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The Mediating Effect of KM Capabilities: Evidence from the Manufacturing and Technology Industries

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Abstract—**Based upon the theory of technology assimilation, information technology (IT) use for knowledge management (KM) is modeled to affect KM capabilities, which in turn affect KM effectiveness. A survey of 108 managers from manufacturing and technology industries indicates that IT support for KM had a significant positive relationship with KM capabilities and, in turn, affected the KM effectiveness. No significant direct relationship was detected between IT use for KM and KM effectiveness, indicating that KM capabilities variable is a full mediator. The results provide explanation for the lack of a direct link between IT use of KM and KM effectiveness and provides a potential framework for studies examining the impacts of other types of IT investments on KM effectiveness or success. The results also suggest that investments in IT use for KM must be carefully evaluated in terms of strategic directions to positively impact KM effectiveness as well as organisational performance.**

Keywords- Knowledge management; IT use; KM capabilities; technology assimilation

I. INTRODUCTION

Extant empirical evidence on IT investments in general has shown mixed results and studies specific to KM investment are limited [1]. A decision to invest in IT use for KM in knowledge-based organisations such as those from the manufacturing and technology industries will most likely to be based on whether or not there is a positive impact between IT use for KM and KM success or effectiveness. A focus of this study is, therefore, to examine the relationship between IT use for KM and KM effectiveness, which involve individual as well organisational level of KM effectiveness, in manufacturing and technology industries. We propose that IT use for KM may not directly influence KM effectiveness, but will have an indirect influence.

Numerous IS researchers suggest that in the context of KM, IT can be used to enhance the KM capabilities of an organisation [2,3]. IT use for KM will help an organisation's KM effectiveness primarily through its impacts on enhancing the level of organisational KM capabilities. This indirect capability of IT use for KM on KM effectiveness in the manufacturing and technology industries, however, has not been explored empirically in the literature. Given the growing number of IT applications and investment in KM in the manufacturing and technology industries, this study focuses on the relationships among IT use for KM, KM capabilities, and KM effectiveness. More specifically, we predict that IT use for KM does not have a direct impact on KM effectiveness; rather, IT use for KM has a direct impact on KM capabilities, which, in turn, affects the KM effectiveness.

II. BACKGROUND

A. KM Capabilities

KM is largely regarded as a process involving various activities to deal with knowledge [4]. KM processes are defined as processes that support the flow of knowledge within an organisation and that organisations with effective knowledge management must have these processes effectively supported and managed [5]. Research has proposed a systematic KM framework that consists of four main KM processes of knowledge creation, knowledge storage, knowledge transfer, and knowledge application [4]. In addition to this framework, other KM frameworks have also been proposed by various KM researchers [6,7,8,9,10]. Although these KM frameworks are composed of different stages, some of which are more detailed than others, these stages can be grouped under four similar underlying concepts of creation, storage, transfer, and application of knowledge. Thus, this framework is considered as sufficiently broad to permit complete analysis of organisational KM capabilities.

B. KM Effectiveness

The knowledge-based theory of the firm considers knowledge to be a firm's most strategically significant resource, because knowledge-based resources are generally difficult to imitate and socially complex. In addition, unique knowledge bases resources and organisation's capabilities are considered as the main determinants of sustained competitive advantage and superior organisational performance [11]. Thus, the main objective of any KM initiatives is to increase the effectiveness, efficiency and adaptability of KM efforts so as to add more value to the overall performance of the organisation [12].

Consequently, effective KM is considered essential to the success of contemporary organisations [13,14]. KM effectiveness is measured in terms of realizing successful outcomes of KM processes, including generating; sharing and applying knowledge; increasing knowledge satisfaction

and enhancing organisational performance [15,16]. KM effectiveness can be evaluated at two different levels, which involve individual-level and organisational-level of KM effectiveness. Individual-level of KM effectiveness, which is facilitated with the support of KM processes, enables individuals to expand their knowledge and learning ability. Thus, individual-level effectiveness focuses on the perceptions of the individuals who are involved in KM efforts, relating the extent of how well do they receive and understand the knowledge required to perform their tasks. The individual-level effectiveness is thus considered to facilitate the effectiveness of KM at the organisational level [17]. Organisational-level KM effectiveness represents the key contribution of KM by improving organisational performance through improved organisational effectiveness, enhanced ability to innovate, more collaborated efforts, and rapid development of new products and services. Moreover, organisational-level KM effectiveness is considered as significantly contributed by individual-level KM effectiveness.

C. *IT Support for KM*

IT is defined as "a generic term for the convergence of computers, hardware, software, telecommunications, Internet, electronics and the resulting technologies" [18]. In the context of KM, IT is perceived as a knowledge platform [19], or the infrastructure to knowledge management [20]. IT is identified as a major determinant of KM success by many IS researchers [2,21,22,18] and is recognised as both a key contributor and an enabler to the field of KM [6,2,1] that brings strategic benefits.

IT use for KM allows an organization to create, share, store, and use knowledge more efficiently and effectively. Therefore, the support of IT for KM is essential for initiating and carrying out KM activities [1]. Still, the direct link between IT use for KM and KM effectiveness is unclear. Research has also indicated that the extent of IT use for KM in an organisation is simply related to the general IT use and no relationship between IT use of KM and KM effectiveness was found [23]. Similarly, [24] found no evidence of a relationship between IT use for knowledge sharing and KM success.

Consequently, a review of "IT use for KM" literature was conducted to investigate the link between IT and KM effectiveness more closely. Numerous IS researchers posit that in the context of KM, IT can be used to enhance the KM capabilities of an organisation [2,3]. In addition, based upon the theory of technology assimilation [25,26], technologies must be infused and diffused into business processes to enhance organisational effectiveness. Thus, in the context of KM, IT should therefore become the enablers of KM processes to exhibit its effect on KM effectiveness. Without the diffusion of IT within the KM processes, IT alone is not sufficient to improve KM effectiveness. KM capabilities are very important in ensuring successful KM, in a way that organisations with higher KM capabilities will have higher chances to achieve successful KM [2,27,28]. It appears from this discussion that IT use of KM will enhance an organisation's capability of handling their knowledge more effectively and efficiently and, in turn, influence KM effectiveness.

In accordance with extant literature and based upon the technology assimilation theory, we argue that the impact of IT use for KM on KM effective and organisation's performance is only indirect through the organisation's capability to manage knowledge [27,29]. With regards to the relationship of IT and KM, KM capabilities can then be considered as a full mediator between IT use for KM, and KM effectiveness. The research model for this study is depicted in figure 1.

III. HYPOTHESES

Regardless of the type of KM strategy adopted by an organisation, IT plays an important role in the organisation's ability to create new knowledge and apply existing knowledge effectively [4,29]. Thus, more organisations are using IT as strategic enablers of their formal KM initiatives [30]. As discussed earlier, IT use for KM is considered to have a positive impact on the processes of knowledge creation, storing, transfer, and application, which constitute the KM capabilities of an organisation. Organisations can, therefore, enhance their KM capabilities through IT use for KM.

H1: The levels of IT use for KM are positively associated with the level of KM capabilities.

KM capabilities refer to an organisation's capability to create, store, transfer and apply organisational knowledge [27]. Knowledge creation is defined as the capability to improve continuously, and create new knowledge by expanding the existing knowledge [30]. Knowledge storing occurs in an organisation when employees record, gather, and make their own personal and organisational knowledge available and accessible to others [8].

Knowledge transfer process, which is defined as the dissemination of knowledge in an organisation [31,32], and is also referred to as the process of sharing knowledge [33,34], serves as the mechanism to facilitate the exchanges of knowledge within an organisation. Lastly, knowledge application is the actual use of the knowledge, which can be used to adjust strategic direction, solve new problems, and improve efficiency [2].

One of the most important objectives of KM is to create value from organization's knowledge resources so they can be utilised through the applications and action towards an organisation's competitive edge [35]. This indicates that the effectiveness of KM mostly depends on the capabilities of an organisation to efficiently produce effective knowledge and support the process of using and putting the knowledge into actions [36]. Thus, KM capabilities are argued to have

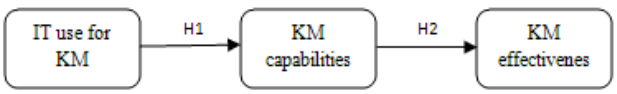

Figure 1. Proposed research model

significant effect on KM effectiveness. Moreover, prior studies have also provided empirical evidence demonstrating

a positive relationship between KM capabilities and KM effectiveness [2,27,28]. Based upon the preceding discussion, we therefore propose that organisations with higher levels of KM capabilities are able to rapidly enhance their level of KM effectiveness.

H2: Higher levels of KM capabilities associate with higher level of KM effectiveness.

IV. RESEARCH METHOD

A. Sample

Survey invitation emails were sent in August 2009 to 587 IT or KM managers in manufacturing and technology services from Malaysian listed organisations using a web-based online survey. In order to entice participation, the potential respondents were offered incentive in the form the study's final report. Two weeks after the invitation, reminder emails were sent out. Three weeks after the reminder emails, we sent out another reminder emails to the organisations that had not yet participated in the survey. A total of 109 organisations responded to the survey, yielding a response rate of 18%. 108 had complete data usable for analysis (1 response contained invalid data).

B. Constructs

In this study, IT use for KM construct is represented by the use of IT to support KM processes of knowledge creation, knowledge storage, knowledge transfer, and knowledge application. The scales for this construct were developed using items adapted from IT support for KM constructs used in previous studies [2,37,38]. The corresponding measuring items were revised to measure the degree of IT use for each KM process. The items were also worded according to the needs of the study and for the purpose of improving the face validity of the items.

KM capabilities are measured by the extent of organisational capabilities to create, store, transfer and apply knowledge. The measuring items for the knowledge creation, storage, transfer and application for this construct were adapted from an original instrument developed by [2] and from other studies measuring 'knowledge capability' construct [13].

Based on earlier discussion, this KM effectiveness is considered as a two-dimensional construct, comprising of individual-level KM effectiveness and organization-level KM effectiveness sub-constructs [1,39]. Individual-level KM effectiveness is measured as the extent to which individual perceive it as easy to access to knowledge and that the available knowledge is useful in their tasks. Organisational-level effectiveness is measured as the extent of organisational improvement in organisational effectiveness, ability to innovate, collaboration efforts, and development of new products and services.

All constructs and sub-constructs are measured using five-point Likert scales. Although the constructs used in this study have been validated in the literature, they were examined using partial least square (PLS) technique. PLS is superior to traditional statistical method such as factor analysis, regression, path analysis, and supports formative structures, which are appropriate for testing models in the early stages of development [40]. In addition, PLS has minimal demands on sample size, measurement scales and does not assume any distributional form for measured variables [41].

The reliability and validity of the constructs can be demonstrated through measures of internal reliability, convergent, and discriminant validities [42]. Each of the constructs adopted in this study employed multiple items, so convergent validity was assessed by examining the loading of each item on the corresponding construct. Each of the items was significantly loaded into its corresponding construct, thus, convergent validity is met. Internal reliabilities of the examined constructs were obtained by estimating internal composite reliability (ICR) and Cronbach's alpha. An internal composite reliability of 0.7 or greater is acceptable for social science research [42]. The results of the constructs' reliability are shown in Table 1, and exceed the recommended level of reliability measures [43].

Discriminant validity refers to the degree to which items differentiate between constructs, or measure distinct concepts [44]. To evaluate discriminant validity, the constructs should have an average variance extracted (AVE) of at least 0.5 [42]. Table 1 indicates appropriate discriminant validity under this requirement.

V. DATA ANALYSIS AND RESULTS

The test of the structural model involves the tests of the amount of variance explained by the independent variables, which is the R^2 value, as well as the strengths of the relationships between the dependent and independent variables, which is the size and significance of the path coefficients. A bootstrap re-sampling procedure was used to generate the t-statistics for the path coefficients [40]. The structural model results are presented in figure 2. As hypothesised, IT use for KM had a direct significant positive relationship with KM capabilities (0.72, and p-value<0.001).

Additionally, as proposed, KM effectiveness was significantly associated with KM capabilities and explained

TABLE I. RELIABILITY OF CONSTRUCTS

Items	AVE	Cronbach alpha	ICR
IT use for KM	0.646	0.817	0.879
IT use for knowledge creation	0.636	0.706	0.839
IT use for knowledge storage	0.733	0.882	0.917
IT use for knowledge transfer	0.747	0.850	0.898
IT use for knowledge application	0.689	0.871	0.898
KM capabilities	0.784	0.912	0.935
Knowledge creation process	0.775	0.922	0.932
Knowledge storage process	0.843	0.942	0.956
Knowledge transfer process	0.684	0.874	0.896
Knowledge application process	0.846	0.946	0.957
KM effectiveness	0.795	0.763	0.885
Individual-level effectiveness	0.894	0.939	0.962
Organisational-level effectiveness	0.826	0.911	0.950

62% of the dependent construct's variance with a significant (t-value=4.5, p-value<0.001) path coefficient of 0.47. Thus, hypotheses 1 and 2 were supported. The high obtained R^2 value implies that KM capabilities were indeed critical determinants of KM effectiveness.

In order to further understand the effect of IT use for KM on KM effectiveness, the structural model test includes a direct link between IT use for KM and KM effectiveness to investigate the direct relationship between the two constructs. The results shows that the correlation between IT use for KM and KM effectiveness was not significant with a coefficient of 0.37 and p-value>0.001. Furthermore, KM capabilities can be considered as full mediator as there was no significant direct relationship between IT use for KM and KM effectiveness [45]. In other words, the impact of IT use for KM on KM effectiveness was only indirect through the mediation effect of KM capabilities.

VI. CONCLUSIONS

In this study, we examined how IT use for KM influences an organisation's KM effectiveness. We argue that the impact of IT use for KM on KM effectiveness is only indirect through KM capabilities. The argument is based upon the theory of technology assimilation, as well as suggestions by prior research. KM capabilities, which include KM processes of creating, storing, transferring, and applying organisational knowledge, enable organisations to utilise their knowledge effectively to achieve KM effectiveness or success. IT use for KM is argued to directly enhance an organisation's KM capabilities, which in turn affects KM effectiveness.

Based upon a survey of managers in 108 manufacturing and technology organisations, IT use for KM was found to have a positive impact on an organisation's KM capabilities. In addition, the levels of an organisation's KM capabilities were significantly associated with the organisation's KM effectiveness. However, there was no significant direct relationship between IT use for KM and KM effectiveness, indicating KM capabilities as full mediator between the two variables.

Like any study, this study also has several limitations. For example, the data for this study is obtained from single informants, which may result in possible bias. In addition, the findings of this study may only be generalized to the population of organisations within the sampling frame of manufacturing and technology organisations within a small region. Lastly, other possible factors of influence were not included in the study such as management capability, organisational culture, and structure. Thus, future studies could examine other potentials antecedents of KM effectiveness and possibly link it to organisational performance. Nevertheless, the R^2 value obtained in this study indicates the importance of the impact of KM capabilities on KM effectiveness.

Despite the limitations mentioned in the previous section, the findings of this study have formed useful implications for researchers and the management in the manufacturing and technology industries. For researchers, this study adds a variation of IT use for KM literature by empirically testing its relationship to KM effectiveness and providing a potential framework for future studies examining the impacts of IT investments on KM effectiveness. In particular, links between specific IT use and key KM capabilities could be further examined to provide more specific guidelines for the management in the organisations studied.

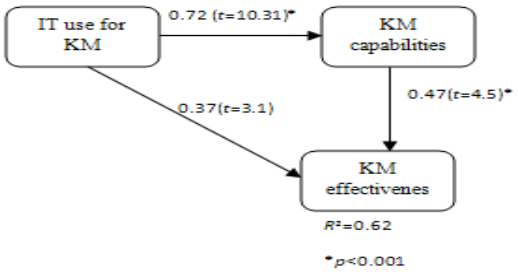

Figure 2. Results of structural model

For the management in the manufacturing and technology sectors, the implication is that, although the investments in IT may not directly enhance an organisation's KM effectiveness, it does however, appears to be an organisation's important resource to implement their strategies, which in turn influences their KM effectiveness. Thus, the management in these organisations could carefully match their IT investment decisions to their strategic directions. In addition, the complete mediation of the effects of IT indicates that the management could consider other management interventions for enhancing organisational KM effectiveness. For example, management could employ strategic management practices, supportive culture, and suitable organisational structure. In particular, the presence of the mediating capabilities provides additional insights into the structure that could be developed in order to achieve their desired KM objectives.

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