 38.4% of the overall respondents. For education level, the majority were holders of master's degree at 37.7%, followed by those with bachelor's degrees at 35.3%, and then Doctorate degrees at 26.8%. A small percentage of respondents (0.2%) had a diploma as their highest education level. Most respondents had experience in the field of 5-10 years, specifically representing 43.8% of the study respondents. The research hypotheses of this study were tested using structural equation modeling (SEM). The measurement model also uses confirmatory factor analysis (CFA).

This was to check the properties of the study items. The measurement model proposed in this study demonstrates how the latent variables or hypothetical constructs are assessed with respect to their observed variables. The assessment is performed to determine the validity and reliability of the responses of the observed variables for the latent variables (see: Bagozzi & Yi, 1988; Newkirk & Lederer, 2006; Kline, 2010). Results of the factor loadings, Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE) of the study variables are provided in Table 2. As the factor loadings were all greater than 0.50 as proposed by Bagozzi and Yi (1988) and Creswell (2009), convergent validity is affirmable. The AVE values also were demonstrating convergent validity, based on Bagozzi and Yi (1988) and Hair et al. (2010), because the obtained values surpassed 0.50. In terms of the values of composite reliability, the table shows that they surpassed 0.60. Hence, internal consistency existed in the latent variables.

Table 1
Sample's Demographics

Variable	Category	Count	Percentage
Gender	Male	191	46.5
	Female	220	53.5
	Total	411	100
Age	Less than 25	62	15.1
	25 to less than 34	158	38.4
	34 to less than 45	122	29.7
	45 to less than 55	53	12.9
	55 years old and above	16	3.9
	Total	411	100
Education	Diploma	1	0.2
	Bachelor's	145	35.3
	Master's	155	37.7
	Doctorate	110	26.8
	Total	411	100
Years of Experience	Less than 5 years	93	22.6
	From 5 to less than 10 years	180	43.8
	From 10 years to less than 15 years	111	27
	15 years and above	27	6.6
	Total	411	100

Table 2
Factor Loading, Composite Reliability, and Average Variance Extracted Results

Latent Variable	Indicator	FL	AVE (> 0.50)	CR (> 0.70)	Cronbach's Alpha (> 0.70)
IT Application	ITA1	0.798	0.514	0.913	0.916
	ITA2	0.612			
	ITA3	0.763			
	ITA4	0.724			
	ITA5	0.743			
	ITA6	0.709			
	ITA7	0.673			
	ITA8	0.633			
	ITA9	0.709			
	ITA10	0.781			
Knowledge Management	KM1	0.815	0.565	0.921	0.935
	KM2	0.753			
	KM3	0.7			
	KM4	0.659			
	KM5	0.805			
	KM6	0.79			
	KM7	0.813			
	KM8	0.694			
	KM9	0.716			
Project Performance	PP1	0.763	0.650	0.943	0.652
	PP2	0.822			
	PP3	0.784			
	PP4	0.893			
	PP5	0.822			
	PP6	0.776			
	PP7	0.77			
	PP8	0.768			
	PP9	0.85			

3.1 Discriminant Validity

The intercorrelations between construct pairs are displayed in Table 3.

Table 3
Discriminant Validity

	1	2	3
IT Application	0.717		
Knowledge Management	0.466**	0.752	
Project Performance	0.323**	0.241**	0.806

**. Correlation is significant at the 0.01 level (1-tailed), *. Correlation is significant at the 0.05 level (1-tailed).

Clearly from the table, the intercorrelations appear to be lower in comparison to the square root of the estimates of AVE of the two constructs, and so, following Hair et al. (2006), discriminant validity is confirmed. Results showed adequate convergent and discriminant validity. A statistical effect on the model's aptness for the dataset was established, and the maximum probability (ML) estimate seems fitting in SEM in the simultaneous estimation of all parameters of the model. The x2 / df ratio can also be made an indicator, where three values or less are required for the model to be deemed acceptable. Here, small percentage value denotes good fit; the smaller the percentage value, the better the fit. However, James et al. (1982) proposed a ratio of between 2 and 5 for a good fit. Additionally, AGFI, NFI, IFI, TLI, and CFI value of 0.80-0.90 is regarded as tolerable. In interpreting the RMSEA value, the model's goodness-of-fit is considered, and the value should fall in the range between 0.05 and 0.08 (Hair et al., 2006) to be acceptable. Table 4 presents the measurement model results. As shown, the measurement model fits the gathered data.

Table 4
Goodness-of-fit Statistics for the Three-factor CFA Model

$\chi 2$	$\chi 2$/DF	AGFI	CFI	TLI	NFI	GFI	RMSEA
543.147	1.638	0.901	0.982	0.973	0.951	0.922	0.054

4. Hypotheses Testing and Result of the Study

The obtained empirical results are worth discussing. Three hypotheses representing the study objectives were proposed and tested, and results supported all the three hypotheses, as indicated in Table 5. As shown in Table 5 on the CR of each parameter, perceived IT application significantly, positively and directly affects knowledge management (P = 0 0.035), which denotes support to H1. Additionally, results showed significant and positive impact of IT application on project performance (P = ***). Hence, H2 was supported. Further, results showed a positive and significant impact of knowledge management on project performance (P = ***), H3 was therefore supported. Fig. 1 displays the relations and results among the variables.

Table 5
Structural Equation Modelling Regression Weights

			Unstandardized Regression Weights	S.E.	C.R.	P	Standardized Regression Weights	R^2
ITA	→	KM	0.134	0.064	2.105	0.035	0.102	0.74
ITA	→	PP	0.45	0.024	18.939	***	0.474	
KM	→	PP	0.484	0.018	26.799	***	0.543	

S.E. = Standard errors of the regression weights, P = p-value (*<0.05, **<0.01, ***<0.001)

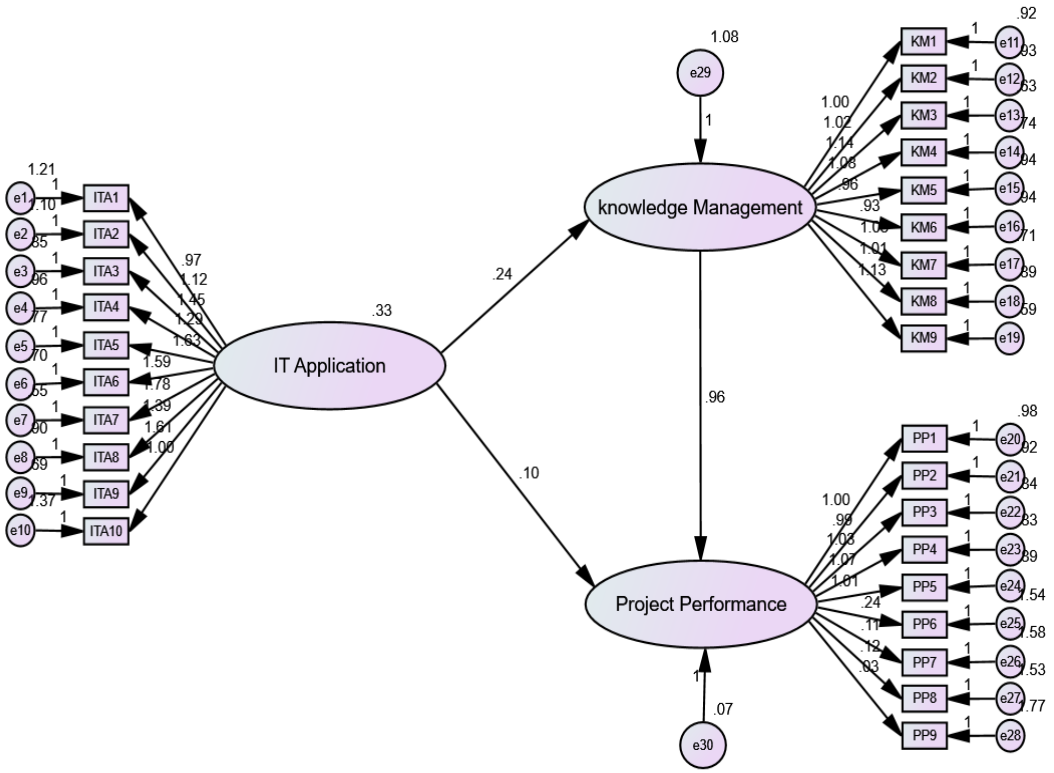

Fig. 1. Study Structural Equation Modelling

4.1 Result of Knowledge Management as a Mediating Effect

A full mediation is confirmed if the indirect effect surpasses the direct effect (Hair et al., 2010), but not the other way around. Table 6 accordingly shows that the direct effect (0.122) is lower than the indirect effect (0.178), affirming the full mediation of knowledge management in the relationship between IT application and project performance. H4 was hence supported.

Table 6
Summary of Results for the Theoretical Model

Hypothesis	From	Mediation	To	Direct effect	Indirect effect	Total effect	Results
H4	ITA	KM	PP	0.122	0.178	0.3	Supported

5. Discussion and Conclusions

The literature shows the lack of studies that looked into the impacts of the use of IT tools and KM on the success of projects within the context of the construction industry. This study hence presented and validated a model that evaluates the relationships between IT application and KM practice adoption, and project performance. The model was validated via structural equation modeling. Results demonstrated the wide usage of IT tools as support to KM practice, implying the significant linkage between IT tools usage and KM levels.

Results were demonstrating the effectiveness of IT tools (E-mail, the Internet, and document management systems) in supporting the KM practice. Furthermore, when adding KM into project management, various innovative IT tools (e.g., search engine, personal digital assistant, video conference, knowledge management system, data and knowledge mining techniques, database management system and enterprise information portal) could be employed. These tools could also be employed in

implementing knowledge management systems of projects. For project managers, they need to be able to utilize these tools effectively in supporting the practices of KM.

Results also demonstrated significant positive impact of IT tools usage on KM. This finding was also reported in previous studies. Still, despite this discovery, no model has been proposed for the evaluation of the relationships involving IT application, KM practice adoption, and project performance. Not only that, the effect of the numerous IT tools on project KM has not been empirically examined. Additionally, results were demonstrating KM as a major factor affecting project performance.

For practitioners, results of this study impart some implications, particularly in terms of knowledge storage and integration practice. As reported in past studies, the use of formal managerial procedures in the construction industry in knowledge management has been fairly low (AL-Sous et al., 2023), demonstrating the importance of storage and integration of knowledge in a capital facility project. Additionally, documentation of valuable ideas and new knowledge is necessary, so that project knowledge could be effectively managed. Not only that, the ideas and knowledge need to be stored and updated from time to time. For managers, effective management of knowledge of various types from various sources is highly critical. Moreover, knowledge should be shared among the project team members, and project managers should promote cooperation among members of various units so that new methods, knowledge, and inventions could be attained. Team members should use knowledge in resolving issues and working more efficiently and effectively. Finally, knowledge in the project should be practiced.

KM practice drives project outcomes through knowledge sharing and communication in team operations (Balle et al., 2019). Previous studies accordingly found strong connection between knowledge sharing and communication and team performance (AL-Sous et al., 2023). Additionally, knowledge integration and sharing increase the effectiveness of the project team and may also foster the sense of equality among project team members. Clearly, solidification of storage, integration and sharing of knowledge benefits projects, as proven by previous studies that reported the potential of KM practice in promoting innovativeness and creation. Indeed, KM could result in innovative intangible assets.

KM practice adoption as mediator in the relationship between IT application and project performance was examined. As shown by past studies, IT is integral in KM (Kolasani, 2023) and that there is a link between KM and a critical determinant of performance outcomes, but the mediating roles of KM between the two constructs have not been addressed in previous studies. KM practice adoption may transform the new knowledge to innovative practices. Additionally, the adoption of KM which improves understanding of innovation knowledge, could result in improved project performance. This study hence concluded full mediation of KM in the effects of IT application on project performance. Hence, the potential impact of IT application on project performance through the adoption of KM practice could be expected. Relevantly, past studies also mentioned mediation that exists between IT application and performance outcomes (Balle et al., 2019).

All in all, this study, through its findings, affirmed the benefits of IT application and KM practice adoption within the construction industry especially. Not only that, the findings could facilitate those of interest, managers especially, in improving KM, or at least, in determining whether or not to adopt KM in various types of projects. As for the study limitations; firstly, this study employed a cross-sectional design, which means that this study provides no insight into how IT application and KM practice adoption may change as time passes. On the other hand, a longitudinal design may resolve this issue, as it could provide insight into if and how the relationships between the two constructs could change with time. Another limitation is the industry employed in this study, namely the construction industry. For this reason, the results may not be applicable to other industries. Future studies should thus consider looking into another industry. This could enrich the current understanding into the relationships involving IT application, KM practice adoption, and project success.

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