Knowledge management technologies and organizational performance: a meta-analytic study

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Abstract

Purpose: This meta-analytic study tries to synthesize the mixed relationships between knowledge management technologies (KMT) and organizational performance as well as to explore the impacts of contextual elements, such as national culture, economy, and industries, on these relationships.

Methods: Findings on various subjects from 40 previous empirical studies were examined using meta-analysis.

Findings: It was found that KMT are positively related to overall organizational performance as well as financial and non-financial performance and that the relationship between KMT and financial performance is stronger in developing economies than in developed economies.

Originality: As the first meta-analytic study to address the generalisability of KMT–organizational performance relationships, this paper offers an improved understanding of the benefits of KMT. It also expands knowledge about how contextual issues related to national culture, economies, and industries affect KMT payoffs.

Practical implication: It helps practitioners better understand the role of KMT in organizational performance in various contexts and provides practical suggestions for KMT implementation.

Paper type: Research Paper

Keywords: Knowledge management, Information technology, Organizational performance, Meta-analysis, National culture

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1. Introduction

Knowledge management (KM) has become a popular topic in information management research over the past two decades (Sharma *et al*., 2021), with information technologies (IT) understood to drive KM (Sun *et al*., 2022). KM projects are more likely to be successful when supported by IT (Davenport *et al*., 1998), which facilitates people's access to knowledge (Chang and Chuang, 2011). IT also offer organizations competitive advantages over their rivals (Tanriverdi, 2005) by enabling KM activities, such as knowledge searching, creation, retention, sharing and application (Alavi and Leidner, 2001; Lee *et al*., 2020). KM technologies (KMT), referring to the application of IT to support knowledge processes (such as knowledge sharing, creation, and application), collaboration and communication, learning, decision-making and problem-solving, have drawn tremendous attention from researchers and practitioners, particularly concerning the relationships between KMT and organizational performance (Inkinen, 2016). However, KMT–organizational performance relationships remain ambiguous due to mixed empirical findings, which inhibit the generalisability of KMT–organizational performance relationships.

There are some theoretical explanations for negative or positive findings of KMT–organizational performance relationships, but so far, there has been no study that tried to resolve the contradictions. For example, Inkinen (2016) as well as Gupta and Chopra (2018) conducted systematic reviews on this topic, but systematic reviews cannot provide effect size of the causal relationships, which is problematic because it cannot solve these

contradictions. As inconsistent KMT–organizational performance relationships remain a critical issue in the theoretical development of the topic, we ask, what is the relationship between KMT and organizational performance based on earlier research? A meta-analysis can be used to reduce the heterogeneity of contradictory findings by providing reliable knowledge with a comprehensive effect size for the relationships based on various empirical studies (Hempel, 2020). Current meta-analysis in the KM, IT and performance fields have investigated different aspects of their respective constructs, such as IT investment–firm financial performance relationships (Lim *et al*., 2011), IT resource–firm performance relationships (Liang et al., 2010), IT–strategic alignments (Gerow *et al*., 2014) and knowledge-friendly organizational culture (KFOC)–organizational performance relationships (Liu *et al*., 2021). However, a meta-analysis of KMT and organizational performance is lacking in both the IT and KM literatures, obscuring the role of KMT in organizational performance.

Furthermore, both KM (Kim, 2020) and IT applications (Zhang *et al*., 2018) are socially and culturally embedded human activities, affected by regional idiosyncrasies (Hussinki *et al*., 2017) and environment heterogeneities (Domenech *et al*., 2016). Therefore, contextual elements, such as national culture, economy and industry, play a critical role in KMT applications and their outcomes. However, most studies on KMT– organizational performance relationships have neglected the ramifications and potential impacts of these contextual factors (Inkinen, 2016). Therefore, current research lacks theoretical coherence regarding KMT– organizational performance relationships, and the influence of contextual elements (national culture, economy and industry) on these relationships remain unknown.

To redress these inadequacies, we carry out a meta-analysis of the relationships between KMT and organizational performance, testing for the moderating impacts of national cultural dimensions, economy types and industrial types. By doing so, this research contributes to the literature in several ways. First, it deepens knowledge-based theory by empirically demonstrating the overall strength of the effect sizes of the relationship between KMT and organizational performance. Second, to the best of our knowledge, it is the first meta-analysis to scrutinise KMT– organizational performance relationships by applying secondary data, particularly in light of the moderating impacts of national culture, economy and industry. This study outlines if, how and why these contextual factors do (or do not) moderate KMT– organizational performance relationships. Based on data collected from 40 papers from different countries and regions, our results add valuable, unique empirical findings to the current literature.

2. Research questions

2.1 KMT

KMT, a dominant KM practice (Inkinen, 2016), includes IT infrastructure and its application for managing knowledge (Heisig, 2009; Liu *et al*., 2022a). Although KMT was differently named in literature, such as IT support (Lee *et al*., 2012), technical infrastructure (Boumarafi and Jabnoun, 2008), technology and tools (Hartono *et al*., 2016) etc., the functions of KMT in organizations are almost the same. KMT is used to facilitate KM activities (e.g., knowledge creation, acquisition, sharing, transferring, searching, retrieving, retention and application) (Barão *et al*., 2017) that ~~facilitate~~ advance collaboration and communication (Chen *et al*., 2011) and support learning (Gold *et al*.,

2001), decision-making and problem-solving (Kebede, 2010). In this study, a broad definition is used to include as many relevant previous studies as possible, therefore, *KMT are defined as tools, platforms and infrastructures developed by IT that are applied to support KM activities, learning, collaboration and decision-making in organizations*. This definition covers off-the-shelf information technologies/tools as well as custom developed technical solutions for managing knowledge.

2.2 Three types of organizational performance

To evaluate organizational performance, we followed Liu *et al*. (2021), who identified that organizational performance has generally been examined in the three following categories in KM literature: financial performance (FP), non-financial performance (NFP) and overall organizational performance (OOP). FP concerns firms' capability to use their resources to increase their profits or stock values (Hitt and Brynjolfsson, 1996), with typical indicators including return on investment, profitability, return on equity, cash flow, sales growth and market share. NFP measures firm performance through non-monetary indicators, such as organizational process, product quality and people's attitudes (Abdel-Maksoud *et al*., 2005), with typical indicators including cost reduction, time to market, stakeholders' satisfaction, employee development, organizational reputation and research and development. OOP comprises financial and non-financial indicators to measure firms' integrative operation and development status.

2.3 KMT and organizational performance

Knowledge-based theory argues that organizations that effectively and efficiently manage knowledge can achieve competitive advantages (Grant, 1996; Nonaka and Toyama, 2005). Because KMT can enhance organizational performance when supporting organizations' management of knowledge, many studies published to date have explored the interdependency between KMT and organizational performance. However, their findings are sometimes contradictory, presenting a variety of insignificant, negative and significantly positive KMT–performance relationships. For instance, Inkinen and Kianto (2014), Shih *et al*. (2009), Yang *et al*. (2009), Chen and Liang (2011), Roldán *et al*. (2014) and Payal *et al*. (2016) reported insignificant relationships between KMT and FP, while Andreeva and Kianto (2012) reported that KMT negatively affected firm FP. The relationship between KMT and NFP has provoked similar controversy (Chen and Liang, 2011). Mills and Smith (2011), Lee *et al*. (2008) and Yang *et al*. (2009) reported a negative relationship between KMT and NFP, and Matin and Sabagh (2015) found that KMT and OOP were negatively associated. However, Han and Wang (2012) and Li and Han (2008) argued that IT applications for KM would not lead to better OOP. Payal *et al*. (2016) also found that KMT did not affect OOP.

Several potential reasons exist for these insignificant and negative findings. First, a large investment in KMT decreases firms' economic outcomes (Andreeva and Kianto, 2012; Yang et al., 2009). Second, reaping the benefits of KMT requires employees to actively apply the technologies over a long period (Andreeva and Kianto, 2012) because simply implementing KMT cannot create competitive advantages (Kmieciak *et al*., 2012). Third, although KMT can aid knowledge sharing, face-to-face communication cannot be

replaced (Yang *et al*., 2009). Finally, the insignificant results may be due to sampling errors and response biases because most studies selected a limited sample.

Conversely, Chen and Huang (2014), Jain and Moreno (2015), Kamath *et al*. (2016), Lee and Lee (2007), Maiga *et al*. (2013), Soto-Acosta *et* al. (2018), Tanriverdi (2005), Vaccaro *et al*. (2010) and Valdez-Juárez *et al*. (2018) concluded that the KMT–firm FP relationship was significantly positive. Many other researchers, including Lee et al. (2012), Lee and Lee (2007), Liang *et al*. (2013), Mageswari *et al*. (2017), Maiga *et al*. (2013) and Valdez-Juárez *et al*. (2018), also revealed positive relationships between KMT and NFP. Similarly, numerous studies have shown a positive relationship between KMT and OOP (Choe, 2016; Kamhawi, 2012; Kroh *et al*., 2018; Mageswari *et al*., 2017; Pee *et al*., 2010; Wang *et al*., 2007; Wong and Wong, 2011).

These positive findings can be explained from the following perspectives. First, knowledge-based theory argues that firms can achieve competitive advantages if they effectively integrate knowledge (Grant, 1996). KMT can facilitate such integration through KM activities (Mageswari *et al*., 2017) or learning (Maiga *et al*., 2013), allowing firms to achieve financial and non-financial benefits (Li and Han, 2008). Second, KMT can help meet firms' knowledge needs, supporting customer and supplier KM and enabling firms to integrate external knowledge to achieve competitive advantages. Third, KMT can improve firm performance through additional factors, such as knowledge stocks (Payal *et al*., 2016), KM practices (i.e., human resource management [Andreeva and Kianto, 2012], KFOC, and structure [Matin and Sabagh, 2015; Mills and Smith, 2011]), KM activities and employees' participation and application (Lee *et al*., 2008).

Although rational explanations may exist for the contradictory findings surrounding KMT–organizational performance relationships, these findings hamper the theoretical development and practical application of KMT because they do not provide a consistent basis regarding KMT–organizational performance relationships. Therefore, the first research question is as follows: What is the relationship between KMT and organizational performance (FP, NFP and OOP)?

2.4 Contextual factors in KMT research

Meaningful contextual descriptions in the literature may explain the conflicting findings (Kirkman et al., 2006) concerning KM– organizational performance relationships because contexts are contingent elements that affect KM (Liu *et al*., 2019) and moderate the relations between KM and its payoffs. Contexts can also strongly impact on research findings (Johns, 2006) and clarify variances among studies (Stanley, 2012). In this study, we selected national culture, national economy and industry as contextual factors to further examine KMT– organizational performance relationships for the following reasons. First, national culture impacts KM activities and KMT application (Wilkesmann *et al*., 2009; Liu *et al*., 2022b). Second, national economy reflects the social development of a country (region), impacting firms' investment strategies and development paths. Third, industry type affects firms' KM strategies and focuses, which may explain differences in KMT applications. Fourth, limited attention has been paid to the moderating effects of these contextual factors on KMT– organizational performance relationships.

A critical contextual factor, national culture affects people's KM activities as well as the relation between KM and its benefits (King, 2007). National culture can be defined as the

collective mode of the minds of a national people that distinguishes them from other nationalities (Hofstede, 1993; Hofstede *et al*., 2010). By affecting citizens' views, it can affect their KM activities and IT adoption (Hofstede *et al*., 2010) and behavior (King, 2007). National culture can be manifested by the following features (Hofstede *et al*., 2010): power distance, individualism versus collectivism, femininity versus masculinity, uncertainty avoidance, long-term versus short-term orientation and indulgence-oriented versus restraint-oriented culture. Different degrees of these dimensions strengthen or weaken KMT adoption and KM activities. For instance, low power distance societies have led to enhanced knowledge creation via diversified top management teams in multi-national corporations (Boone *et al*., 2019), whereas high power distance societies have been a barrier to knowledge transfer (Wilkesmann *et al*., 2009). Modes of IT adoption also differ between individualistic and collective societies. People in individualistic societies are more likely to apply state-of-the-art techniques based on their own judgement, while those in collective societies tend to follow others' choices when selecting new technologies (Lee *et al*., 2013). Khalil and Marouf (2017) also found that more KMT projects were initiated in individualistic societies than collective ones. Weidenfeld *et al*. (2016), Khalil and Marouf (2017) and Magnier-Watanabe and Senoo (2010) have identified other dimensions of national culture that impact KM activities and applications.

While current studies show that national culture strengthens or weakens KM activities and application, whether national culture affects KMT–performance relationships remains unclear. Thus, the second research question is as follows: Does national culture

moderate the relationships between KMT and organizational performance (FP, NFP and OOP)?

As active knowledge creators, many firms in developed economies have led technological development for hundreds of years and were some of the first to apply KMT to facilitate communication and KM. However, with increased globalisation in the last century, firms in developing economies have had more opportunities to learn from their competitors in developed economies, including in KMT adoption. The global spread of Covid-19 has also pushed more people to work remotely with the help of KMT. However, it remains unclear whether firms in developed economies can enjoy the early-application advantages of KMT. Therefore, the third research question is as follows: Does national economy moderate the relationships between KMT and organizational performance (FP, NFP and OOP)?

The width and depth of IT application may vary across industries. In service industries, firms require knowledge to be integrated more quickly and are better at applying IT for KM than firms in manufacturing industries. For instance, IT-related service firms have outperformed firms in the manufacturing industry in terms of KMT implementation and application (Chawla *et al*., 2010), and more KM projects have been undertaken in consultancy firms than in manufacturing firms (Chase, 1997). Such evidence shows that firms in the service industries have more opportunities to apply KMT than in the manufacturing industries, but whether differences in KMT application between service and manufacturing industries can explain KMT– organizational performance relationship requires further study. Therefore, the fourth research question is as follows: Does industry

type moderate the relationships between KMT and organizational performance (FP, NFP and OOP)?

3. Research method and implementation

3.1 Meta-analysis

Meta-analysis is a methodological and statistical method (Noel and Todd, 2012) intended to produce empirical knowledge about general associations, particularly causal relationships (Matt and Cook, 2009), by statistically analysing a large number of quantitative findings from separate studies to create conclusive generalisations (Hempel, 2020; Hartung *et al*., 2008). Widely adopted in scientific research, such as in information system research (Blut, 2021), this approach can be used to draw conclusions based on numerous studies that examine identical issues by correcting errors and biases and can reveal knowledge by investigating the characteristics of the individual studies, such as through sub-group analysis (Noel and Todd, 2012). As we aim to investigate the KMT–organizational performance relationship across empirical papers, a meta-analytic method was applied to synthesize previous scholarly findings. Group moderating tests were also used to explore whether the moderators are associated with the effect sizes in this study. As shown in Table I, this meta-analysis employs the seven stages proposed by Cooper (2017) to produce an unbiased description of the cumulative state of evidence on the proposed research questions in the research synthesis.

Table I: Research procedures

<Please insert Table I here>

3.2 Coding method of variables

3.2.1 Main study variables

KMT: The KMT measurements are interwoven in the following ways. The first focuses on applying IT to facilitate knowledge creation, acquisition, sharing, transferring, searching, retrieving, retention and application (Boumarafi and Jabnoun, 2008; Cohen and Olsen, 2015; Huang *et al*., 2010; Kamhawi, 2012; Kroh *et al*., 2018; Matin and Sabagh, 2015; Wang *et al*., 2007). The second emphasises IT for KM collaboration and communication in organizations (Chen *et al*., 2011; Choe, 2016; Hartono *et al*., 2016; Jain and Moreno, 2015; Kamath *et al*., 2016; Maiga *et al*., 2013; Mills and Smith, 2011; Payal *et al*., 2016). The third focuses on IT in learning, decision-making and problem-solving (Fong and Chen, 2012; Kraśnicka *et al*., 2018; Lee *et al*., 2012; Liang *et al*., 2013; Valdez-Juárez *et al*., 2018). The last addresses the adoption of IT tools and platforms to support KM (Chong *et al*., 2011; Li and Han, 2008; Mageswari *et al*., 2017; Migdadi, 2009). These measurements were coded as KMT because previous surveys used these items to gauge KMT.

Organizational performance: organizational performance was measured as follows: financial performance was coded as 'F', non-financial performance as 'NF' and overall organizational performance as 'OOP'.

3.2.2 Moderators

The moderators were coded following Liu *et al*. (2021), as discussed below.

National cultures: The seminal national cultural framework of Hofstede (2001; Hofstede *et al*., 2010) offers the best available model to understand and explain major differences in cross-cultural studies on managerial issues (Kirkman *et al*., 2006). Despite criticism

(Bearden *et al*., 2006; Minkov, 2018), Hofstede's national culture epistemology remains an effective framework for explaining the different characteristics between national cultures (Kaba and Osei-Bryson, 2013), particularly in quantitative studies (Beugelsdijk et al., 2017; Beugelsdijk *et al*., 2015), e.g., Liu *et al*. (2021). Therefore, we adopt the model to examine the impacts of national cultural features on KMT–organizational performance relationships.

Six dimensions of the national culture framework by Hofstede *et al*. (2010) – namely, power distance (PD), individualism versus collectivism (IC), masculinity versus femininity (MF), uncertainty avoidance (UA), long-term orientation versus short-term orientation (LS) and indulgence versus restrained (IR) culture – were used to code. The coding was based on threshold values, comprising the values closest to the mean of each cultural dimension of the regions (Liu *et al*., 2021). For instance, the mean value of IC is 38.62, therefore, 38 is chosen as the threshold value for IC classifications. If the value is less than (or equal to) 38, the region was coded as "C", indicating it is a collective society, otherwise, the region was coded as "I", indicating it is an individualistic society. Other features of national culture were coded in the same way (Detailed classifications, see Appendix B)

Economies: Economy was coded as 'developing versus transition versus developed' based on the countries or regions where the surveys were conducted. The codification of

the economy followed the *World Economic Situation and Prospects 2018* published by the United Nations (2018)[1].

Industry: Three main types of industries in the selected previous research were identified and coded as 'manufacturing', 'service' and 'multiple', which are composed of observations across different industries including both service and manufacturing.

3.3 Searching the literature

3.3.1 Searching strategy

To address the research questions, the Scopus database was adopted to search empirical papers because (1) more KM-relevant journals are covered in this database than others, e.g., Web of Science and (2) Scopus also provides a user-friendly interface for selecting studies (e.g., retaining lists of selected studies, showing search results year by year). Paper selection standards are crucial when implementing meta-analysis (Cooper, 1998). In this study, *knowledge management* and *performance* were adopted to retrieve studies from 1975 to 2018 containing these words in the title, abstract or keywords. These terms were used, first, because we wanted to obtain as many studies as possible in the KM discipline, second, because the name of KMT varies from study to study and, third, because using *information technology* as a search term produced excessive irrelevant papers.

3.3.2 Selection procedure exclusion criteria

[1] According to United Nations (2018), the classification is based on geographical location or on ad hoc criteria. More details can be found on page 139, *World Economic Situation and Prospects 2018*.

After filtering 32,496 papers in the Scopus database, 40 studies concerning KMT and organizational performance were chosen for information coding. Detailed selection procedures and criteria can be found in Table II.

Table II: Selection procedures & criteria

<Please insert Table II here>

3.4 Coding process

The authors carried out rounds of discussions on the data coding details, agreeing on the list of information items to code and the steps. In the first round, KMT, organizational performance were coded, including names of authors, effect size – correlation coefficients (other statistics were converted into correlation coefficients when applicable, see Appendix A for details), number of subjects, countries (regions) and types of industries of the sample selected and measurement of KMT and organizational performance. In the second round, the studies' quality was re-examined to evaluate whether they were qualified to incorporate in the meta-analysis (e.g., appropriateness of measurements and effect sizes). In the third round, values were assigned to each moderator. (See Appendix B for final coding details.)

4. Empirical results and explanations

To answer the first research question, as shown in Table III, the empirical results of this study demonstrated that KMT was positively related to OOP ($r_{KMT-OOP}$ = .440, 95% confidence interval (CI): .241, .604, *Z*-value = 4.077, p < .001), FP (r_{KMT-FP} = .366, 95% CI: .240, .481, *Z*-value = 5.403, p <.001) and NFP ($r_{KMT-NFP}$ = .442, 95% CI: .349, .527, *Z*-value = 8.442, p < .001). These findings are consistent with numerous other studies

linking KMT to organizational performance. Several factors can explain these findings based on our study. First, KMT facilitates organizations' knowledge flows (Lee et al., 2019) and KM activities, such as knowledge creation, acquisition, sharing (Nguyen et al., 2019), transferring, searching, retention and application (Gold et al., 2001; Lee and Lee, 2007). Second, KMT enables smooth communication and collaboration (Chen et al., 2011), helping employees obtain the necessary knowledge to handle their tasks more easily. Third, KMT can help organizations to solve complicated problems and support decision making (Kianto and Andreeva, 2014; Valdez-Juárez et al., 2018), by, for example, extracting knowledge using big data analytics. Overall, KMT improves organizations' capability to effectively and efficiently manage their intellectual resources, resulting in satisfying organizational performance.

Table III: Main effects of KMT– organizational performance relationships

<Please insert Table III here>

As for the second research question, none of the categorical comparisons of the national cultural dimensions were significant, suggesting that the benefits of KMT are universal across various national cultures. This observation may be explained as follows. As the internet, computers and smartphones have become popular worldwide, people are increasingly familiar with IT applications. These applications, particularly social media platforms, such as Facebook, Twitter and Tik Tok can be applied by many people, enabling them to communicate more easily, rapidly expand their social networks and obtain knowledge from multiple channels. Furthermore, the agility of KMT means they can be customised to any organization. Such customisation may weaken the negative effects of national culture on KMT implementation and payoffs.

For the third research question, as shown in Table IV, the KMT–FP relationship was stronger in developing economies ($r_{developed}$ =.224***< $r_{developing}$ = .442***) than in developed economies. This may be because IT development is not evenly balanced between developed and developing economies as most state-of-the-art technologies were invented, developed and applied in developed economies. As the application of KMT is normal for firms in developed economies, it becomes difficult to achieve extra benefits in a context of homogeneous technical resources. In contrast, many KMT approaches are still new in developing countries. Following a resource-based view, a rarity of capabilities and resources translates to competitive advantages across firms. Therefore, in developing economies, KMT may exert a rarity-based advantage over competitors that do not possess them. (As shown in Appendix E, the tests for KMT–NFP relationship and KMT–OOP relationship were insignificant).

Table IV: Categorical moderator test of economies (KMT–FP relationship)

<Please insert Table IV here>

For the last research question, categorical comparisons in different industries for KMT–organizational performance relationships were insignificant (see Appendix E), suggesting that KMT are equally beneficial in service and manufacturing industries. These findings may be due to the wide applications of KMT in all industries, which provide value for them. Such wide applications of KMT may not produce different rarity-based advantages between them.

5. Discussion

5.1 Theoretical contributions

The present study contributes to several streams of literature. First, this is the first meta-analytic study that examined the KMT–organizational performance relationships, which expands the research of Inkinen (2016) and Gupta and Chopra (2018) by providing specific effect sizes of the examined relationships. Second, it advances ~~information~~ IT and KM literatures by clarifying the critical role of KMT in organizational performance through strong empirical evidence based on a large number of datasets (5,260 subjects in 20 studies for the KMT–OOP relationship, 3,046 subjects in 14 studies for the KMT–FP relationship, and 3,747 subjects in 19 studies for the KMT–NFP relationship). By conducting a meta-analysis of KMT–performance relationships, called for in several recent studies (Liu *et al*., 2020; Liu *et al*., 2021, 2022c), this paper enables a deeper and more integrated understanding of how KM practices affect organizational performance. ~~Second~~Third, this paper enriches recent research discussions concerning the macro- and meso-level contextuality of knowledge-related issues in organizations (Andreeva *et al*., 2021; Tsui *et al*., 2016). It empirically demonstrates that the benefits of KMT are universal across different national cultures and industries, although firms in developing economies can gain more competitive advantages by adopting KMT than those in developed economies. Hence, this work provides valuable insights into the contributions of KMT in different contexts.

5.2 Practical implications

The findings can help practitioners implement KMT in several ways. First, organizations should continuously invest in, and encourage employees to use, tools and systems premised on KMT (G. Liu *et al*., 2020). Second, they should provide KMT for collaboration and communication, such as instant messaging systems and teleconference systems

(e.g. Zoom); this provision has become especially important with the global spread of Covid-19. Third, relevant training programmes should be provided to help employees apply KMT. Fourth, IT talent (Bennett and Hall, 2020) should be fostered to help organizations deal with any potential problems with KMT applications. Finally, the findings seem to suggest that managers might ignore the impacts of national culture on KMT deployment; however, practitioners should consider KMT in different cultural backgrounds. For specific cases, it is still recommended that practitioners should systematically evaluate the trade-off between KMT and the impacts of national culture. The findings also highlight the clear usefulness of KMT in different economies. For instance, practitioners in developing economies should adopt more KMT in their organizations, while practitioners in developed economies should embark on more advanced KMT, such as 5G, big data analytics, artificial intelligence, and machine learning. Though the differences between service and manufacturing industries were insignificant, it does not mean the KMT can be used without considering the actual requirements of a firm in a specific industry. Managers still need to maximize their KMT solutions based on their business needs to help their organization to achieve competitive advantages

5.3 Limitations and future directions

Despite the contributions of this study, it has some limitations. First, only papers in English written from 1975 to 2018 and found in the Scopus database were selected. Therefore, the results may be limited by language and database biases, though such biases were negligible according to the study of Livingston *et al.* (2008). Second, Minkov (2018) claims that Hofstede's national culture dimensions, which we adopted to examine the moderating

influence of national culture on KMT– organizational performance relationships, do not reflect the current situation. Therefore, monumentalism versus flexibility (Minkov *et al*., 2018), a recently developed national culture value, could be adopted into the research model. Future studies could also apply other national culture classifications, such as the cultural values of the global leadership and organizational behavior effectiveness (GLOBE) project (Dorfman *et al*., 2012), to analyze the moderating effects of national culture. Third, coded industries were divided into only two general categories, with the effect sizes based on service and manufacturing industries being compared. Future meta-analysis could compare the differences between KMT–organizational performance relationships in specific industries, such as electronic appliance manufacturers versus insurance companies. Fourth, the application of advanced technologies, such as artificial intelligence, big data analytics and machine learning for KM and their benefits merit further investigations. Finally, as this study adopted only KMT and organizational performance as its primary variables, future studies can encompass more variables, such as organizational learning, KM activities, innovation, team/project performance and employee job performance, into their research models. More moderators, such as size of organizations, respondent type, and publication type may be included in the future research as well.

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Appendices

Appendix A: Effect size transformation

Please refer to Appendix B of Liu et al. (2021a)

Appendix B: Descriptive statistics

Table BI: Coding details and descriptive statistics (KMT–OOP relationship)

<Please insert Table BI here>

Table BII: Coding details and descriptive statistics (KMT–FP relationship)

<Please insert Table BII here>

Table BIII: Coding details and descriptive statistics (KMT–NFP relationship)

<Please insert Table BIII here>

Appendix C: Publication bias test

Table CI: Publication bias analysis

<Please insert Table CI here>

Appendix D: Homogeneity test

Table DI: Homogeneity test

<Please insert Table DI here>

Appendix E: Moderating tests of contextual factors

Table EI: Moderating test of national culture (KMT–OOP relationship)

<Please insert Table EI here>

Table EII: Moderating test of national culture (KMT–FP relationship)

<Please insert Table EII here>

Table EIII: Moderating test of national culture (KMT–NFP relationship)

<Please insert Table EIII here>

Table EIV: Moderating test of economies (KMT–OOP relationship)

<Please insert Table EIV here>

Table EV: Moderating test of economies (KMT–NFP relationship)

<Please insert Table EV here>

Table EVI: Moderating test of industries[2] (KMT–OOP relationship)

<Please insert Table EVI here>

Table EVII: Moderating test of industries (KMT–FP relationship)

<Please insert Table EVII here>

Table EVIII: Moderating test of industries (KMT–NFP relationship)

<Please insert Table EVIII here>

[2] Multiple industries include of both manufacturing and service aspects for which scholars have collected data. Therefore, it is difficult to compare the service and manufacturing industries, so the studies that collected data from multiple industries were excluded in the categorical analysis concerning industries.

Tables

Table Ⅰ: Research procedures

Number	Steps	Corresponding section	Detailed step in present study
1	Formulating problem	Sections 2 & 3.2	**Variable definition and targeted relationships:** *Primary variables:* KMT, organizational performance (FP, NFP and OOP) *Moderators*: national culture, economy and industry *Relationship*: KMT–organizational performance, effects of contextual factors on KMT–organizational performance relationships
2	Locating literature	Section 3.3	**Sources**: Scopus database **Terms**: knowledge management, performance
3	Selecting information	Section 3.4	**Data collection items:** *Study information*: author, year, effect size, sample size, KMT measurement, organizational performance measurement, country(region) and industry
4	Assess quality of studies	Section 3.4	**Effect size selection criteria**: (a) Studies report correlation coefficient or other statistic values that can be used to calculate correlation coefficient; or (b) studies applied surveys to collect data and test KMT–organizational performance relationships
5	Analysing and integrating study outcomes	Section 4	**Estimation method**: A random-effects model was used to calculate main effects; sub-group analysis was adopted to test moderating effects; Failsafe *N* was used to test publication bias; I^2 was used to examine homogeneity.
6	Explaining findings	Section 5	Discussing the cumulative empirical evidence in terms of its strength, generality and limitations
7	Showing results	Whole paper	Presenting the findings

Table Ⅱ: Selection procedures & criteria

Step	No. of studies remaining	Selection procedures & criteria
1	32,496	Search *knowledge management* and *performance* as keywords in the Scopus database from 1975–2018
2	31,526	Excluded 970 studies not in English
3	24,663	Limited discipline to computer science, engineering, social science, business management and accounting, decision science, psychology,economics, econometrics and finance, arts and humanities and multidisciplinary
4	1,474	Removed 23,189 studies not on topic after examining abstract and titles year by year
5	1,338	Removed 136 unobtainable studies
6	1,344	Added 6 studies by snowballing from references lists
7	978	Removed 366 studies not on topic
8	838	Removed 140 qualitative studies
9	836	Removed 2 studies in other languages
10	672	Removed 164 studies without presenting correlation coefficient (or other statistics that can be applied to calculate correlation coefficient)

Step	No. of studies remaining	Selection procedures & criteria
11	499	Removed 173 studies outside variable measurement
12	456	Removed 43 studies measuring KM as an overall variable
13	448	Removed 8 studies reporting sub-variable correlations
14	446	Removed 2 studies reporting wrong correlations
15	444	Removed 2 duplicated studies
16	410	Removed 34 studies with unwanted methods, e.g., simulation
17	408	Removed 2 studies without presenting measurement
18	386	Removed 22 literature review papers
19	307	Removed 79 studies on group performance
20	260	Removed 47 studies on personal performance
21	182	Removed 78 studies on KM and innovation performance
22	132	Removed 50 studies about KM activities and organizational performance
23	127	Removed 5 studies because of incomplete information
24	117	Removed 10 studies beyond scope of measurement
25	116[1]	Removed 1 study because of a duplicated effect size
26	40	Removed 76 studies concerning KM activities and other KM practices
Summary: 40 studies about KMT and organizational performance were investigated in this research		

Table III: Main effects of KMT–organizational performance relationships

Study	No. of studies	Total subjects	Effect size	95% CI		Two-tailed test	
				Lower limited	Upper limited	*Z*-value	*p*-value
KMT–OOP	20	5,260	.440	.241	.604	4.077	.000
KMT–FP	15	3,046	.366	.240	.481	5.403	.000
KMT–NFP	19	3,747	.442	.349	.527	8.442	.000

Table IV: Categorical moderator test of economies (KMT–FP relationship)

Economies	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Developed economies	5	.224	.129	.315	4.535	.000
Developing economies	7	.442	.240	.607	4.045	.000
Total between	$Q_{between}$: 3.726; df(Q):1; *p*-value: .054* < .1					

Note: Kianto and Andreeva (2014) was excluded because the data were collected in Finland, Russia and China

[1] Among these 116 studies, KFOC–organizational performance relationship was examined in 56, KM leadership–organisational performance in 22, strategic KM–organisational performance in 14, knowledge codification strategy–organisational performance in 14, knowledge personalisation strategy–organisational performance in 12, KMT–organisational performance in 40, and organisational learning–organisational performance in 45.

Table BI: Coding details and descriptive statistics (KMT–OOP relationship)

SN	Study name	Effect size	Sample size	Region	PD	IC	MF	UA	LS	IR	Economy	Industry
1	Boumarafi and Jabnoun, 2008-OOP	.256	89	UAE	L	C	M	S	NA	NA	Developing	Multiple
2	Chen et al., 2011-OOP	.787	556	China	L	C	M	W	L	R	Developing	Service
3	Choe, 2016-OOP	.472	117	Korea	S	C	F	S	L	R	Developing	Manufacturing
4	Chuang et al., 2013-OOP	.435	119	Taiwan (China)	S	C	F	S	L	I	Developing	Manufacturing
5	Fong and Chen, 2012-OOP	.270	149	China	L	C	M	W	L	R	Developing	Service
6	Huang et al., 2010-OOP	.680	170	Taiwan (China)	S	C	F	S	L	I	Developing	Manufacturing
7	Jain and Moreno, 2015-OOP	.500	205	India	L	I	M	W	L	R	Developing	Manufacturing
8	Kamath et al., 2016-OOP	.450	249	India	L	I	M	W	L	R	Developing	Manufacturing
9	Kamhawi, 2012-OOP	.310	167	Bahraini	NA	NA	NA	NA	NA	NA	Developing	Multiple
10	Kroh et al., 2018-OOP	.260	116	Germany and Austria	S	I	M	S	L	NA	Developed	Multiple
11	Li and Han, 2008-OOP	-.160	126	China	L	C	M	W	L	R	Developing	Multiple
12	Lin et al., 2009-OOP	.459	236	China	L	C	M	W	L	R	Developing	Multiple
13	Mageswari et al., 2017-OOP	.122	251	Malaysia	L	C	M	W	S	I	Developing	Manufacturing
14	Matin and Sabagh, 2015-OOP	-.100	148	Iran	S	I	F	W	S	R	Developing	Unclear
15	Migdadi, 2009-OOP	.963	418	Saudi Arabia	L	C	M	S	S	I	Developing	Unclear
16	Payal et al. 2016-OOP	.355	100	India	L	I	M	W	L	R	Developing	Service
17	Pee et al., 2010-OOP	.320	101	Singapore	L	C	M	W	L	R	Developing	Service

SN	Study name	Effect size	Sample size	Region	PD	IC	MF	UA	LS	IR	Economy	Industry
18	Samson et al., 2017-OOP	.546	1,597	Australia	S	I	M	W	S	I	Developed	Multiple
19	Wang et al., 2007-OOP	.260	113	Taiwan (China)	S	C	F	S	L	I	Developing	Manufacturing
20	Wong and Wong, 2011-OOP	.415	233	Malaysia	L	C	M	W	S	I	Developing	Manufacturing

Note: [1]Respondents of Kamhawi (2012)'s study were from Bahrain where Hofstede national culture scores are not available. [2] Boumarafi and Jabnoun (2008)'s study was carried out in the UAE in which scores of indulgence and long-term orientation are not obtainable while [3]Kroh et al. (2018) sampled their study in Germany and Austria where degree of indulgence is different. Therefore, unavailable classifications of national culture dimensions were abstained when moderating effects of these dimensions of national culture were tested.[4] The study of Matin and Sabagh (2015) and Migdadi, (2009) did not specify the industries in which they collected data; in hence, these two studies were dropped when categorical moderating effect of industry was analyzed. PD: power distance, IC: individualism versus collectivism, MF: masculinity versus femininity, UA: uncertainty avoidance, LS: long-term orientation versus short-term orientation, IR: indulgent versus restrained culture; S of PD denotes small power distance regions; L denotes large power distance regions; I of IC denotes individualistic regions; C denotes collective regions; M denotes masculine regions; F denotes feminine regions; W denotes weak uncertainty avoidance regions; S of UA denotes strong uncertainty avoidance regions; S of LS denotes short-term oriented regions; L denotes long-term oriented regions; I of IR denotes indulgent regions; R denotes restrained regions.

Table BII: Coding details and descriptive statistics (KMT–FP relationship)

SN	Study name	Effect size	Sample size	Region	PD	IC	MF	UA	LS	IR	Economy	Industry
1	Chen and Liang, 2011-F	.490	97	Taiwan (China)	S	C	F	S	L	I	Developing	Multiple
2	Chen et al., 2008-F	.640	150	Taiwan (China)	S	C	F	S	L	I	Developing	Manufacturing
3	Cohen and Olsen, 2015-F	.410	112	South Africa	S	I	M	W	S	I	Developing	Service
4	Hartono et al., 2016-F	.270	117	Indonesia	L	C	F	W	L	R	Developing	Service
5	Inkinen and Kianto, 2014-F	.193	261	Finland	S	I	F	W	S	I	Developed	Multiple
6	Kianto and Andreeva, 2014-P-F [1]	.424	86	Finland, China, Russia	NA	NA	NA	NA	NA	NA	NA	Manufacturing
7	Kianto and Andreeva, 2014-S-F [1]	.435	61	Finland, China, Russia	NA	NA	NA	NA	NA	NA	NA	Service
8	Kianto et al., 2013-F	.078	399	Finland	S	I	F	W	S	I	Developed	Multiple
9	Kraśnicka et al., 2018-F	.255	301	Poland	L	I	M	S	S	R	Developed	Multiple

SN	Study name	Effect size	Sample size	Region	PD	IC	MF	UA	LS	IR	Economy	Industry
10	Lee and Lee, 2007-F	.399	215	Korea	S	C	F	S	L	R	Developing	Multiple
11	Maiga et al., 2013-F	.300	598	US	S	I	M	W	S	I	Developed	Manufacturing
12	Roldán et al., 2014-F	.331	82	Spain	S	I	F	S	L	R	Developed	Multiple
13	Shih et al., 2009-F	.032	155	Taiwan (China)	S	C	F	S	L	I	Developing	Manufacturing
14	Valdez-Juárez et al., 2018-F	.687	412	Mexico	L	C	M	S	S	I	Developing	Multiple

Note: [1] The data in Kianto and Andreeva (2014)'s study was from Finland, China and Russia where national cultures and economies are different. Therefore, this study was dropped out when moderating effects of national culture and economy were examined. PD: power distance, IC: individualism versus collectivism, MF: masculinity versus femininity, UA: uncertainty avoidance, LS: long-term orientation versus short-term orientation, IR: indulgent versus restrained culture; S of PD denotes small power distance regions; L denotes large power distance regions; I of IC denotes individualistic regions; C denotes collective regions; M denotes masculine regions; F denotes feminine regions; W denotes weak uncertainty avoidance regions; S of UA denotes strong uncertainty avoidance regions; S of LS denotes short-term oriented regions; L denotes long-term oriented regions; I of IR denotes indulgent regions; R denotes restrained regions.

Table BIII: Coding details and descriptive statistics (KMT–NFP relationship)

SN	Study name	Effect size	Sample size	Region	PD	IC	MF	UA	LS	IR	Economy	Industry
1	Boumarafi and Jabnoun, 2008-NF [1]	.530	89	UAE	L	C	M	S	NA	NA	Developing	Multiple
2	Chen and Liang, 2011-NF	.575	97	Taiwan (China)	S	C	F	S	L	I	Developing	Multiple
3	Chong et al., 2011-NF [4]	.206	203	Malaysia	L	C	M	W	S	I	Developing	Government
4	Chuang et al., 2013-NF	.366	119	Taiwan (China)	S	C	F	S	L	I	Developing	Manufacturing
5	Cohen and Olsen, 2015-NF	.228	112	South Africa	S	I	M	W	S	I	Developing	Service
6	Huang et al., 2010-NF	.250	170	Taiwan (China)	S	C	F	S	L	I	Developing	Manufacturing
7	Kianto and Andreeva, 2014-P-NF [2]	.425	175	Finland, China, Russia	NA	NA	NA	NA	NA	NA	NA	Manufacturing
8	Kianto and Andreeva, 2014-S-NF [2]	.347	120	Finland, China, Russia	NA	NA	NA	NA	NA	NA	NA	Service
9	Kim and Hancer, 2010-NF	.440	179	US	S	I	M	W	S	I	Developed	Service
10	Lee and Lee, 2007-NF	.456	215	Korea	S	C	F	S	L	R	Developing	Multiple

SN	Study name	Effect size	Sample size	Region	PD	IC	MF	UA	LS	IR	Economy	Industry
11	Lee et al., 2012-NF	.508	105	Korea	S	C	F	S	L	R	Developing	Multiple
12	Liang et al., 2013-NF [3]	.743	213	Taiwan (China), Japan	S	NA	NA	S	L	NA	NA	Unclear
13	Mageswari et al., 2017-NF	.075	251	Malaysia	L	C	M	W	S	I	Developing	Manufacturing
14	Maiga et al., 2013-NF	.374	598	US	S	I	M	W	S	I	Developed	Manufacturing
15	Mills and Smith, 2011-NF [1]	.576	189	Jamaica	S	I	M	W	NA	NA	Developing	Multiple
16	Shih et al., 2009-NF	.249	155	Taiwan (China)	S	C	F	S	L	I	Developing	Manufacturing
17	Sucahyo et al. 2016-NF	.386	139	Indonesia	L	C	F	W	L	R	Developing	Multiple
18	Tan and Wong, 2015-NF	.722	206	Malaysia	L	C	M	W	S	I	Developing	Manufacturing
19	Valdez-Juárez et al., 2018-NF	.605	412	Mexico	L	C	M	S	S	I	Developing	Multiple

Note: [1] Boumarafi and Jabnoun (2008) as well as Mills and Smith (2011) selected data in the UAE and Jamaica, respectively. The score of the long-term and the score of indulgence are unavailable in these two nations. Therefore, these two studies were left out when moderating impacts of the long-term orientation and indulgence were examined. [2] Kianto and Andreeva (2014) conducted surveys in Finland, China and Russia, but these three countries are inconsistent regarding national culture and economic status. Therefore, this study was excluded when the moderating impacts of national culture and economy were investigated. [3] Liang et al. (2013) sampled in Taiwan (China) and Japan, but individualism, masculinity and indulgence are not in the same group of these two regions. Thus, this study was also exluded when moderating effects of individualism, masculinity and indulgence were tested. [4] Chong et al. (2011) conducted their surveys in a department of Ministry of Finance, Malaysia. [3] Liang et al (2013) did not clearly report industries of data selection. Thus, these two studies were deleted when moderating impacts of industries was tested. PD: power distance, IC: individualism versus collectivism, MF: masculinity versus femininity, UA: uncertainty avoidance, LS: long-term orientation versus short-term orientation, IR: indulgent versus restrained culture; S of PD denotes small power distance regions; L denotes large power distance regions; I of IC denotes individualistic regions; C denotes collective regions; M denotes masculine regions; F denotes feminine regions; W denotes weak uncertainty avoidance regions; S of UA denotes strong uncertainty avoidance regions; S of LS denotes short-term oriented regions; L denotes long-term oriented regions; I of IR denotes indulgent regions; R denotes restrained regions.

Table CI: Publication bias analysis

Studies	Failsafe N	k	N/5k+10	Result
KMT–OOP	6,832	20	62.109	No publication bias
KMT–FP	1,371	14	17.138	No publication bias
KMT–NFP	3,871	19	36.867	No publication bias

Table DI: Homogeneity test

Studies	No. of studies	Heterogeneity				Tau-square				Result
		Q	df(Q)	*p*	I^2	τ^2	SE	δ^2	τ	
KMT–OOP	20	1243.845	19	.000	98.472	.262	.124	.015	.512	Heterogenous
KMT–FP	14	183.932	13	.000	92.932	.064	.032	.001	.253	Heterogenous
KMT–NFP	19	202.343	18	.000	91.104	.054	.022	.000	.232	Heterogenous

Appendix E: Moderating tests of contextual factors

Table EI: Moderating test of national culture (KMT–OOP relationship)

National culture dimension	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Power distance (L)	12	.478	.146	.714	2.727	.006
Power distance (S)	7	.389	.196	.553	3.795	.000
Total between	$Q_{between}$: .250; df(Q):1; p-value: .617					
Collectivism (C)	13	.487	.169	.714	2.882	.004
Individualism (I)	6	.354	.167	.518	3.587	.000
Total between	$Q_{between}$: .585; df(Q):1; p-value: .444					
Femininity (F)	5	.376	.071	.617	2.387	.017
Masculinity (M)	14	.470	.220	.662	3.490	.001
Total between	$Q_{between}$: .272; df(Q):1; p-value: .602					
Uncertainty avoidance (S)	7	.577	.031	.858	2.058	.040
Uncertainty avoidance (W)	12	.362	.187	.514	3.907	.000
Total between	$Q_{between}$: .698; df(Q):1; p-value: .404					
Long-term orientation (L)	13	.419	.247	.565	4.517	.000
Short-term orientation (S)	5	.547	-.050	.856	1.813	.070
Total between	$Q_{between}$: .227; df(Q):1; p-value: .634					
Indulgence (I)	7	.589	.184	.823	2.703	.007
Restrained (R)	10	.367	.126	.568	2.920	.004
Total between	$Q_{between}$: 1.060; df(Q):1; p-value: .303					

Note: [1] Kamhawi (2012) was excluded; [2] Boumarafi and Jabnoun (2008) was excluded; [3] Kroh *et al.*, (2018) was excluded.

Table EII: Moderating test of national culture (KMT–FP relationship)

National culture dimension	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Power distance (L)	3	.433	.041	.709	2.149	.032
Power distance (S)	9	.327	.197	.445	4.774	.000

National culture dimension	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Total between	$Q_{between}$: .299; df(Q):1; *p*-value: .585					
Collectivism (C)	6	.447	.215	.631	3.587	.000
Individualism (I)	6	.250	.156	.340	5.090	.000
Total between	$Q_{between}$: 2.477; df(Q):1; p-value: .116					
Femininity (F)	8	.315	.155	.459	3.759	.000
Masculinity (M)	4	.432	.169	638	3.107	.002
Total between	$Q_{between}$: .632; df(Q):1; *p*-value: .427					
Uncertainty avoidance (S)	7	.429	.221	.599	3.838	.000
Uncertainty avoidance (W)	5	.243	.130	.350	4.139	.000
Total between	$Q_{between}$: 2.482; df(Q):1; *p*-value: .115					
Long-term orientation (L)	6	.375	.185	.538	3.732	.000
Short-term orientation (S)	6	.339	.120	.527	2.976	.003
Total between	$Q_{between}$: .068; df(Q):1; *p*-value: .794					
Indulgence (I)	8	.377	.175	.549	3.536	.000
Restrained (R)	4	.312	.236	.384	7.722	.000
Total between	$Q_{between}$: .382; df(Q):1; *p*-value: .537					

Note: [1] Kianto and Andreeva (2014) was excluded

Table EIII: Moderating test of national culture (KMT–NFP relationship)

National culture dimension	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Power distance (L)	6	.448	.209	.636	3.506	.000
Power distance (S)	11	.449	.340	.546	7.345	.000
Total between	$Q_{between}$: .000; df(Q):1; *p*-value: .990					
Collectivism (C)	12	.427	.296	.543	5.897	.000
Individualism (I)	4	.416	.286	.532	5.828	.000
Total between	$Q_{between}$: .015; df(Q):1; *p*-value: .904					
Femininity (F)	7	.399	.305	.485	7.729	.000
Masculinity (M)	9	.439	.289	.569	5.300	.000
Total between	$Q_{between}$: .221; df(Q):1; *p*-value: .638					
Uncertainty avoidance (S)	9	.493	.365	.603	6.696	.000
Uncertainty avoidance (W)	8	.397	.235	.537	4.565	.000
Total between	$Q_{between}$: .967; df(Q):1; *p*-value: .326					
Long-term orientation (L)	8	.459	.307	.588	5.425	.000
Short-term orientation (S)	7	.405	.218	.563	4.050	.000
Total between	$Q_{between}$: .225; df(Q):1; p-value: .635					
Indulgence (I)	11	.391	.256	.511	5.361	.000
Restrained (R)	3	.448	.371	.518	10.222	.000
Total between	$Q_{between}$:.574; df(Q):1; *p*-value: .449					

Note: [1] Boumarafi and Jabnoun (2008), Mills and Smith (2011), [2] Kianto and Andreeva (2014), and [3] Liang *et al*. (2013) were excluded.

Table EIV: Moderating test of economies (KMT–OOP relationship)

Economies	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Developed economies	2	.423	.112	.658	2.610	.009
Developing economies	18	.442	.192	.639	3.317	.001
Total between	$Q_{between}$: .011; df(Q):1; *p*-value: .915					

Table EV: Moderating test of economies (KMT–NFP relationship)

Economies	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Developed economies	2	.390	.328	.448	11.420	.000
Developing economies	14	.426	.309	.531	6.542	.000
Total between	$Q_{between}$: .319; df(Q):1; *p*-value: .572					

Note: [2] Kianto and Andreeva (2014) and [3] Liang et al. (2013) were excluded.

Table EVI: Moderating test of industries[2] (KMT–OOP relationship)

Industry type	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Manufacturing	8	.429	.300	.543	6.010	.000
Service	4	.474	.042	.756	2.135	.033
Total between	$Q_{between}$:.050 ; df(Q):1; *p*-value: .824					

Note: [4] Matin and Sabagh (2015) and Migdadi, (2009) were excluded

Table EVII: Moderating test of industries (KMT–FP relationship)

Industry type	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Manufacturing	4	.367	.115	.575	2.803	.005
Service	3	.361	.255	.458	6.328	.000
Total between	$Q_{between}$: .003; df(Q):1; *p*-value: .959					

Table EVIII: Moderating test of industries (KMT–NFP relationship)

Industry type	No. of studies	Effect size	95% CI		Two-tailed test	
			Lower limited	Upper limited	*Z*-value	*p*-value
Manufacturing	7	.371	.197	.523	4.007	.000
Service	3	.350	.223	.465	5.170	.000
Total between	$Q_{between}$:.043; df(Q):1; *p*-value: .836					

Note: Liang et al., (2013), Chong et al. (2011), and Sucahyo et al. (2016) were excluded.

[2] Multiple industries include of both manufacturing and service aspects for which scholars have collected data. Therefore, it is difficult to compare the service and manufacturing industries, so the studies that collected data from multiple industries were excluded in the categorical analysis concerning industries.