Promoting uncommon use of knowledge in information system departments

The role of human resource management practices

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Abstract

Purpose – The purpose of this paper is to gain a clear understanding of the impact of uncommon use of knowledge (adaptation and augmentation) on the performance of information systems (IS) departments, and to explore the effects of human-resources management (HRM) practices on uncommon use of knowledge.

Design/methodology/approach – A questionnaire-based survey was used to measure the constructs of the research model. A survey package was delivered to project managers or team leads and 133 responses were returned.

Findings – The empirical results indicate that knowledge adaptation has a significant effect on departmental performance, whereas knowledge augmentation is more important to innovation than to routine departmental performance. The results also show that, while knowledge adaptation can be enhanced by communication and an uncertainty-avoidance culture, knowledge augmentation is an outcome of shared decision-making, the use of teams, and innovation-based policies.

Research limitations/implications – Given the positive impact of uncommon use of knowledge on IS department performance, future research should explore other factors besides HRM practices to boost it.

Practical implications – The results can serve as guidance for managers looking to select HRM practices to promote uncommon use of knowledge.

Originality/value – This study introduces knowledge adaptation and knowledge augmentation as the component processes of uncommon use of knowledge to the IS discipline, and empirically validates the antecedents and consequences of uncommon use of knowledge using survey data.

Keywords Partial least squares, IS performance, Management practices, Knowledge-based theory

Paper type Research paper

Introduction

The work of information systems (IS) departments, including planning, systems development, and supporting business operations, is knowledge-intensive and requires both business and technological knowledge, as well as both internal and external expertise. IS departments' performance, in particular, is related to the extent to which they can acquire, store, retrieve and apply knowledge effectively (Gold *et al.*, 2001; Lee and Choi, 2003). According to the resource-based view (RBV) (Barney, 1991; Wernerfelt, 1984), strategic value and competitive

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advantage lie in the management and use of knowledge (Grant, 1996). As a result, superior performance by an IS department rests in its timely and efficient application and blending of multiple knowledge resources in distinct processes (Tesch *et al.*, 2009).

However, IS departments face a range of new challenging problems that cannot necessarily be overcome using solutions based on applying accumulated experience in traditional ways. Knowledge-management researchers have suggested that solving these intractable problems will require executives to use existing knowledge in novel ways, by slightly twisting it or analogizing from other areas (Nag and Gioia, 2012). The present study endorses Nag and Gioia's (2012) proposition that there are two types of uncommon use of knowledge: adaptation and augmentation. The first refers to applying knowledge to modify and improve specific operational activities, whereas the second is defined as criticizing what is known in order to generate new understandings that can aid problem-solving. Using knowledge in novel ways is critically important in a turbulent environment (Nag and Gioia, 2012), and RBV holds that the superior performance of IS departments in terms of efficiency and innovation will yield competitive advantages for their firms.

In IS contexts, there has been extensive research on knowledge management and its components, including knowledge sharing (Chang *et al.*, 2013; Park and Lee, 2014), knowledge transfer (Hsu *et al.*, 2014; Teo and Bhattacherjee, 2014), knowledge integration (Alavi and Tiwana, 2002; Patnayakuni *et al.*, 2007), the use of information technology (IT) to support knowledge management and storage (Addas and Pinsonneault, 2016), among others. The rapid proliferation of IT including clouds and a range of other knowledge-management tools makes it easy to preserve and access vital knowledge. But how can IS departments help their firms to create unique value when their rivals can also access the same information? Previous studies on IS knowledge management have only focused on how to effectively and apply knowledge stored in knowledge-management systems or absorbed from external sources (Alavi and Leidner, 2001; Roberts *et al.*, 2012), i.e., common use of knowledge. The present work, in contrast, proposes that IS departments need to use knowledge in new ways to improve systems-development processes and create innovative IS, i.e., engage in uncommon use of knowledge. Consequently, our first research question is:

RQ1. How does uncommon use of knowledge impact the outcomes of IS departments' routine performance and innovation?

Because some vital knowledge is generated by employees, human capital has long been identified as a strategic resource. However, the micro-foundations of RBV, i.e., how strategic resources develop and create strategic value, have been in a black box (Foss, 2011). The micro-foundations of the knowledge-based view (KBV) are somewhat different: namely, how to motivate the production of knowledge to achieve common goals and provide strategic value to firms. According to the human-resources management (HRM) literature, human resources practices are viewed as an intervention aimed at stimulating desired employee behaviors, and have been found effective in doing so (Bowen and Ostroff, 2004). Effective HRM practices can also foster innovation and improve a firm's ability to sustain its competitive advantage (Beugelsdijk, 2008). We suggest that HRM practices can motivate IS personnel to use knowledge uncommonly. Therefore, our second research question is:

RQ2. What HRM practices can enhance the performance of IS departments by promoting their uncommon use of knowledge?

It is hoped that, in answering the above research questions, this study will make an important contribution to the knowledge-management literature – by highlighting the importance of uncommon use of knowledge, and illustrating ways to enhance it – and to the HRM literature, by demonstrating how effective HRM practices can indirectly enhance unit performance by promoting uncommon use of knowledge. As such, this paper fills a gap in

the literature on HRM practices, which has rarely examined the context of IS departments. Some past studies have identified the importance of HRM practices to firms, and some others have looked at how IS departments contribute to their firms' competitive advantage through generating new knowledge, but questions of how HRM practices affect IS departments' generation, and use of knowledge remain unanswered. Therefore, we attempt to conduct an exploratory study and find out the effects of HRM practices on uncommon use of knowledge.

This paper is organized as follows. In the second section, we review the relevant literature and flesh out the concepts of uncommon use of knowledge and HRM practices. The third section describes our proposed research framework and hypothesis development. The fourth section describes our methods of data collection and examination of the proposed model. The fifth section presents our analysis results, and the sixth and final section comprises a discussion of the findings' implications, along with our conclusions.

Literature review

IS Departments' routine performance vs innovative performance

As firms face intense competition, globalization, and market turbulence, their ability to detect and respond to market opportunities quickly and innovatively is a critical factor in their success (Frambach and Schillewaert, 2002). When firm senses a market opportunity, modern IT enables it to marshal its knowledge and assets to empower its business functions, shape new business strategies, enhance customer relationships, and extend its network (Sambamurthy *et al.*, 2003). Prior research has confirmed that IT investment is beneficial to firms' performance and productivity (Bharadwaj, 2000).

IS departments' performance can be subdivided into routine and innovative performance. The former refers to information quality and the efficiency of IS planning, development, and operation (Saunders and Jones, 1992). Meanwhile, every IS department is also responsible for diffusing IS innovation quickly to enable the business side to respond effectively to market changes. Consequently, IS department's performance is also measured in terms of its implementation of new technologies, its adoption of new methodologies for system development, and its development of new IS to support business operations (Mustonen-Ollila and Lyytinen, 2003; Swanson, 1994).

Outstanding performance by an IS department rests upon effective management of knowledge flows between business users and IS personnel, among IS personnel, and between internal and external experts. Past studies have examined the role of IT in enabling enterprises to respond efficiently and effectively to turbulent markets (Chen *et al.*, 2014; Chen *et al.*, 2015; Overby *et al.*, 2006; Schryen, 2013). These studies found that IT extends the reach and richness of firms' knowledge and processes, allowing IS departments to sense and respond to external turbulence. Therefore, determining how an IS department can best manage knowledge and enable its use in processes is widely seen as critical to a firm's success.

Knowledge as a strategic resource and uncommon use of knowledge

Building on RBV, KBV holds that having the knowledge and knowing how to use it constitute a distinct, unique resource for creating a sustainable competitive advantage (Kogut and Zander, 1992) that is difficult for competitors to imitate and acquire (Barney, 1991). For decades, the critical role of knowledge within the original RBV paradigm has attracted considerable scholarly attention, in multiple areas including strategic management and IS research (e.g. Bassellier *et al.*, 2001; Felin and Hesterly, 2007; Kearns and Sabherwal, 2007; Mao *et al.*, 2016). In the management literature, Kogut and Zander (1992) argued that a firm's knowledge supports its competitive performance because organizations have the combinative capability to synthesize and apply current and acquired knowledge. In the IS

field, the importance of business and technological knowledge has been widely recognized (Bassellier *et al.*, 2001; Tiwana *et al.*, 2003). Insufficient knowledge has been identified as a critical problem in IS development (Sakthivel, 2007). Specifically, IS department performance suffers when a required capability cannot be supplied due to a lack of sufficient knowledge resources (Nelson and Cooprider, 1996).

The knowledge-management literature has emphasized the effective acquisition, storage, and retrieval of knowledge (Alavi and Leidner, 2001; Cohen and Levinthal, 1990; Tsai, 2001). IS personnel often seek knowledge outside their firms, regarding market needs, regulatory constraints, competitive environment, and so forth (Henderson, 1990). Knowledge integration understood as absorbing knowledge from external sources and blending it with existing technical and business knowledge, is a crucial antecedent of firms' IS development capability (Tiwana *et al.*, 2003). However, many companies take no interest in generating new knowledge, focusing, instead, on following past patterns and procedures and maintaining the status quo, even when more efficient options are available (Nag and Gioia, 2012). Highlighting the drawbacks of solely using common knowledge in a turbulent environment, Nag and Gioia (2012, p. 447) criticize such a strategy as a failure to pursue "uncommon knowledge." Common use of knowledge might be sufficient to manage daily operations or to counter routine problems. However, the exposure to new information is infrequent and passive, firms are likely to be incapable of developing better strategies than their competitors. It is reasonable to expect that those firms that do not support uncommon use of knowledge are not willing to change (Nag and Gioia, 2012).

Firms should transform common knowledge into distinctive, uncommon knowledge as a means of achieving competitive advantage in a turbulent environment (Nag and Gioia, 2012). The originators of the uncommon use of knowledge concept divide its use into two modes: knowledge adaptation and knowledge augmentation. The first one, knowledge adaptation, comprises utilization of existing knowledge to arrive at modifications or improvements of specific operational activities; i.e., it emphasizes "tweaking" the knowledge one already possesses to create better solutions to particular problems, control costs, or achieve operational efficiency, as opposed to making dramatic changes. Knowledge augmentation, on the other hand, involves the uncommon use of knowledge to encourage members of a firm to reflect upon, criticize, and question what they have known, and to generate new understandings, to solve problems that in some cases have not arisen yet (Nag and Gioia, 2012). As such, knowledge augmentation does not focus on any particular issue, but rather on the establishment of principles for enhancing the understanding of problems. Executives who embrace knowledge augmentation believe that new technical knowledge guides them to unique insights that support their firms' competitiveness (Nag and Gioia, 2012, p. 439).

Nag and Gioia mention that adaptation and augmentation are related to March's (1991) concepts of knowledge exploitation and exploration, respectively. Like adaptation, the essence of exploitation is to refine and extend current capabilities (March, 1991). Exploitation may improve the efficiency and reliability of existing activities, but it is unlikely to lead to radical innovation (Atuahene-Gima, 2005). In contrast, exploration aims to acquire new knowledge and experiment with new alternatives and may result in radical innovation and create a competitive advantage over the long term (Jansen *et al.*, 2006).

Nevertheless, it can be argued that knowledge exploration and knowledge augmentation are fundamentally different. Gupta *et al.* (2006) have pointed out that the definitions and scopes of exploration and exploitation are ambiguous. Several studies regard exploration and exploitation as constituting the learning process (e.g. Benner and Tushman, 2003; Yan *et al.*, 2016). March (1991) defined exploratory learning as "experimentation with new opportunities that are uncertain, distant, and often negative," and exploitative learning as "the refinement and extension of existing competencies, technologies, and paradigms that

are predictable, proximate, and positive." The concepts of exploratory and exploitative learning have been adopted in a variety of organizational contexts. For example, Uotila *et al.* (2009) analyzed the respective influences of exploration and exploitation on the market values of S&P 500 corporations. Exploratory and exploitative learning have also been found to have performance impacts in the spheres of both product development and mature product-line projects (Brady and Davies, 2004; Hoang and Rothaermel, 2010).

On the other hand, some studies have interpreted exploration and exploitation as within-firm outcomes (e.g. Phelps, 2010; Wang *et al.*, 2014). The question of how firms can strike a balance between exploration and exploitation, for example, has been discussed widely (Benner and Tushman, 2003; He and Wong, 2004; Raisch *et al.*, 2009). But uncommon use of knowledge focuses on the micro-processes that lead to innovative outcomes; and as such, knowledge adaptation and augmentation are not just interchangeable terms for knowledge exploration and exploitation (Nag and Gioia, 2012). Instead, uncommon use of knowledge should be considered as the precise processes that can improve organizations' performance indices.

Furthermore, although Nag and Gioia (2012) draw an analogy between uncommon use of knowledge and the concept of exploitation and exploration, they argue that these two concepts are not exactly the same, which is also adopted in this study. Uncommon use of knowledge (knowledge adaptation and augmentation) goes beyond utilizing existing knowledge in known ways, calling new insights, understanding and the generation of principles for future action. On the contrary, no matter refining existing knowledge or experimenting with new possibilities, exploitation and exploration focus on known knowledge (e.g. refining current knowledge) and using knowledge commonly (e.g. obtaining unknown knowledge from external and utilizing it as others do). Exploitation focuses on applying existing knowledge to modify current procedures to improve efficiency while exploration focuses on acquiring new knowledge to generate new methods and replace existing ones. In contrast, knowledge adaptation underlines on tweaking existing knowledge to create better solution and knowledge augmentation emphasizes on reflecting what the organization has known to generate new insights toward the future and deal with problems that may not have arisen. We, therefore, consider exploration/exploitation as a similar but different concept from uncommon use of knowledge.

To sum up, the findings of the IS literature imply that IS departments need to use existing or acquired knowledge uncommonly to improve the development process and create innovative systems that will ultimately have positive impacts on their firms' success. However, employee behaviors – including using knowledge uncommonly – are partially determined by organizations' internal policies. HRM practices have been found effective in fostering knowledge-sharing and enhancing knowledge flows within organizations (Cabrera and Cabrera, 2005; Minbaeva *et al.*, 2009). Thus, our research will also explore the antecedents of knowledge adaptation and knowledge augmentation from an HRM perspective.

HRM practices

The increasingly knowledge-intensive nature of work highlights the importance of human capital: the skills and abilities of the individuals and the stock of knowledge within an organization (Cabrera and Cabrera, 2005). Human capital has been viewed as a type of strategic resource that provides a competitive advantage to firms because it is valuable, unique, inimitable and non-substitutable (Crook *et al.*, 2011; Hitt *et al.*, 2001). Based on a meta-analysis, Crook *et al.* (2011) recommended that managers invest in programs that increase and retain their firms' human capital, since it is strongly related to firm performance, and especially so when human capital cannot be traded in the market.

While human capital itself is a strategic resource, HRM practices – i.e., the tools that firms use to manage human capital – can stimulate employees' behaviors consistent with strategies. HRM practices are a source of competitive advantage insofar as they develop a highly skilled and highly motivated workforce (Lado and Wilson, 1994; Wright *et al.*, 2001). IT departments invest in recruiting highly talented staff that constitute highly skilled human-resource pools. Additionally, IT departments need to motivate their members to focus on knowledge-based value creation and production. The key role of motivation to joint production in a KBV context has been emphasized by Foss (2011): if such motivation is strong, an organization's members generate shared representations of actions and tasks to achieve its common goals, and this has a positive impact on work productivity and innovative performance.

Wright *et al.* (2001) suggested that a firm can elicit desired employee behaviors through HRM practices. IT departments should utilize HRM practices aimed at assessing and enhancing both employees' skills and their motivation to generate valuable, unique, inimitable and sustainable resources because doing so will lead to high departmental performance. Employees should also be rewarded, to sustain their motivation toward participating in certain activities; and HRM practices that include appropriate reward systems can serve as a signal for employees to interpret their organization's climate (Schneider and Barbera, 2014).

Effective HRM practices maintain a human-capital pool with high levels of skill and motivation, which in turn constitutes a basis of competitive advantage. Empirical studies have confirmed their positive impact on organizational performance (e.g. Becker and Huselid, 2006; Collins and Clark, 2003) and innovative outcomes (e.g. Beugelsdijk, 2008; Oke *et al.*, 2012). Effective HRM practices can also increase employee learning, as well as facilitate and encourage the transfer and sharing of knowledge (Cabrera and Cabrera, 2005; Wright *et al.*, 2001). Recently, many studies have attempted to unlock the black box that is said to lie between HRM practices and firms' performance. For example, Jiang *et al.* (2012) proposed that human-resources systems influence operational and financial outcomes through human capital and employee motivation. Ployhart and Moliterno (2011) suggested that organizational-level HRM practices shape individuals' knowledge, skills, and abilities, and transform them into unit-level outcomes (such as sustainable competitive advantage). Barrick *et al.* (2015), meanwhile, proposed that collective organizational engagement acts as a mediator of the relationship between organizational practices (including HRM practices, among others) and organizational performance.

Wright *et al.* (2001) proposed a model of the fundamental strategic HRM components that are most likely to help firms sustain their competitive advantage. The people-management practices in their model include both the traditional human-resources functions (staffing, training, rewards, appraisal, recognition) and strategies that have an impact on shaping employees' competencies, cognition, and attitudes (work design, participation, communication). Cabrera and Cabrera (2005) followed Wright *et al.*'s lead, summarizing the people-management practices that can foster knowledge-sharing. Specifically, they proposed that organizations can facilitate and encourage knowledge-sharing via people-management practices including work design, staffing, training/development, performance appraisal, compensation/rewards, organizational culture and technology. Human-resources practices ideally aim at developing employees' skills, fostering and increasing their motivation, and encouraging them to participate (Wright and Boswell, 2002). The HRM practices that past studies have proposed are listed in Table I. From these frameworks, the current study identifies the five key HRM practices of IT departments, which can be divided into three dimensions: motivation (innovation-based policies and uncertainty-avoidance culture), empowerment (shared decision-making), and employee learning (teamwork design and communication). This study excludes the technology category used in Cabrera and

Table I. HRM practices from literature

Study	Selected HRM practices							
Wright *et al.* (2001)	Staffing	Training	Rewards	Appraisal		Participation	Work design	Communication
Yahya and Goh (2002)		Training	Reward and compensation	Performance appraisal		Decision-making		
Cabrera and Cabrera (2005)	Staffing	Training and development	Compensation and rewards	Performance appraisal	Culture		Work design	
Evans and Davis (2005)	Staffing	Training	Compensation			Decentralized decision making	Self-managed teams	Communication
Ngo *et al.* (2008)	Selection and recruitment	Training	Compensation	Performance appraisal				
Beugelsdijk (2008)	Recruitment	Training and education	Performance-based pay			Job autonomy	Task rotation	
Chen and Huang (2009)	Staffing	Training	Compensation	Performance appraisal		Participation		
This study	HRM Practices	Innovation-based policies			Culture-uncertainty avoidance	Shared decision-making	Teamwork design	Communication
	Dimension	Motivation				Empowerment	Employee learning	

Cabrera's (2005) study from its set of key HRM practices, due to our tighter focus on firms' IT infrastructure. These five practices have been selected because of their effects on the knowledge-management process, including knowledge-sharing, knowledge-creation and knowledge-use. We argue that each practice addresses a separate, vital aspect of the knowledge-management process: work design and communication help employees learn, and increase the firm's repository of knowledge; innovation-based policies and culture stimulate IS personnel to create new knowledge, and shared decision-making empowers employees to turn new ideas into tangible outcomes.

The HRM practices aimed at fostering motivation can be divided into two general types: innovation-based policies and an uncertainty-avoidance culture. The first refers to the extent to which a firm adopts policies that facilitate employee-generated innovation, including recruitment/staffing processes, training/development programs, compensation, rewards and recognition systems (Oke *et al.*, 2012). Maurer (2010) found that stable project staffing and objective project rewards gave rise to team members' trust, which in turn enhanced knowledge acquisition, thus promoting product innovation. Appropriate team training, meanwhile, enables members to learn optimal team task-analysis tools and relevant information delivery methods, as well as how knowledge, skills, and attitudes should be exchanged, which potentially enhances team performance (Salas *et al.*, 2008).

An uncertainty-avoidance culture is one whose members seek orderliness, consistency and structure (Javidan *et al.*, 2005). A member of a culture that ranks high on the uncertainty-avoidance scale tends to prefer organized, formal and structured forms of communication while a member of a culture in which uncertainty-avoidance is low is more likely to use informal, unplanned and unstructured communication. This cultural difference plays a significant role in knowledge transfer in global projects (Javidan *et al.*, 2005). Regarding such culture influences on IS planning and implementation decisions, low uncertainty-avoidance cultures tend to embrace new ideas and changes more positively. Hwang (2005) found that the uncertainty-avoidance culture was a useful informal control mechanism to ensure commitment and communication among the stakeholders in an ERP implementation project. Keil *et al.* (2000) found that software-project leaders from a low uncertainty-avoidance culture tended to be comfortable with ambiguous situations and to have a high propensity for being able to deal with unknown risks. Additionally, high uncertainty-avoidance behavior can be manifested at the individual level: as demands for detailed and precise information, as well as strict adherence to rules and agreed strategies (Im *et al.*, 2011).

Shared decision-making, an HRM practice aimed at empowering employees, refers to seeking team members' input in making decisions (Patnayakuni *et al.*, 2007). The relevant literature suggests that participation in decision-making is critical to a team's ability to transform new ideas and knowledge into innovative outcomes. For example, De Dreu and West (2001) found that participation and minority dissent have an interactive effect on innovation in teams. And for Carbonell and Rodriguez-Escudero (2013), shared decision-making served as a critical moderator in the relationships between management controls and the role expectations of new-product development teams.

As noted above, teamwork design and communication are the two HRM practices we classify as employee learning. In the context of the current research, teamwork design refers to the use of teams to perform IS development activities (Patnayakuni *et al.*, 2007), which has been shown to facilitate the integration of individuals' knowledge into projects (Okhuysen and Eisenhardt, 2002). Communication, meanwhile, is defined as human interaction via conversation and the use of body language and deemed fundamental to encourage knowledge transfer (Smith and Rupp, 2002). Within the literature on HRM practices, Evans and Davis (2005) proposed that open communication is a vital characteristic of a high-performance work system: influencing the relationships among employees and ultimately,

organizational performance. The literature also suggested the importance of regular information-sharing communication as an aspect of high-performance HRM practice (Kehoe and Wright, 2013). Past studies identified communication as one of the critical success factors for software-development projects (Wagstrom *et al.*, 2010), ERP implementation projects (Ko *et al.*, 2005) and knowledge sharing within teams (De Vries *et al.*, 2006).

The proposed framework

IS departments employ a variety of management practices during software-development projects, IS planning, and daily operations in support of business strategy (Acuna *et al.*, 2006). Systems that include multiple HRM practices are ambiguous, socially complex and historically evolved (Wright *et al.*, 2001). They can be considered critical resources that allow organizations to perform tasks in ways that differ from the practices of their rivals, and to develop unique people competencies that are aligned with their business strategies (Barney and Wright, 1998). We propose that effective HRM practices in IS departments shape their employees' behaviors, beliefs and attitudes in ways that facilitate uncommon use of knowledge, and this leads to superior departmental performance. The present study proposes that, by fostering uncommon use of knowledge, IS departments can achieve better routine performance as well as the creation of innovative solutions. Our research model is shown in Figure 1.

Hypothesis development

From uncommon use of knowledge to outcomes

IS personnel draw on their existing knowledge, skills, and experience to determine what needs to be done to solve problems, meet business needs, and support their firms' strategic changes (Aladwani, 2002). However, IS departments' efficiency is unlikely to be improved if the solutions and routines they identify are merely applied repetitively. As discussed above, knowledge adaptation is defined as an ability to use existing knowledge to modify and improve specific operational activities, thus improving operational efficiency (Barney and Wright, 1998; Nag and Gioia, 2012). Accordingly, we hypothesize:

H1. Knowledge adaptation will have a positive impact on the routine performance of an IS department.

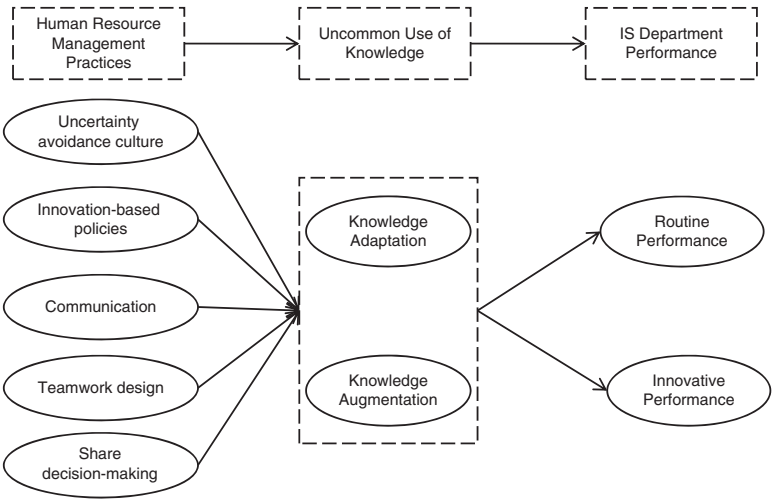


Figure 1.
Research model

Knowledge augmentation, as we have seen, mainly involves assessing external knowledge and challenging existing ideas using innovative concepts. Past studies have revealed that team in a creative environment are more willing to try novel things and connect ideas from different areas (Gilson and Shalley, 2004), and innovative solutions are associated with higher performance (Gilson *et al.*, 2005). Therefore, we propose:

H2a. Knowledge augmentation will have a positive impact on the routine performance of an IS department.

Knowledge adaptation alone is insufficient for the generation of novel solutions and new approaches. Innovation emerges from those process-management activities that significantly depart from current technological or market competencies of the organization's industry (Benner and Tushman, 2003). The pursuit of learning outside the existing knowledge pool leads to new insights and fosters the variation and novelty that radical innovation requires (Kang and Snell, 2009). In the knowledge-augmentation process, IS personnel go beyond what is known, developing unique insights and applying them to the solution of future problems, and thereby meeting changing user needs more efficiently. In an innovation-oriented environment, IS personnel are willing to adapt to new technologies and diffuse innovation to other departments of their organization. Therefore, we propose:

H2b. Knowledge augmentation will have a positive impact on the innovative performance of an IS department.

From human resource management practices to uncommon use of knowledge

As discussed above, members of a workplace culture marked by high uncertainty avoidance will tend to focus on standardized processes and structures, detailed routines, budgets, and rules, and to reinforce efficient coordination by establishing rooted patterns of interdependence and behavior (Kang and Snell, 2009; Shane *et al.*, 1995). Unsurprisingly, IS departments in high uncertainty-avoidance cultures invest considerable time and effort in planning and designing their processes and policies, and their personnel is expected to follow clear norms and standard operational procedures intended to mitigate risks (Javidan *et al.*, 2005). In other words, IS employees in such cultures are not usually allowed to question existing knowledge and are unlikely to transcend an established mind-set. Instead, they concentrate on refining and improving existing processes and routines. As the IS department improves routines, which it repeats, it becomes more competent and efficient over time, but variations in its outcomes decrease (March, 1991). Therefore, we propose:

H3a. An uncertainty-avoidance culture will be positively correlated with knowledge adaptation.

On the other hand, in a low uncertainty-avoidance culture, people are more willing to break the rules and norms in the pursuit of innovation (Shane *et al.*, 1995). This loose connection to rules and preordained processes allows individuals and groups to experiment autonomously regarding the way they work. In contrast, this cannot happen when people adhere strictly to prescribed procedures or processes in detail (Kang and Snell, 2009). It has also been found that employees in a low uncertainty-avoidance culture are more willing to explore opportunities to adapt to change and to develop new ideas (Javidan *et al.*, 2005). Therefore, we propose:

H3b. An uncertainty-avoidance culture will be negatively correlated with knowledge augmentation.

Empirical studies have shown that innovation in firms is enhanced if "being innovative" is required for recruitment, compensation, and promotion of employees (Khazanchi *et al.*, 2007).

Innovation-based policies such as hiring creative employees and rewarding innovative initiatives allow organizational units to acquire pools of employees with the expertise to solve difficult problems and produce novel ideas (Seijts and Latham, 2005). When reward systems are innovation-based, employees are motivated to develop norms and goals that will improve their performance (Kang *et al.*, 2007); and such systems might even make IS personnel more willing to refine existing IS processes, rather than merely focusing on their duty to maintain the system. Therefore, we propose:

H4a. Innovation-based policies will be positively correlated with knowledge adaptation.

As well as facilitating innovation itself (Oke *et al.*, 2012), innovation-based HRM policies foster other aspects of a positive workplace climate, such as psychological safety, that inspire employees to learn and be innovative (Edmondson, 1999). In such an environment, employees are recognized for generating new ideas and breaking the rules (Khazanchi *et al.*, 2007) and rewarded for achieving innovative outcomes (Seijts and Latham, 2005). In the specific context of IS departments, a creative climate can be expected to give members more flexibility to try emerging technology. Therefore, we propose:

H4b. Innovation-based policies will be positively correlated with knowledge augmentation.

Communication can be classified into two types, formal and informal, with the first flowing through official meetings, manuals, sets of procedures, rulebooks, and the like (Mohr and Nevin, 1990). Informal communication, on the other hand, is based on social relationships among employees, which enable them to share work-relevant information and create collaboration opportunities outside of formal channels (Smith *et al.*, 1994). The communication capabilities of an organization's members will impact on their abilities to seek potential solutions and to match answers to problems (Goodman and Darr, 1998). In the present study, we primarily focus on informal communication among IS department members. Individuals who frequently communicate with others are more inclined to share knowledge than those who infrequently communicate (Reagans and McEvily, 2003). Frequent informal communication between department members enables them to learn from one another, to exchange task-relevant ideas and information, and to devise and assess alternative solutions to problems (Akgün *et al.*, 2006). Therefore, we propose:

H5a. Communication will be positively correlated with knowledge adaptation.

Through communication, the members of an IS department can also build a sharing atmosphere and express new ideas, thus increasing the quality of the knowledge they create (Patnayakuni *et al.*, 2007). Connectedness through communication increases opportunities for informal knowledge sharing by exhibiting individuals' knowledge (Atuahene-Gima, 2005; Jansen *et al.*, 2006). It allows people to combine unrelated matrices of knowledge in ways that are likely to encourage organizational learning (He and Wong, 2004; Ireland *et al.*, 2003). Communication among team members can prompt them to identify process-related problems and generate new ideas for solving them, through discussions, debates and conflicts that challenge current assumptions and renew knowledge, thereby improving how the team integrates acquired information into innovative solutions. Therefore, we propose:

H5b. Communication will be positively correlated with knowledge augmentation.

Teamwork is a process of integrating individual knowledge into a joint stock of knowledge and realizing the value of the combined knowledge (Okhuysen and Eisenhardt, 2002). Teamwork designs can provide members of a department with opportunities to work in close collaboration with others and expose them to a broad range of perspectives, skills and information that they may use to arrive at new views on their work (Tesluk *et al.*, 1997).

An IS development team usually includes members of multiple departments with diverse expertise, e.g., users, programmers and project managers. Consequently a wide range of viewpoints on the existing process and distinctive styles of decision-making and problem-solving lead to a comprehensive analysis of problems (Richard, 2000). Greater demographic diversity among its members can also enhance a team's capacity for creative problem solving (Reagans and Zuckerman, 2001). Therefore, we propose:

H6a. Teamwork design will be positively correlated with knowledge adaptation.

Unsurprisingly, the use of teams has been found to be positively related to firms' innovative performance (Laursen and Foss, 2003). Integrating the perspectives and skills of each team member into its collective knowledge boosts the team's creativity in the sphere of system development (Tiwana and Mclean, 2005). Exposure to a broad range of information and different perspectives enhances the creativity of individual team members (Kang *et al.*, 2007). Moreover, potential creativity can be increased through interactions with others and the resultant cross-fertilization of ideas (Perry-Smith and Shalley, 2003). Consequently, the use of teams can integrate the knowledge of team members to create value and innovation. Thus, we hypothesize:

H6b. Teamwork design will be positively correlated with knowledge augmentation.

Shared decision-making refers to organizational members collectively defining problems; seeking and sharing information, ideas, and viewpoints; planning the implementation of actions; and evaluating the results (Sagie and Koslowsky, 1999). It tends to make employees feel recognized and empowered to take on more responsibilities in pursuit of their organization's desired outcomes (Driscoll, 1978). When employees participate in shared decision-making, they actively engage in brainstorming and generating alternatives, and refine existing solutions and processes by selecting, implementing and evaluating these options (Harrison, 1985). Therefore, we propose:

H7a. Shared decision-making will be positively correlated with knowledge adaptation.

In the process of shared decision-making, team members strive to generate a comprehensive understanding of various perspectives for collective decisions and high team performance. This process encourages team members to understand others' expertise and share their knowledge as a means to expand their knowledge and acquire new skills (Patnayakuni *et al.*, 2007). Empowering department members to solve problems increases both the opportunity and the need for knowledge sharing (Srivastava *et al.*, 2006). It also increases team members' sense of involvement and commitment to innovating (Damanpour, 1991). In a decentralized organizational structure with a focus on employee empowerment, employees with more task autonomy and flexible working hours can generate more innovative outcomes (Beugelsdijk, 2008). According to Hurley and Hult (1998), when a team's members are encouraged to learn and to develop new ideas and are given opportunities to influence group decisions, that team becomes more innovative (see also Bligh *et al.*, 2006). Members with a high level of participative decision-making feel that they have the freedom to speak their minds about organizational activities (Hult *et al.*, 2000). Therefore, we propose:

H7b. Shared decision-making will be positively correlated with knowledge augmentation.

Research methods

Data collection

We conducted a survey of IS departments to test the proposed hypotheses empirically. IS departments are the appropriate target to test the model because of its unique features of operating in a turbulent environment and demanding uncommon use of knowledge in new

technology adoption or process refinement to overcome changing circumstances and create a competitive advantage for their organizations. The targeted respondents consisted of managers of IS departments who were members of the Information Management Association (IMA) in Taiwan. The IMA aims to enhance communication among IS professionals. More than 300 IMA members consist of many senior executives and managers of IS departments from major companies in Taiwan, as well as academia specializing in information management. Nearly half of the members work in manufacturing and information and communication technology (ICT) industries. It is consistent with the rapid growth of manufacturing and ICT sectors in Taiwan. We contacted all members of the IMA to explain the purpose of this study, solicit their participation, and ask them to list possible non-IMA-member participants working for their respective firms and organizations. A provisional list of 750 participants was created and survey packages were sent to each of them. We received 150 survey responses and removed 17 of them because of incomplete responses, a valid response rate of 17.7 percent. Table II provides detailed information on the sample's demographics.

To examine the potential issue of non-response bias, we followed Sivo *et al.* (2006) in comparing the demographic and response differences between early and late respondents. The results of this comparison revealed no significant differences between the two waves of respondents, indicating that response bias was not an issue.

Constructs and measurement

All constructs of our research model were measured with Likert scales, ranging from 1 (strongly disagree) to 7 (strongly agree). Since we garnered the mechanisms of uncommon use of knowledge from the qualitative interviews conducted by Nag and Gioia (2012), seven quantitative measurement items for those mechanisms, including four for knowledge adaptation and three for knowledge augmentation, were developed particularly for this study. However, other construct measures were based on those used in prior studies, as explained in more detail below.

Routine performance measures the efficiency of IS departments in developing and implementing IS projects, using five items adapted from Delone and Mclean (1992) and Ravichandran and Lertwongsatien (2005). Innovative performance, which refers to the extent of IS departments' innovative activities, was measured using four items

Variables	Categories	No.	%	Variables	Categories	No.	%
Industry type	Information Technology	47	35.3	No. of company employee	< 30	15	11.3
	Financial	2	1.5		30–50	7	5.3
	Manufacturing	39	29.3		50–100	11	8.3
	Service	8	6.0		100–500	26	19.5
	Medical	13	9.8		500–1,000	15	11.3
	Hospitality	1	0.8		1,000–5,000	26	19.5
	Retailing	1	0.8		> 5,000	33	24.8
	Government	10	7.5	No. of IS employee	< 5	21	15.8
	School	9	6.8		5–10	18	13.5
	Others	3	2.3		10–15	15	11.3
Position	Senior member	62	46.6		15–20	14	10.5
	Manager	20	15		20–50	14	10.5
	Senior manager	12	9		50–100	12	9
	Administrator	38	28.6		> 100	39	29.3
	Others	1	0.8				

Note: $n = 133$

Table II.
Sample demographics

adapted from existing survey instruments (Dyer and Song, 1997; Lichtenthaler, 2009; Song *et al.*, 2006).

We divided HRM practices into five constructs. Uncertainty avoidance, the extent to which the members of a culture feel threatened by uncertain or unknown situations and try to avoid them (Hofstede *et al.*, 1991), was measured using three items obtained from Hwang (2005). Innovation-based policies, including people-focused policies and recruitment, selection, and reward systems that foster the development of innovation, was measured using four items from Oke *et al.* (2012). Communication, the extent of informal interaction within IS departments and between IS and non-IS personnel within an organization, was measured using three items adapted from Patnayakuni *et al.* (2007). And work design (the use of teams for IS design activities) and shared decision-making (as more fully explained above) were each measured by three items adapted from Patnayakuni *et al.* (2007).

Since IT departments' routine performance and innovative performance are conceived of as consequences of uncommon use of knowledge, we controlled for firm size, industry type and IS department size.

Reliability and validity

To develop our measurement items for knowledge adaptation and knowledge augmentation, we first reviewed the relevant literature to establish these domains' backgrounds. After generating draft measurement instruments for each, we invited several scholars to evaluate them and conducted a pre-test and pilot test. Lastly, we evaluated the measurement model's item reliability, convergent validity and discriminant validity. Reliability was tested using composite reliability (CR), Cronbach's α, item-total correlation (ITC) and factor loading. The values of CR, Cronbach's α, and factor loadings should all exceed 0.7, and the ITC should not be lower than 0.3. Convergent validity was examined by CR and average variance extracted (AVE) for each construct (Fornell and Larcker, 1981). The value of AVE should be higher than 0.5. For discriminant validity, the correlation between construct pairs should be lower than 0.90, and the square root of AVE should be higher than the inter-construct correlation coefficients (Fornell and Larcker, 1981). As shown in Table III, all these value requirements were met. Table IV presents the descriptive statistics and relevant correlation information.

Common-method variance

Since we collected both the independent and dependent variables simultaneously from the same respondents, we needed to ensure that there was no significant method effect on the predefined causal relationship. Harman's single factor analysis showed that the variance explained by the first factor was 16.52. We also followed the approach recommended by Malhotra *et al.* (2006) for estimating the potential impact of common method variance (CMV). Since no significant difference was found between the original and adjusted correlation matrices, CMV is unlikely to be a problem in this study.

Multicollinearity

Multicollinearity is a phenomenon in which two or more predictors in a model are highly correlated. The variance inflation factor (VIF) provides information on the presence of multicollinearity, and the scores should remain below 3.3 (Kock and Lynn, 2012). In the case of our model, the values of VIF were less than 2.3 for all five independent variables, well within the acceptable range. A correlation coefficient magnitude of between 0.5 and 0.7 indicates that the variables moderately correlated, and a magnitude between 0.3 and 0.5 indicates low correlation (Hair *et al.*, 2010). Because the correlation coefficients shown in Table III are all below 0.7, the five independent variables used in this study are not highly correlated.

Constructs	Items	Loadings	ITC
Uncertainty avoidance culture α: 0.91; AVE: 0.84; CR: 0.94	It is important to have job requirements and instructions spelled out in detail so that employees always know what they are expected to do	0.930	0.828
	Rules and regulations are important because they inform employees what the organization expects of them	0.910	0.807
	Standard operating procedures are helpful to employees on the job	0.912	0.802
Communication α: 0.85; AVE: 0.76 ; CR: 0.91	There is extensive informal communication among IS employees at the same level	0.865	0.675
	There is extensive informal communication among IS employees at different levels	0.908	0.773
	There is extensive informal communication between IS employees and employees in other departments	0.848	0.691
Shared decision-making *α: 0.87*; AVE: 0.80; CR: 0.92	Participative decision-making is broadly used in these development projects	0.916	0.769
	Decision-making authority rests with managers, as opposed to development staff. (R)	0.878	0.744
	Joint-decision-making by managers and analysts/ programmers is the norm in our ISD	0.884	0.758
Teamwork design α: 0.78; AVE: 0.69 ; CR: 0.87	All projects are managed by autonomous teams	0.832	0.594
	System development is team-based	0.873	0.678
	Project team performance is evaluated, rather than individual performance	0.794	0.576
Innovation-based policies *α:* 0.94; AVE: 0.80; CR: 0.95	Our human resource policies support a culture of innovation	0.870	0.784
	The rewards and recognition systems encourage innovation	0.877	0.811
	Innovation is a key criterion in our recruitment and selection process	0.939	0.899
	Innovation forms part of our training and development programs	0.907	0.851
	Clear innovation targets are set for all employees	0.868	0.801
Knowledge augmentation α: 0.84; AVE: 0.76; CR: 0.91	We encourage everyone to question what they think they know, to generate new understanding	0.897	0.680
	We analyze problems to figure out how solutions apply to other problems	0.875	0.756
	We use new technical knowledge to find unique insights	0.844	0.690
Knowledge adaptation α: 0.78; AVE: 0.61; CR: 0.86	We are capable of refining and extending our existing knowledge and technologies to enhance the efficiency of the firm	0.743	0.476
	We usually change the operation processes (development, implementation, maintenance process) we use slightly to obtain better performance	0.870	0.694
	We regularly recombine and integrate existing technologies in new product or service processes	0.798	0.639
	Our innovation comes through small steps rather than giant leaps	0.691	0.542
Routine performance α: 0.92; AVE: 0.76 ; CR: 0.94	Information quality provided by our IT department has met our firm's objectives	0.865	0.772
	The quality of information system development or implementation by our IT department has met our firm's objectives	0.883	0.816
	The efficiency of developing or implementing an information system by our IT department has been successful	0.876	0.806
	The efficiency of introducing an information system by our IT department has been successful	0.855	0.786

(*continued*)

Table III.
The results of factor analysis

Constructs	Items	Loadings	ITC
Innovative performance α: 0.89; AVE: 0.76; CR: 0.93	The efficiency of maintaining an information system by our IT department has been successful	0.866	0.776
	The overall performance of developing an innovative information system program has met our objectives	0.819	0.703
	From an overall profitability standpoint, implementing a new information system program has been successful	0.888	0.779
	We successfully use an innovative method to plan and manage information systems and launch novel development processes	0.855	0.748
	We successfully use innovative information technology to support business operations	0.911	0.814

Table III.

Note: ITC, Item-total correlation

					Correlation matrix								
	Mean	Std	M3	M4	INN	IBP	SDM	PE	WD	AD	AUG	COM	UAC
INN	4.19	1.404	−0.291	−0.647	*0.87*								
IBP	4.21	1.370	−0.282	−0.253	0.56	*0.89*							
SDM	4.25	1.317	−0.308	−0.276	0.44	0.61	*0.89*						
PE	4.62	1.013	−0.590	0.412	0.54	0.35	0.26	*0.87*					
WD	4.83	1.250	−0.390	0.403	0.39	0.64	0.59	0.40	*0.83*				
AD	5.13	0.988	−0.213	−0.273	0.34	0.40	0.43	0.53	0.45	*0.78*			
AUG	4.34	1.224	−0.297	−0.049	0.63	0.65	0.57	0.42	0.57	0.53	*0.87*		
COM	4.71	1.205	−0.128	−0.325	0.36	0.65	0.55	0.46	0.59	0.55	0.48	*0.87*	
UAC	5.35	1.195	−0.634	0.607	0.24	0.43	0.40	0.37	0.54	0.59	0.36	0.57	*0.92*

Table IV.
Descriptive statics and correlation matrix

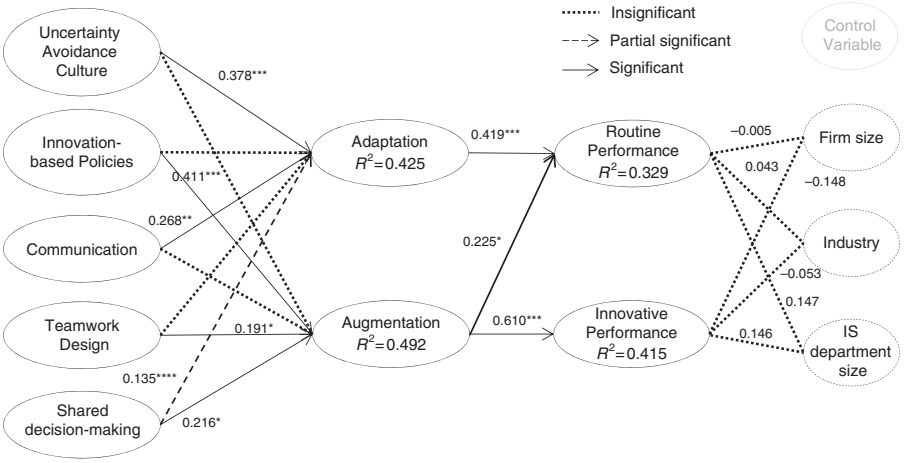
Notes: INN, Innovative performance; IBP, innovation-based policies; SDM, shared decision-making; PE, routine performance; WD, work design; AD, adaptation; AUG, augmentation; COM, communication; UAC, uncertainty avoidance culture; Std, standard deviation; M3, skewness; M4, kurtosis. The italic faced data on diagonal of the correlation matrix represent the squared roots of AVE

Results

We applied partial least squares regression with a bootstrapping technique to examine the proposed model (Chin, 1998). The test results are shown in Figure 2. The path coefficients from knowledge adaptation to routine performance, and from knowledge augmentation to routine performance and innovative performance, were both positive and significant ($\beta = 0.419$, $p < 0.001$; $\beta = 0.610$, $p < 0.001$; $\beta = 0.225$, $p < 0.05$). Therefore, *H1*, *H2a* and *H2b* are supported. Together, knowledge adaptation and knowledge augmentation explained 32.9 percent of the variance in routine performance, while the latter explained 41.5 percent of the variance of innovative performance.

The path coefficients from uncertainty avoidance and communication to knowledge adaptation were also positive and significant ($\beta = 0.378$, $p < 0.001$; $\beta = 0.268$, $p < 0.01$), indicating that an uncertainty-avoidance culture and communication both contribute to knowledge adaptation. The path coefficient from shared decision-making to knowledge adaptation was partially significant ($\beta = 0.135$, $p < 0.1$), while those from work design and innovation-based policies to knowledge adaptation were not significant ($\beta = 0.036$, $p > 0.1$; $\beta = -0.046$, $p > 0.1$). Thus, *H3a* and *H5a* are supported but *H4a*, *H6a* and *H7a* are not.

The path coefficients to knowledge augmentation from uncertainty avoidance and communication were not significant ($\beta = 0.009$, $p < 0.1$; $\beta = -0.023$, $p > 0.1$), but those from



Notes: *p<0.05; **p<0.01; ***p<0.001; ****p<0.1

Figure 2.
Results of hypotheses testing

shared decision-making, work design and innovation-based policies were all both positive and significant ($\beta = 0.216$, $p < 0.05$; $\beta = 0.191$, $p < 0.05$; $\beta = 0.411$, $p < 0.001$). Therefore, *H4b*, *H6b*, *H7b* are all supported, but *H3b* and *H5b* are not. The five HRM practices collectively explain 42.5 and 49.2 percent of the variance in knowledge adaptation and knowledge augmentation, respectively.

Discussion and conclusion

The objectives of the present study are: to examine the relationship of uncommon use of knowledge to IS departments' routine performance and innovative performance, which together represent such departments' overall performance; and to explore the factors that foster uncommon use of knowledge from an HRM perspective. Our empirical results indicate, first, that knowledge adaptation had a significant effect on both aspects of departmental performance, while knowledge augmentation was more critical to innovative performance than to routine performance. Our second key finding was that high uncertainty avoidance and high communication enhanced knowledge adaptation, while teamwork design and innovation-based policies were critical to promoting knowledge augmentation. We also found that shared decision-making was essential to both knowledge augmentation and knowledge adaptation, but much more critical to the former.

The positive impact of uncertainty avoidance on knowledge adaptation is in line with the prior findings by Erez and Nouri (2010), who argued that individuals in uncertainty-avoidance cultures focus on elaborating the usefulness and appropriateness of their ideas to the situation in order to reduce ambiguity, primarily when working on a well-defined task. Likewise, our finding that within-team communication significantly impacted knowledge adaptation is consistent with research by Akgün *et al.* (2014), who demonstrated the critical effects of communication on information acquisition, dissemination, and implementation, which in turn improved project outcomes. The impact of teamwork design on knowledge augmentation has been consistently identified in past studies (Hoegl and Parboteeah, 2007; Okhuysen and Eisenhardt, 2002; Tiwana and Mclean, 2005). Specifically, the use of teams gives people opportunities to become engaged, to communicate, to criticize and question what is known, and to integrate group

members' experience, insights, and skills to generate new ideas and solutions. Shared decision-making was also previously found to benefit the generation of novel approaches: with De Dreu and West (2001) suggesting that minority dissent in teams enhances creativity and divergent thinking, and is more likely to occur when members are highly active in decision-making.

On the other hand, some of our findings were inconsistent with our expectations. First, the empirical results show that communication had a limited effect on knowledge augmentation, but a relatively strong effect on knowledge adaptation. This finding may indicate that the generation of creative ideas based on frequent communication is a separate process from idea implementation, with the latter sometimes requiring the breaking or changing of current rules. Additionally, some studies have found a curvilinear effect of frequent communication on team creativity and performance (Leenders *et al.*, 2003; Patrashkova-Volzdoska *et al.*, 2003): i.e., high levels of communication and interaction can distract members from exploring possible solutions and choosing a novel and appropriate ones. The excessive use of IT can also cause communication overload (Karr-Wisniewski and Lu, 2010; Lee *et al.*, 2016).

Second, we found that teamwork design was not related to knowledge adaptation in a significant way. To help explain this finding, we re-examined the issue from a team-diversity perspective. If an IS development team is composed of members with different expertise, they can learn from each other to generate novel insights; but members' different viewpoints may also create divergence to the point that performance is inhibited. Both positive and adverse effects of team diversity have been found to be related to team outcomes (Horwitz and Horwitz, 2007; Van Knippenberg and Schippers, 2007), and diversity in job-tenure, attitude and experience may negatively affect problem-solving processes (Tsui and O'Reilly, 1989). And third, uncertainty avoidance was not found to impact knowledge augmentation significantly. We would suggest that the intensity of uncertainty-avoidance cultures may play a critical role in their effects on outcomes. Some prior studies have indicated that moderate levels of uncertainty avoidance may facilitate the implementation of innovative ideas because people with high levels of uncertainty avoidance tend to focus on precision and punctuality, which can facilitate the process of refining collected ideas (Hofstede and Hofstede, 2001; Rank *et al.*, 2004).

The pattern of differential effects of the five studied HRM practices on uncommon use of knowledge is well aligned with previous studies. For example, Jansen *et al.* (2006) found that centralization of decision-making negatively influenced a unit's exploratory innovation, and formalization (with clear rules, procedures, instructions, and communication) had a positive relationship on exploitative innovation. Similarly, Gabriel Cegarra-Navarro *et al.* (2011, p. 1099) noted that "adapting for tomorrow requires change, flexibility, and creativity," whereas "profits for today require order, control, and stability." Uncertainty-avoidance cultures lead their members to avoid dramatic changes and to make small, incremental ones instead. Frequent communication allows changes to occur naturally, rather than as sudden shocks to the system, and this facilitates the adaptation of existing processes. In contrast, innovation-based policies, teamwork design, and shared decision-making create opportunities for participation, the generation of new ideas, and making new changes happen; and thus, these practices contribute to the development of new directions for firms.

Some limitations of this study should be noted. First, the generalizability of the results might be limited due to the exclusively Taiwanese sample pool, and future studies may wish to verify the results using Western data. Second, we validated the proposed model through cross-sectional data. This study's primary purpose was to illustrate the potential impacts of HRM practices on uncommon use of knowledge. However, a certain level of

overlap among different HRM-practice components is possible: for example, shared decision-making may be a precondition of innovation-based policies, and communication may be enhanced when a teamwork structure is adopted. These questions cannot be answered using cross-sectional data. We, therefore, encourage future studies to answer these questions through the collection of longitudinal data. Additionally, the data we collected were all self-reported, and future studies should consider using third-party and other more objective forms of data to evaluate outcome variables such as the extent of routine performance and innovative performance. Third, the measurement items of the constructs in the model can be improved. This study explored the antecedents and outcomes of knowledge adaptation and augmentation and examined the model with empirical data. However, a compromise was made to keep the survey instrument at a manageable length. For example, the survey items covering communication mainly focused on quantity. Future studies are encouraged to validate and extend the current model by utilizing a more comprehensive survey instrument, especially the scale of knowledge adaptation and knowledge augmentation. Fourth, to maintain the parsimonious nature of our research model, we explored the antecedents of uncommon use of knowledge from an HRM-practice perspective only. Notably, the HRM practices included in this study may be applied to all departments within an organization, but it is possible that the relative importance of each practice might differ from one department to another. For a specific department, specific HRM practices might also play a role in enhancing or blocking uncommon use of knowledge. Accordingly, future studies are encouraged to verify not only the impacts of the proposed variables but other possible factors, on non-IS departments. Also, we also believe that exploring factors other than HRM practices might help researchers learn how to boost uncommon use of knowledge, given its positive impact on IS performance. For example, a leader may play a critical role in coaching subordinates in how to use knowledge (Nag and Gioia, 2012). Therefore, future studies are encouraged to explore the impacts of leader-related factors, including executive knowledge schemes or scanning tendencies, on knowledge-use behaviors. And fifth, our study only included five traditional HRM practices, derived from the prior literature, but other, more nuanced HRM-practice frameworks probably can and should be devised.

Implications for academia

Nag and Gioia (2012) proposed the concept and illustrated it with several empirical cases. The present study has introduced the two modes of uncommon use of knowledge into the discipline of IS and empirically validated its antecedents and consequences using survey data. We first showed that knowledge augmentation had a positive impact on both routine performance and, albeit to a lesser extent, on innovative performance. This result implies that being able to apply known methods to solving unknown problems, or to adapt solutions from one type of problem to a different kind, are critical aspects of IS departments' status as innovative. We measured being innovative according to the extent to which IS departments can introduce new technologies or systems to support business goals. The linkage we found between augmentation and innovative performance highlights how vital it is for employees to question what they think they know, to apply known methods to new types of problems, and to play with new techniques to gain new insights.

On the other hand, we found that system-development performance was associated with both knowledge augmentation and knowledge adaptation. In the latter case, the ability to refine an existing process, enhance current approaches to system development, and put together different parts to form a new whole enables IS departments to align with firms' strategies and create high-quality systems. And, even though IS development performance

is only somewhat associated with augmentation, it is still noticeable that performance can be enhanced when employees understand what is known and apply adapted solutions to solve new problems.

Besides showing the effect of uncommon use of knowledge on IS-department outcomes, we explored possible ways to increase such use from an HRM perspective. The empirical results demonstrated that knowledge adaptation and knowledge augmentation are essential mediators of the relationships between HRM practices and IS department's routine and innovative performance. Specifically, the empirical results showed that knowledge adaptation can be enhanced by uncertainty avoidance and that communication and augmentation can be boosted by shared decision-making, the use of teams, and innovation-based policies. These results confirm that HRM practices can lead to better outcomes through promoting uncommon use of knowledge, and goes some way to explaining why such practices can boost innovative performance and improve routine performance.

Implications for practitioners

Our results confirm that uncommon use of knowledge is positively associated with IS departments' performance. While such performance, in general, is related to both knowledge adaptation and knowledge augmentation, innovative performance, in particular, is associated with knowledge augmentation only. This result implies that organizations should emphasize both types of uncommon use of knowledge if improving system-development performance is their goal, but focus more narrowly on augmentation when their objective is the introduction into the organization of innovative technologies.

More importantly, this study identifies possible ways to promote knowledge adaptation and augmentation from an HRM perspective. Based on our results, we recommend that managers of IS departments choose the HRM practices that are most appropriate to promoting uncommon use of knowledge. To increase knowledge adaptation, managers should foster an uncertainty-avoidance culture and encourage informal communication among their employees. The former will require policies that are crystal clear and well-defined procedures for accomplishing tasks. These aspects are vital because the adaptation-style uncommon use of knowledge mostly focuses on refining current ways of doing things. The likelihood of refinement being achieved is small if there is uncertainty regarding any of the steps needed to accomplish each task. Promoting informal communication between different sub-units within IS departments, meanwhile, allows their members to exchange thoughts or confirm ideas about how best to refine their routines.

To boost augmentation-style uncommon use of knowledge, on the other hand, managers can empower their employees by engaging them in the decision-making process; forming teams with diverse expertise to promote the exchange of ideas; and constructing policies to encourage innovative performance. In contrast to systems that limit decision-making to management or committees, those that allow their members to engage in such a process allow a much broader range of different ideas to be considered. Shared decision-making also promotes employees' sense of ownership, which in turn drives them to take responsibility for figuring out better ways to achieve high performance. While team-based structures have been shown to facilitate the exchange of ideas, managers should pay careful attention to selecting members with diverse knowledge, and perform team-building activities to ensure that members of the team can work together with high levels of effectiveness and enjoy the benefits of teamwork. Finally, managers should provide rewards that promote uncommon use of knowledge and offer training that will encourage their team members to think differently.

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