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Pathways to individual performance: Examining the interplay between knowledge bases and repository kms use

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ABSTRACT

The aims of this study are to gain further insight into the contingent performance effects of repository knowledge management systems (KMS) use. While prior research has laid the foundations, a nuanced understanding of the interplay between the individual's personal and social knowledge bases and KMS usage behaviors is missing. Drawing from prior information systems literature, we identify two components of KMS use, usage frequency and usage intensity. We examine the influence of knowledge bases on individual performance, and the moderating influence of the usage behaviors. We test the hypothesized research model on usage and performance data from 18,219 real estate agents. We find support for different pathways to individual performance based on configurations of knowledge bases and usage behavior. Overall, the study provides an integrated view of the interplay between the three constituents of technology-based learning – cognition, behavior, and performance.

Knowledge has been recognized as a key resource that impacts an organization's competitiveness [2]. Organizations, therefore, continue to invest in a broad range of knowledge management systems (KMS) specially purposed for the transfer of reusable knowledge assets [1,59]. In particular, this study focuses on the most common form of KMS [6, 28], repository KMS. A repository KMS is a structured collection of documents storing organizational knowledge such that they can be accessed by organizational members[1] [1,5,60]. Repository KMS use is a specific form of behavior of the individual directed toward acquiring knowledge encapsulated as electronic documents from the knowledge repository.[2] A burgeoning stream of empirical literature has begun to explore the consequences of repository KMS use [20,32,34,35,72]. Prior research has found that repository KMS accelerate the speed with which knowledge is acquired and disseminated to organizational members [34, 35], and thus serve as a particularly effective intraorganizational learning mechanism [23,30,74].

Despite the progress made by prior literature, there are two crucial gaps that limit our understanding of KMS use and its impact on performance. First, individuals are required to evaluate the usefulness of knowledge that comes in from the KMS and in doing so, they draw on their personal knowledge and knowledge from social ties. Prior studies have examined personal knowledge [14,24,35], while fewer have examined social knowledge [20,34]. Yet, no research to date has explored both their impact on KMS use. Second, existing studies have tended to conceptualize user behavior as implicitly unidimensional, which focuses exclusively on a single component. This lack of granularity is further reflected in the operationalization of constructs, whereby studies measure one form of behavior while the others are ignored. The lack of acknowledgement of usage components hinders progress, as we are unable to build a collective tradition across studies as warned by Burton-Jones & Straub [12]. The two gaps foretell a greater cleavage in the literature on KMS, as one centered either on behaviorism or on cognitivism (Ertmer & Newby, 1993). On the one side, some have tried to explain the behaviors directed toward the KMS using theoretical lenses (e.g., task-technology fit, technology acceptance, and the theory of planned behavior), focusing on the individual's cognitive aspects. Fewer studies attempt to identify the social factors and how they influence KMS use [39]. On the other side, literature has examined the outcomes of using KMS such as job performance, innovation, decision quality, etc., often relying on organizational learning theory to

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[1] Another common type of KMS is a network KMS that facilitates tacit knowledge transfer through personal communication between individuals ([8]).

[2] This study focuses on repository KMS use as the act of acquiring documents and does not consider the role of contributing documents in individual learning.

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understand the drivers of learning and performance. We are unaware of any studies that integrate these multiple perspectives of personal cognition, social cognition, behavior, and performance.

Given the issues identified above, the focus of this study is to examine the interplay between knowledge bases and KMS repository usage behaviors, and explain how they may interact to influence an individual's performance. Specifically, this study aims to address two broad research questions. First, *do personal and social knowledge bases influence how an individual uses the repository KMS*. To address this question is important for a couple of reasons. As mentioned previously, while extant research has focused on the positive influence of personal knowledge on individual performance, it is not clear how personal knowledge influences KMS use itself. In other words, while personal knowledge may increase individual performance, it may also have an adverse impact on the extent to which the individual uses the KMS [41]. Furthermore, as social knowledge has not been examined alongside personal knowledge, several questions of the efficacy of social knowledge still remain, which includes whether it has an independent effect on KMS use, beyond the influence of personal knowledge. In other words, it is unclear if personal and social knowledge are complements, substitutes, or variables that influence KMS use independently. Understanding the dynamics of the user's knowledge bases on how they use the KMS repository, can be germane to building and designing more efficient and effective KMS. Second, *do personal and social knowledge bases interact with KMS usage behaviors, to influence individual performance*. As noted earlier, prior literature has applied either the cognitive paradigm (knowledge bases) or behavioral paradigm (unidimensional KMS use) to explain individual performance effects. However, organizational learning has argued that learning is a complex and nuanced process that includes cognition as well as behavior and that cognition and behavior interact in important ways to impact performance (Reagans et al., 2005; O'leary et al., 2011). Without considering both behavior and cognition together, the danger is that we end up with a partial view of the rich and nuanced processes underlying repository KMS use. To leverage technology for knowledge management has often proven to be a difficult challenge for organizations. A nuanced understanding of the processes underlying learning from KMS will mean that organizations are better positioned to promote and motivate behaviors that are more effective.

In addressing the two research questions, we begin by recognizing the role that personal knowledge and social knowledge bases play in the individual's learning process. Next, we draw from prior literature on KMS and system usage to identify two salient components of an individual's behavior while using a repository KMS, *usage frequency,* and *usage intensity*. Drawing from social cognitive theory (SCT) [3], we propose our research model hypothesizing that personal and social knowledge have an impact on how individuals use a repository KMS. Furthermore, the model recognizes that personal and social knowledge bases moderate the relationship between KMS use and individual performance. We test the research model on a comprehensive dataset of 18, 219 agents from one of the largest real estate franchise companies in the United States.

Overall, this study advances KMS literature by enriching our understanding of the role of knowledge bases and KMS usage behaviors on how they influence performance. In particular, it makes three main contributions. First, this study extends our understanding by incorporating individual knowledge bases (personal and social knowledge) and KMS use behavior (frequency and intensity) in a single study. Thus, it provides an integrated view of cognition and behavior in the KMS context. Second, this study is among the first to investigate the influence of the individual's knowledge base on the components of repository KMS use behaviors. In doing so, it explicitly acknowledges the important, but varied, role that the individual's knowledge bases play to learn from technology. Finally, our study investigates the interplay between knowledge bases and usage behaviors on individual performance. It reveals that there is nuance in the way that human cognition and human action come together to influence performance.

This paper is organized as follows. In the theoretical background section, we clarify and distinguish between personal and social knowledge bases. In addition, we conduct a comprehensive review of literature to identify the two repository KMS usage behaviors using the staged approach [12]. Next, we lay out our research model and hypotheses. We explain our research method and our results in the subsequent section. Finally, the last section discusses the implications of this research.

1. Theoretical background

1.1. The role of personal and social knowledge bases

The ability to evaluate knowledge that comes from KMS for its usefulness/appositeness has been stressed as being important in prior literature (Lehrer, 1987; Reagans et al., 2005; [35]). In other words, evaluating any incoming piece of knowledge requires coherent justification based on prior knowledge bases. Two elements of the evaluation process have been identified in prior literature. First, the incoming knowledge needs to be judged for its inherent quality and usefulness [55] and second, its pertinence and suitability to be applied to the context of the focal actor [26,68,69,75,76].

Research on intellectual capital [58] inform our understanding of the knowledge bases' elements. In particular, research at the individual level has recognized two elements, the personal intellectual capital of the individual (stemming from their knowledge, experience, and skills), and the individual's social capital (their access to external knowledge afforded by their social network) [56]. We term these two as *personal knowledge* and *social knowledge*. Personal and social knowledge bases provide the background knowledge to coherently evaluate incoming new knowledge from a KMS.

Personal knowledge is based on the focal individual's coherence and justification from prior experiences that let the actor evaluate knowledge, whereas social knowledge refers to the aggregate knowledge that is available in a referent group (such as a team) that is accessible by the focal individual. In other words, the distinction between personal knowledge and social knowledge exists at the cognitive boundaries of the individual's knowledge. Personal knowledge represents the individuals knowing (i.e., some form of justified belief) [53] and emerges from her/his *experience* [35]. Thus, personal knowledge emerges from the individual's experiences, is the accumulation of "actions, thinking, and conversations" ([81], p. 9) enacted in prior work, and is representative of individuals' knowledge used in enacting work practices [9]. In contrast, social knowledge exists beyond the individual, but within reach of the individual through the use of some form of social ties. Social knowledge here refers to social ties that form bridges such that the focal individual can access other's personal knowledge. Social knowledge emerges from the *social ties* of the individual, which let her/him gain greater access to "informal learning processes such as storytelling, conversation, coaching, and apprenticeship" ([81], p. 9), which may help to understand ambiguous cause and effect relationships [9].

Individuals with high levels of personal knowledge (through higher levels of experience) are better at evaluating knowledge, as has been recognized by prior literature ([35]; Reagans et al., 2005). Through the process of experimenting and learning, trial and error, in performing their professional activities, individuals become more proficient in judging what works and what does not work. In addition, experienced professionals also become better judges of the context that they work, and the nuances of the routines and practices relevant to their setting. In contrast to personal knowledge, the role of social knowledge has not received as much attention in KMS literature. Yet, it has been recognized in organizational learning literature as being an important aspect predicting individual performance (Reagans et al., 2005; O'leary et al., 2011). Social knowledge can also serve as a means to evaluate knowledge coming from KMS. Social knowledge provides the individual with an opportunity to leverage what others have accumulated, thereby increasing their capacity to process and evaluate incoming knowledge.

Thus, personal and social knowledge represent the two bases for an individual user to evaluate the knowledge from a repository KMS. It is also important to note here that the two knowledge bases are orthogonal and independent and not the ends of a continuum.

1.2. The salient components of repository KMS use

To aid in our conceptual development of the components of KMS use, we rely on the advice of Burton-Jones and Straub [12]. Commenting on the broader system use construct in information systems (IS) literature, Burton-Jones and Straub [12] argue that system use has often been treated in implicit ways, wherein the construct has been unsystematically conceptualized and operationalized. Stressing the need for reconceptualizing system usage in varied contexts, they state "…system usage is not the type of construct that can have a single conceptualization or measure. Unlike constructs that are strictly unidimensional or multidimensional with specific, known dimensions, we believe that relevant measures and dimensions of system usage will vary across contexts" ([12], p. 231). Furthermore, they propose a two-step, staged approach to reconceptualize system usage in different contexts. Stage one begins with defining the distinguishing characteristics of system use in the context. Stage two pertains to select the usage measures that are pertinent.

Here, we identify the dimensions of repository KMS use such that they are both content-valid and contextualized [12]. Repository KMS contain knowledge in the explicit form, stored as documents that are downloaded by individual users. The individual's behavior to acquire knowledge from these systems is therefore a specific conception of the broader construct of system usage that is pertinent within the context of repository KMS. Repository KMS differ from other types of technology-based systems in fundamental ways making their usage conducive to learning. For one, in most cases, the individual's use of a knowledge repository is not to achieve a specific job function, but to more broadly seek out knowledge that in turn may help increase performance [1,4]. Furthermore, this behavior is autonomous, voluntary, and self-directed by the focal individuals who are once removed from the performance of their task. In other words, behavior directed towards a knowledge repository focuses on the extent to which the user employs the system to foster learning, and is a rich conceptualization of system use involving the user and system [12].

Following the staged approach recommended by Burton-Jones and Straub [12], in the initial step, we examined the diversity of the broader system use measures. Discarding coarse binary measures of use (such as use/non-use) as well as those that pertain to the use of the information rather than system use itself, we narrowed the dimensions of usage behavior to those which could play a direct role in learning: *usage frequency* and *usage intensity*.[3] As a next step, we conducted a literature review of empirical KMS use literature. From our selection process,[4] we identified 42 articles that originate from 27 journals (see Table A.1). Of these studies, 33 employed surveys, 5 analyzed system log files, 2 conducted experiments, and 2 utilized a combination of experiments and log file analysis(Table A.2). A listing of the articles can be found in Appendix A(Table A.3).

While examining the KMS use constructs in prior literature, we found that most construct names indicate a broad/implicit treatment of usage behavior. However, in some cases, the construct names indicate specific behavioral dimensions. For example, two studies utilize effort-based names such as *search effort* [54] and *KMS usage intensity* [18], while other studies utilize time-based names such as *frequency of information seeking* [64], *frequency of knowledge reuse* [80], *interaction frequency* [84], and *KMS usage frequency* [18].

A further examination of the empirical research revealed that 24 studies measure a time-based dimension as indicated by the use of measurement item terminology such as "frequently," "rarely," and "often" (e.g., [15,20,25,32,63,71,80,84]) and in the construction of usage log measures that determine the number of discreet system access events across an observable time period [65]. An additional 11 studies examine an effort-based dimension as indicated by measurement item terminology such as "intensity," "extent," "level," and "degree" (e.g., [26,33,72]) or alternately by constructing measures from usage logs indicating the magnitude of document downloads within discreet time periods (e.g., [34,35,54,55,79]). In one study, both effort-based and time-based dimensions of use were aggregated into a single construct prior to analysis [72]. To our knowledge, only one study examines both effort-based and time-based dimensions simultaneously [18], but focus on the antecedents driving these behaviors rather than their subsequent performance effects. In 8 studies, a specific behavior is not clearly specified in the construct name or in the associated measures. Taken together, our examination of prior empirical research suggests that KMS use has two underlying dimensions, one related to the time-based (i.e., usage frequency) component of usage behavior and the other related to the effort-based (i.e., usage intensity) of the behavior. While there may exist other relevant components of usage (such as appropriateness of use, proportion of use, etc.) our review suggests that usage frequency and intensity are the most salient as recognized by prior literature.

The first behavioral component, *usage frequency*, focuses on the temporal regularity in which the focal actor accesses the system across an observable time period. The second behavioral component, *usage intensity,* is an effort-based construct focused on the extent to which an actor acquires knowledge from the repository within access events. Thus, independent from the repeated usage events captured by the frequency component, intensity captures the degree of effort expressed within each interaction with the system. This effort-based component of usage behavior indicates the extent of use to garner a greater amount of information. As such, while both behavioral components may impact learning and performance, each serves a distinct role in creating value.

2. Research model and hypotheses

In this section, we build on our above-mentioned recognition of the influence of personal and social knowledge bases and the components of repository KMS use to develop our research model, shown below in Fig. 1. The dashed line represents the focus of studies in prior literature, whereas the solid lines indicate the focus of this study. The research model integrates arguments from SCT [3] as well as contingency theory to understand the dynamics of personal and social cognition, KMS use behavior, and performance. SCT integrates the arguments from personal cognition (thoughts and experiences) along with those of social cognition (from others in the referral group) to encompass multiple determinants of the individual's learning behavior [47]. SCT has often been used to explain learning from technology, both in KMS and in general IS literature [39,16]. Furthermore, through the inclusion of contingent effects on individual performance, the model aims to further our understanding of KMS use behavior as a consequence of personal

[3] Note that [12] use the label "extent of use" instead of intensity. In addition to frequency and intensity, duration has been recognized by prior literature on general system use (for example, see [78]). However, in our context, users did not read the documents on the knowledge repository but downloaded it from the repository. Thus, as argued earlier, since knowledge repositories are not directly involved in task achievement, duration is not relevant. In our robustness checks section, we report on the empirical results of duration, which serve to reinforce the same.

[4] Using the EBSCOhost database, we searched all knowledge management, information system, and management articles published from January 2004 until August 2016 using the search terms "knowledge management system," "electronic knowledge repository," and "knowledge repository." To narrow our search, we added additional search terms "acquisition," "reuse," "seeking," "search," "sourcing," "utilization," "use," "usage," and "access." From the search results, we read through the abstracts to select articles that examined either the antecedents or outcomes of repository KMS use. We then examined the full text of these articles and identified relevant studies that were not in the original search results.

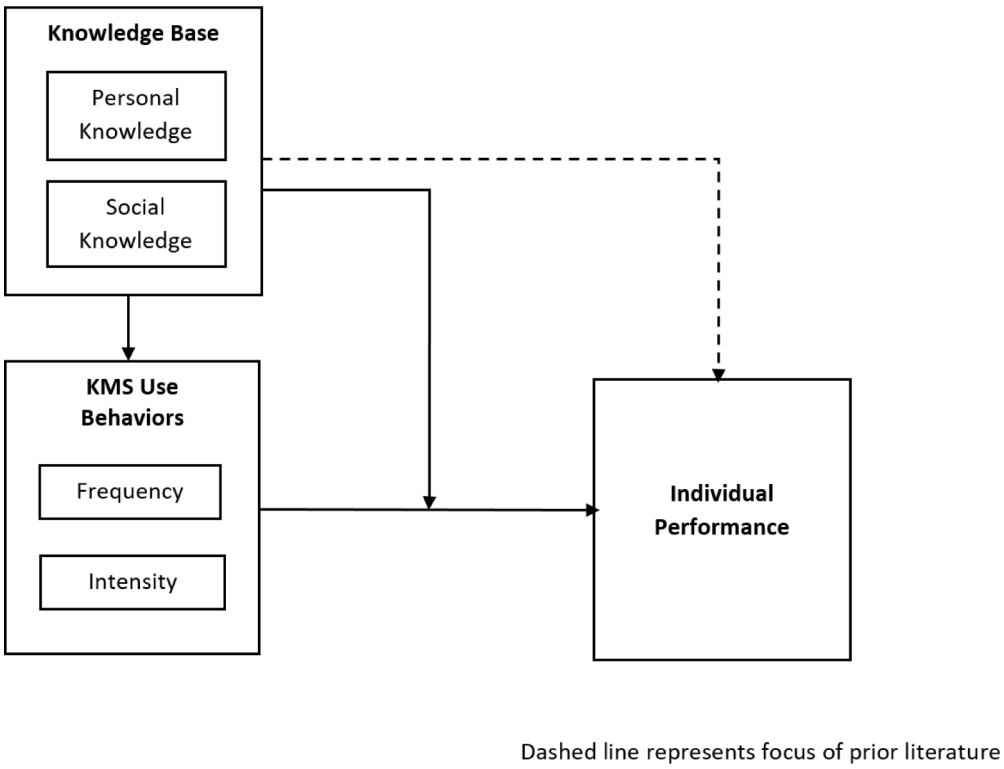

Fig. 1. Reasearch Model.

and social knowledge as well as the behavioral and cognitive contingencies impacting individual performance.

3. The impact of personal knowledge on the components of KMS use

We argue here that greater personal knowledge will reduce both frequency and intensity of KMS use. Personal knowledge influences not just the assessment of information but also the individual's reactions to it [78]. An individual user with greater personal knowledge may not find the knowledge contained in a repository KMS to be of much use because s/he already knows it or perhaps, because the knowledge may be judged to be irrelevant to her/his own context [35].

As Markus [41] argues, the most likely individuals to use knowledge repositories are those with low levels of experience and personal knowledge to tackle immediate problems related to their job. Experienced individuals on the other hand, are more likely to seek knowledge on unusual challenges and situations, which they have not encountered before [41]. It has been argued that individuals with greater experience are less likely to find such relevant knowledge that is not already known to them while using a repository KMS [26]. The lower likelihood of finding relevant knowledge may dissuade individuals with higher personal knowledge to peruse the KMS less frequently, simply because they have been disappointed in their attempt to find new knowledge in earlier attempts. Thus, we argue that greater personal knowledge leads to lower frequency of repository KMS use.

H1: Greater personal knowledge leads to lower frequency of repository KMS use.

Individuals with high levels of personal knowledge are also likely to impact KMS usage intensity negatively. As mentioned previously, experienced users are likely to seek knowledge on rare/unusual/challenging situations that they have not encountered before. With higher levels of personal knowledge and experience, the likelihood to encounter such unfamiliar situations is low. Furthermore, these unusual situations are likely to require knowledge that is more complex and tacit than others. Given the challenges inherent to codify knowledge such that it is made available in repository based KMS [26,35], the search for knowledge by experienced individuals that addresses their unusual challenges is likely to yield fewer relevant results within the repository KMS. Thus, we argue that greater personal knowledge leads to lower intensity of repository KMS use.

H2: Greater personal knowledge leads to lower intensity of repository KMS use.

3.1. The impact of social knowledge on the components of KMS use

Social knowledge emerges from the social ties that the focal individual has with other individuals with a shared work practice, usually a team/group. Individuals socialize with others and shape their own tacit knowledge [49,50]. Communities of practice [9,37,73,81] and networks of practice literatures [10,51,77] argue that individual learning is enhanced when individuals socially interact with others within a particular shared practice. Literature has long recognized that these social ties are an important source of knowledge for individuals [27,34]. Beyond an individual's personal knowledge, we hypothesize here that social knowledge has an important role to influence KMS use behavior.

As individuals interact with others within their network, they are exposed to a constant stream of new information that emerges from the conversations and storytelling they share with others [81]. With greater social knowledge, there is a greater likelihood that the focal individual will be exposed to knowledge that is completely new or knowledge that may challenge their existing beliefs or perhaps even clarify existing knowledge in terms of what context it would be effective and when it would not be effective. As the social interactions are temporally continuous (i.e., occur frequently), dealing with new knowledge arising from their social ties is a continuous issue facing the individual. When faced with incoming knowledge that is new/challenging/clarifying, the individual user may frequently be motivated to use the KMS as a means of externally validating the new knowledge that is accessed with social ties. Therefore, we hypothesize that greater social knowledge leads to

greater frequency of repository KMS use.

H3: Greater social knowledge leads to higher frequency of repository KMS use.

Regardless of whether the knowledge from social ties is new or challenging or clarifying, the individual is likely to seek out a greater number of documents from the KMS, and thus use the KMS with more intensity. For example, if the incoming knowledge from social ties is new, the individual is likely to think "what else do I need to know?", and in the process of answering this question, is likely to broaden their search and acquisition of documents from the KMS. Similarly, if the incoming knowledge from social ties is challenging, the individual is likely to alleviate the uncertainty between her/his existing knowledge by seeking out a greater number of documents from the KMS to either validate existing knowledge or validate the incoming knowledge. Finally, the process of clarifying existing knowledge is likely to trigger a wide search for relevant knowledge, in seeking to elucidate the knowledge contextual nature. Therefore, we hypothesize that greater social knowledge leads to greater intensity of repository KMS use.

H4: Greater social knowledge leads to higher intensity of repository KMS use.

3.2. Interaction of KMS use and knowledge bases

While both knowledge bases (social and personal knowledge), and usage behaviors (frequency and intensity) are likely to positively impact an individual's performance, we argue here that certain configurations of knowledge bases and usage behavior are likely to interact positively and provide greater benefit to the individuals than others. In other words, the pertinent knowledge base is likely to provide greater benefit for the individual when accompanied by specific type of usage behaviors. Firstly, we posit that individuals with greater personal knowledge are more likely to perform better when they intensely acquire knowledge, rather than frequently acquire knowledge. In addition, we posit that individuals with greater access to social knowledge are likely to increase performance when they frequently acquire knowledge, rather than intensely acquire knowledge.

Increase in professional experience has been recognized to have at least two distinct benefits. One, an increase in professional experience increases the capacity for information processing. It has been argued in prior literature that those with greater professional experience are superior in acquiring new information [7,52]. Because of their prior domain knowledge, experienced professionals are more adept at acquiring knowledge [35] and applying heuristic techniques to assimilate this knowledge. For example, by employing schemas and automated rules, which allow for greater information processing with lower cognitive effort [66,67]. Two, with an increase in experience, the need for information processing is decreased. A greater amount of contextual awareness gained from professional experience reduces cognitive demands [82] and decreases effort and rework by acquiring only those documents that are well suited to their needs [45,66,67]. Experienced actors are also more likely to mitigate potential information overload problems by filtering pertinent knowledge from useless or redundant items [21,22]. With an increased capacity to process information, individuals with greater professional experience are likely to be more efficient when they intensely acquire knowledge from the repository KMS, in contrast to those who frequently acquire knowledge. As there is increased information processing capacity, the temporal gaps in going back and forth between accessing knowledge and processing it for relevance can be avoided. It therefore follows that the benefits of usage intensity depend on the user's information processing ability. Thus, we hypothesize that

H5: Individuals with greater personal knowledge are likely to perform better when they intensely acquire knowledge as compared to those who frequently acquire knowledge.

Social ties provide access to the expertise of other team members, i.e., social knowledge. Individuals participating in social groupings, such as teams, may benefit from the available diversity of expertise through collective sensemaking activities (Boland & Tenkasi, 1995; [13]). Social knowledge gained by others may further enhance the cognitive benefits of usage intensity by helping users generate new ideas and test these ideas against the varied understanding of other members [4,40]. The vetting of knowledge through socialization is likely to increase the breadth of understanding of the user [49,50]. Recent KMS literature also suggests that greater access to social knowledge is helpful in overcoming internalization challenges [34]. While increased team tenure may prove to be advantageous, the socialization and vetting of knowledge is inherently a time-consuming process, requiring the focal individual to parse smaller amounts of information. In other words, greater social ties, while they allow the individual to leverage the knowledge of the team, also require smaller amounts of information to be processed more frequently due to the inherent limitations in the extent of communication possible between the individual and the members of the team. Further limitations to process knowledge also arise from the cognitive limitations of the individual, who may not be able to retain all the relevant knowledge as well as the contextual information that makes it relevant. It therefore follows that while social knowledge ascribes certain advantages to the focal individual, those who frequently acquire knowledge, rather than intensely, are likely to leverage these advantages to impact performance. Thus, we hypothesize that

H6: Individuals with greater social knowledge are likely to perform better when they frequently acquire knowledge as compared to those who intensely acquire knowledge.

4. Research method

4.1. Research setting

The real estate industry provides a knowledge-intensive setting within which to examine the influence of KMS usage behavior on individual performance outcomes. First, real estate agents are highly responsible to update their knowledge to accommodate changes in real estate regulations, stay in tune with trends in the mortgage industry, and offer a relevant value proposition for prospective home buyers and home sellers – thus making repository KMS use an important part of their learning. Second, the work activities required to conduct real estate transactions are conducted by the focal agent. This allows an examination of individual performance effects. Third, while some of the knowledge involved in the real estate industry is tacit (real estate sales), repositories contain documents wherein implicit knowledge is codified into documents and made explicit, which thus makes it available to agents. Finally, the real estate industry has gone through dramatic changes that result in a greater need for agents to not only rely on accrued professional experience, but also to collaborate in teams to gain social knowledge.

Between 2000 and 2010, the real estate industry endured a radical expansion and rationalization cycle. Membership in the National Association of Realtors grew from roughly 0.75 million members in 2000 to a peak of more than 1.3 million members in 2006 and has since declined to 1 million members in 2011.[5] Between 2006 and 2009, home sales declined drastically with the number of new home sales, which decreased from 1.05 million to 374,000.[6] To endure the financial impact of this turbulent period, many real estate agents repurposed their sales practices by branching out from traditional home sales into emerging markets. For instance, some agents entered the short sale market or entered niche markets such as eco-friendly housing and housing for senior citizens. Furthermore, as the industry entered a digital marketing era, agents adopted new work routines to integrate their property

[5] http://www.realtor.org/membership/historic-report Accessed Jan 10th 2016

[6] http://www.census.gov/housing Accessed Jan 10th 2016

listings with new listing aggregation websites. Each of these changes prompted the need for agents to acquire new knowledge.

We gathered data from one of the largest real estate franchises in the United States. The franchise operates under a business model wherein independent real estate agents pay a recurring membership fee in exchange for the right to use the brand and to have access to the shared resources in the franchise network. As stated by the franchise, these agents are "professionals that are in business *for* themselves, but not *by* themselves." Thus, they are highly autonomous, expected to identify and attract potential customers, retain any sales commission earned, and in the process, use franchise resources as needed. Unlike employees of an organization, the agents in our context are completely independent and exercise free will to choose to use (or not use) the KMS. Therefore, the KMS use by agents in this context is completely voluntary in nature, unlike other contexts where organizations could coerce employees to use KMS.

While all agents are affiliated with a local office, some agents opt to work in a team. Teams openly share expertise as part of a formal collaboration structure that combines less experienced agents with seasoned agents. These team structures also allow agents who specialize in a particular domain to closely interact and collaborate with others in their field of expertise.

4.2. KMS repository

To remain valuable to its constituency, the franchise headquarters established routines to collect and encode information of market trends, emerging business practices, and technological advancements, with a dedicated team of experts in the charge of codification of knowledge located at the headquarters. The KMS system investigated here evolved from a stand-alone corporate extranet to a fully integrated agent- and broker-driven resource center that allows user customization. The platform was designed for flexibility and scalability to accommodate future technological needs and enhancements. It was built upon Microsoft SharePoint Server and integrated with internal systems through common industry standards. It included the membership management system, listing management system, lead management system, content management system, active directory, central email server, customer-facing website, and mobile applications. This KMS also integrated with external vendor systems that provide diverse content and services. Highlights of the knowledge resources provided include:

Design Center: On-demand design studio, that contains more than 2000 print and digital postcards, flyers, brochures, newsletters, video tours, and web commercials. May be personalized to individual needs.

Download Center: Library of 50,000 digital files uploaded by the franchise headquarters, regions, offices, and sales associates. Contained educational material, business resources, and competitive intelligence targeted to broker owners and office managers, commercial agents, luxury home specialists, REO short-sale and distressed property experts, and eco-friendly real estate specialists.

Marketing Center: Legally approved images, logos, marketing claims, slogans, and latest ad campaign materials for radio, television, print, outdoor, and online marketing purposes. Provided a management tool to launch marketing campaigns through email, Facebook, Twitter, YouTube, LinkedIn, or Google+.

Education Center: More than 1200 on-demand training resources covering aspects of building a real estate business. Contains training videos, agent/broker training on demand, off-site training, webinars, and technology training. Provided interactive tools for agents to develop learning plans and meet continuing education requirements. Content was provided by the franchise, external real estate training professionals, and high-performing agents invited to share best practices.

Technology Blog: Summary of popular technology trends, new software, and mobile apps. Contained archives detailing how to use new technologies to improve real estate business practices.

5. Data collection

We collected data through two primary data files accessed from the franchise headquarters. The first file, retrieved from the knowledge repository, consists of document download activity from March 1 to December 31, 2010. This file contains attributes of each download event, which include the user's unique login, the file name of the document, and the date that the document was downloaded. From these data, we were able to measure the frequency and the intensity of downloads. The second file, retrieved from the membership database, contains agents' current and prior year annual sales commissions, year licensed, team membership status, office location, and individual demographic data.[7] While, as researchers, we did not have access to these documents directly, the self-explanatory titles of the documents span the continuum between explicit (trends in real estate sales) and tacit (seller prelisting package and how to hook buyers) continuum.

6. Measures

6.1. Dependent variable

We measured individual performance, the dependent variable, as the natural log of agent sales commissions for 2010. Commissions are the earnings that the agent generated throughout the calendar year through all operational activities that include the sale and purchase of property. Because individual performance is measured as the actual number of dollars earned by agents, the data set provides an opportunity to examine the economic value of repository KMS use.

6.2. Personal and social knowledge

While personal knowledge stems from an individual's experience, there are three dimensions of "experience" that prior research has discussed [35]; length of time with the organization (organizational tenure), length of time in the current job (job tenure), and length of time spent within the profession (job/professional experience). In the context of the real estate industry, organizational job is not an appropriate measure of personal knowledge, as the definition and nature of jobs varies. Organizational tenure is also not appropriate measure of personal knowledge, as agents often change their affiliation with different real estate brokerage firms. Indeed, a more appropriate measure of personal knowledge is the time since the agent entered the profession. This is also a more inclusive measure of professional experience, as it takes into account the agent's prior professional experience developed before joining the franchise network. Therefore, to measure personal knowledge, we used the number of years that the agent has been in the profession, i.e., held a real estate license.

Prior literature suggests that knowledge sharing among team members is dependent on shared norms, tie strength, and trust [27]. Time is needed to build trust and increase the strength of ties as well as learn the shared norms of the team. The length of time spent within the team will also help the individual agent develop a transactive memory of who knows what. Therefore, social knowledge was measured as the number of years that the agent belonged to the team, i.e., team tenure. For agents who do not belong to a team, the value was assigned as zero.

6.3. Usage frequency and usage intensity

A typical real-estate transaction involves the need for new knowledge at multiple stages. For example, when attracting new buyers or sellers, when marketing and showcasing a property, and when

[7] Although there were some agents who focused on the sale of commercial real estate, a majority (more than 95 percent) of agents sold residential real-estate. Therefore, we focus on residential real estate agents in this study.

Table 1
Summary Statistics and Correlations.

	Mean	Std. Dev.	Min	Max	1	2	3	4	5	6	7
1. Annual Commissions (in US$)	80,355	101,650	1	2,689,932	1						
2. Population	1023,633	1650,183	4827	10,200,000	0.05***	1					
3. Per Capita Income (in US $)	29,785	7062	9824	55,666	0.09***	−0.07***	1				
4. Med. Home Value (in US$)	206,981	99,560	49,752	711,805	0.10***	0.18***	0.66***	1			
5. Foreclosure Rate	0.04	0.02	0	0.123	−0.03***	0.23***	−0.40***	−0.38***	1		
6. Office Size	44.51	32.11	1	155	0.09***	0.12***	0.21***	0.09***	0.00	1	
7. Office Age	14.98	8.65	1	36	0.08***	0.04***	0.14***	0.06***	−0.07***	0.36***	1
8. Office Attrition	8.87	8.37	0	87	0.06***	0.13***	0.14***	0.04***	0.01**	0.75***	0.17***
9. Office Expansion	4.67	5.15	0	44	0.00	0.05***	0.00	−0.05***	0.16***	0.55***	0.00
10. Prior Commissions (in US$)	73,026	101,716	0	2,567,248	0.84***	0.06***	0.09***	0.09***	−0.02***	0.09***	0.11***
11. Gender (1=female; 0=male)	0.61	0.49	0	1	−0.08***	−0.04***	−0.02***	−0.04***	−0.01	−0.03***	−0.04***
12. Tenure	6.68	6.15	0	37	0.23***	0.06***	0.14***	0.08***	−0.04***	0.14***	0.29***
13. Team Size	3.43	9.81	0	84	0.22***	0.02***	0.08***	−0.01	0.01	0.28***	0.05***
14. Professional Experience	15.80	9.80	0	61	0.16***	0.05***	0.11***	0.08***	−0.01*	0.10***	0.18***
15. Team Tenure	0.87	2.08	0	8	0.30***	0.00	0.05***	0.00	0.00	0.08***	0.04***
16. Usage Frequency	3.06	3.36	1	217.5	0.11***	−0.02**	0.01	−0.01	0.01*	−0.03***	−0.06***
17. Usage Intensity	3.40	5.32	1	67	0.01	0.00	0.01	0.00	−0.01*	−0.01*	0.00
$n = 18{,}219$; * $p < 0.1$; ** $p < 0.05$; and *** $p < 0.01$											

	8	9	10	11	12	13	14	15	16
8. Office Attrition	1								
9. Office Expansion	0.52***	1							
10. Prior Commissions (in US$)	0.06***	−0.02***	1						
11. Gender	−0.03***	−0.01*	−0.08***	1					
12. Tenure	0.05***	−0.10***	0.31***	−0.03***	1				
13. Team Size	0.28***	0.20***	0.21***	−0.04***	0.05***	1			
14. Professional Experience	0.03***	−0.06***	0.21***	0.00	0.67***	0.01	1		
15. Team Tenure	0.07***	0.02**	0.31***	−0.05***	0.19***	0.64***	0.11***	1	
16. Usage Frequency	−0.01	0.03***	0.08***	−0.03***	−0.06***	0.02***	−0.06***	0.04***	1
17. Usage Intensity	−0.01	−0.01	0.01	0.00	−0.03***	−0.01	−0.03***	0.00	0.06***

$n = 18{,}219$; * $p < 0.1$; ** $p < 0.05$; and *** $p < 0.01$.

negotiating the conditions of a purchase agreement. The need to acquire knowledge from the repository KMS is therefore driven by communication and decision-making events that lead to the finalization of a transaction. Given the rapid pace in which real estate activities occur, we argue that usage behavior across days is an appropriate timeframe to measure the effects of KMS usage in this setting. We therefore calculated *usage frequency* as the number of distinct days upon which agents accessed the knowledge repository. Accordingly, *usage intensity* was measured as the average number of documents downloaded across all access days,[8] which provides an indication of the magnitude of usage behavior.[9] We log transformed both variables prior to analysis to aid in distributional assumptions.

6.4. Controls

We further operationalized a set of control variables characterizing the market within which the agent competes, the local office with which the agent is affiliated, and the agents themselves – all factors that are likely to impact individual performance outcomes. To control for heterogeneity across markets, we included county population, county per capita income, and median county home value measures obtained from 2010 U.S. census data.[10] These measures provide an indication of the size and munificence of the market in which agents are situated. Furthermore, we included a 2008 estimate of the county foreclosure rate sourced from the U.S. Department of Urban Housing.[11] This measure is intended to capture the housing market turbulence experienced during the subprime mortgage crisis. For the office with which each agent is affiliated, we controlled for the size of the office – operationalized as the number of agents, owners, and managers in the office. We also controlled for the number of years that the office was affiliated with the franchise to control for a competitive advantage that agents may gain when they work in established offices. Additionally, we included measures of the number of agents who have either left or joined the office during the year to control for attrition and expansion effects. At the agent level, we included a general proxy of capability using the natural log of the agent's commissions for the previous year and controlled for the size of the team with which the agent is associated. Finally, we included a contrast code to control for gender effects (0 = male).

6.5. Data analysis

Hierarchical Linear Modelling (HLM) was used as the primary statistical analysis technique and was conducted with Stata 14 [62] using the "mixed" command. HLM allows for the explicit modeling of hierarchical data, which thus accommodates nonindependence in the error term [57,61]. We chose HLM due to the nested nature of the data.

[8] We used the average rather than the total number of downloads because it has a low correlation with the chosen frequency measure. Using the average also allowed us to calculate alternate measures at the weekly level.

[9] Consider the following example of an agent who acquired 30 documents over a ten-month period in 5 daily visits. The usage frequency is measured as 5 and the usage intensity is measured as 6 (30 divided by 5).

[10] http://www.census.gov/2010census/data Accessed Jan 10th 2016

[11] https://www.huduser.gov/portal/datasets/nsp_foreclosure_data.html Accessed Jan 10th 2016

Table 2
Results of HLM Analysis predicting Usage Frequency and Intensity.

	Dependent Variable Usage Frequency		Dependent Variable Usage Intensity	
Constant	1.291***	(0.033)	0.917***	(0.041)
Population	−0.000	(0.000)	0.000	(0.000)
Per Capita Income	0.000***	(0.000)	0.000**	(0.000)
Med. Home Value	−0.000	(0.000)	−0.000*	(0.000)
Foreclosure Rate	0.153	(0.284)	−0.879***	(0.338)
Office Size	−0.000*	(0.000)	−0.001***	(0.000)
Office Age	−0.003***	(0.000)	0.000	(0.000)
Office Attrition	−0.000	(0.000)	0.000	(0.001)
Office Expansion	0.003**	(0.001)	0.002	(0.001)
Prior Commissions	−0.009***	(0.001)	−0.006***	(0.001)
Gender	−0.029***	(0.008)	−0.003	(0.011)
Tenure	−0.002**	(0.001)	−0.001	(0.001)
Team Size	0.000	(0.000)	−0.000	(0.001)
Prof. Experience	−0.020***	(0.006)	−0.031***	(0.007)
Team Tenure	0.025***	(0.006)	0.018**	(0.007)
Model Degrees of Freedom	14		14	
Log Likelihood	−15,032		−20,998	

Standard errors in parentheses; $n = 18{,}219$; Number of groups: 1022 counties; 2743 offices; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Individual real estate agents are nested in the franchise office with which they are affiliated. Furthermore, individual agents are subject to the market forces at play in their geographic location, which therefore require a three level model. Level 1 contains all individual-level variables including all hypothesized effects, level 2 contains office-related control variables, and level 3 contains county-related control variables. The individual level intercept was treated as a random effect to account for heterogeneity in variance at levels 2 and 3. All level 1 independent variables were entered as fixed effects as there was no theoretical reason to expect that these coefficients are heterogeneous across office and market.

7. Results

Our data consist of 18,219 individual agents nested in 2743 franchise offices. These offices are located in 1022 counties spread across 50 states. A full listing of the summary statistics and correlations is shown in Table 1.

To test for office and county level effects, we calculated the intraclass correlation (ICC). ICCs of 0.05 at the office level and 0.1 at the county level cross the 0.05 threshold indicate that substantial heterogeneity exists at these levels [29,61]. We performed an additional check using the state grouping variable but an ICC of 0.02 indicates that individual commissions are relatively homogeneous across states. We therefore kept to a three level HLM model using office and county as the grouping variables. To reduce multicollinearity and increase the interpretability of interaction effects, we standardized all variables included in the interactions prior to the analysis. Variance inflation factors were all below four, which fall below the established thresholds [46,48], the average variance inflation factor was below two, which suggests that multicollinearity was not a threat to our results. Furthermore, we ran a model with overall use, operationalized as the total documents downloaded, as the independent variable. Results indicate that overall use significantly predicted individual agent's financial performance.

Table 2 reports the results of Hypotheses 1–4. The models that predict usage frequency and intensity are tabulated as two columns. Hypotheses 1 and 3 predicted that personal knowledge will negatively impact both usage frequency and intensity. As can be observed in Table 2, professional experience had a significant and negative impact on both usage frequency and intensity, after controlling for all other variables, indicating support for hypotheses 1 and 3. Hypotheses 2 and 4 predicted that social knowledge will have a positive impact on usage frequency and intensity. Team tenure has a positive and significant impact on usage frequency and intensity. As a follow up, we examined if there was an interaction effect between professional experience and team tenure to impact usage frequency and intensity. The p-values for the interaction were not significant, which indicate no interaction effects.

To test our interaction hypotheses (H5 and H6), we introduced the hypothesized variables in a step-wise comparison approach [31] by first establishing a baseline model containing the controls at all three levels, and the main effects of professional experience and team tenure. We then introduced the usage variables by first adding the stand alone main effects of usage frequency in model 2 and usage intensity in model 3 and the concurrent effects of frequency and intensity in model 4. To test the interaction hypotheses, we first introduced the stand-alone interactions between each usage behavior and professional experience (models 5 and 6) followed by the stand-alone interactions between each usage behavior and team tenure (models 7 and 8). Model 9, the full model, contains all concurrent effects.

Although we did not hypothesize the main effects of knowledge bases and KMS usage on performance for the sake of brevity, it is important to note here that all four (i.e., personal knowledge, social knowledge, frequency, and intensity) seem to have a significant and positive impact on performance. Model 1 in Table 3 establishes the main effects of the two knowledge bases, professional experience, and team tenure. Results indicate that both have a strong and positive impact on predicting performance, after removing the influence of all the controls. To convert the coefficient for professional experience in model 1 (0.039) into percentage shows that a one standard deviation increase in experience increases average commissions by 4 percent.[12] Similarly, team tenure also has a very strong impact on performance (12.2 percent). Model 4 shows that when controlling for usage intensity, the effect of usage frequency on commissions is positive and significant ($p < 0.01$). The impact of usage intensity is also supported as evidenced by the positive and significant coefficient. Controlling for frequency, a one standard deviation increase in usage intensity is estimated to increase commissions by an average of 2.2 percent.

The results from models 5–8 indicate that all interactions are significant. However, due to the correlated nature of the independent variables, it is important to assess the full information model (shown in Model 9) such that we gage each individual interaction effect after controlling for the effects of the other interactions. Results from Model 9 indicate that the interaction between usage frequency and professional experience is not significant. The interaction between usage intensity and professional experience on the other hand is shown to be positive and significant ($p < 0.01$). This model indicates that agents with one standard deviation professional experience above the mean are estimated to achieve an additional performance increase from usage intensity of 2.8 percent relative to those with an average level of experience, which thus supports H5. Note that since the coefficient for frequency and experience is not significantly different from zero, a test of difference between coefficients is not required. Similarly, after controlling for all other interaction effects in model 9, the interaction between usage frequency and team tenure is positive and significant ($p < 0.01$), while the interaction between usage intensity and team tenure is not significant. As such, agents who work for longer periods on a team are estimated to gain an additional 2.6 percent increase in commissions when frequently acquiring documents, supporting H6. The simple slopes chart for the two significant interactions is shown below in Fig. 2.

The results can be interpreted in the following way. Individuals with high personal knowledge performed better when they intensely used the KMS as compared to those with high personal knowledge but who used

[12] As the dependent variable is log transformed, we use the formula (expBeta Coefficient – 1) * 100 to calculate the percentage change in commissions. For example, the beta coefficient for usage frequency in model 5 (.057) equates to a 5.87 percent increase in commissions.

Table 3
Results of HLM Analysis predicting Performance.

	Model 1 Knowledge bases and Controls		Model 2 Usage Frequency		Model 3 Usage Intensity		Model 4 Frequency & Intensity Main Effects		Model 5 Frequency x Professional Experience		Model 6 Intensity x Professional Experience		Model 7 Frequency x Team Tenure		Model 8 Intensity x Team Tenure		Model 9 Full Model	
Constant	9.379***	(0.063)	9.370***	(0.062)	9.376***	(0.063)	9.369***	(0.063)	9.370***	(0.062)	9.373***	(0.062)	9.370***	(0.062)	9.370***	(0.062)	9.374***	(0.062)
Population	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Per Capita Income	−0.000***	(0.000)	−0.000***	(0.000)	−0.000***	(0.000)	−0.000***	(0.000)	−0.000***	(0.000)	−0.000***	(0.000)	−0.000***	(0.000)	−0.000***	(0.000)	−0.000***	(0.000)
Med. Home Value	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)
Foreclosure Rate	−0.848	(0.543)	−0.858	(0.542)	−0.814	(0.544)	−0.836	(0.543)	−0.831	(0.542)	−0.841	(0.542)	−0.835	(0.542)	−0.834	(0.542)	−0.837	(0.541)
Office Size	0.001**	(0.001)	0.001**	(0.001)	0.001**	(0.001)	0.001**	(0.001)	0.001**	(0.001)	0.001**	(0.001)	0.001**	(0.001)	0.001**	(0.001)	0.001**	(0.001)
Office Age	0.002	(0.001)	0.002*	(0.001)	0.002	(0.001)	0.002*	(0.001)	0.002*	(0.001)	0.002*	(0.001)	0.002*	(0.001)	0.002	(0.001)	0.002	(0.001)
Office Attrition	−0.005***	(0.002)	−0.005***	(0.002)	−0.005***	(0.002)	−0.005***	(0.002)	−0.005***	(0.002)	−0.005***	(0.002)	−0.006***	(0.002)	−0.006***	(0.002)	−0.006***	(0.002)
Office Expansion	0.010***	(0.002)	0.009***	(0.002)	0.009***	(0.002)	0.009***	(0.002)	0.009***	(0.002)	0.009***	(0.002)	0.009***	(0.002)	0.009***	(0.002)	0.009***	(0.002)
Prior Commissions	0.140***	(0.002)	0.141***	(0.002)	0.140***	(0.002)	0.141***	(0.002)	0.141***	(0.002)	0.141***	(0.002)	0.141***	(0.002)	0.141***	(0.002)	0.140***	(0.002)
Gender	−0.059***	(0.015)	−0.056***	(0.015)	−0.059***	(0.015)	−0.056***	(0.015)	−0.056***	(0.015)	−0.055***	(0.015)	−0.056***	(0.015)	−0.056***	(0.015)	−0.055***	(0.015)
Tenure	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)
Team Size	0.006***	(0.001)	0.006***	(0.001)	0.006***	(0.001)	0.006***	(0.001)	0.006***	(0.001)	0.006***	(0.001)	0.006***	(0.001)	0.006***	(0.001)	0.006***	(0.001)
Prof. Experience	0.039***	(0.010)	0.041***	(0.010)	0.040***	(0.010)	0.041***	(0.010)	0.042***	(0.010)	0.043***	(0.010)	0.041***	(0.010)	0.041***	(0.010)	0.043***	(0.010)
Team Tenure	0.115***	(0.010)	0.112***	(0.010)	0.114***	(0.010)	0.112***	(0.010)	0.112***	(0.010)	0.112***	(0.010)	0.111***	(0.010)	0.111***	(0.010)	0.111***	(0.010)
Usage Frequency			0.063***	(0.007)			0.057***	(0.007)	0.058***	(0.007)	0.058***	(0.007)	0.056***	(0.007)	0.057***	(0.007)	0.056***	(0.007)
Usage Intensity					0.037***	(0.007)	0.022***	(0.007)	0.022***	(0.007)	0.023***	(0.007)	0.023***	(0.007)	0.023***	(0.007)	0.024***	(0.007)
Frequency x Prof. Experience									0.015**	(0.007)							0.004	(0.008)
Intensity x Prof. Experience											0.031***	(0.007)					0.028***	(0.008)
Frequency x Team Tenure													0.030***	(0.007)			0.026***	(0.007)
Intensity x Team Tenure															0.021***	(0.007)	0.010	(0.008)
Model Degrees of Freedom	14		15		15		16		17		17		17		17		20	
Log Likelihood	−25,234		−25,195		−25,220		−25,191		−25,189		−25,181		−25,181		−25,187		−25,172	

Standard errors in parentheses; $n = 18{,}219$; Number of groups: 1022 counties; 2743 offices; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

the KMS less intensely. Furthermore, for such individuals with high personal knowledge, there was no significant interaction with frequency to impact performance. On the other hand, individuals with high social knowledge performed better when they frequently used the KMS as compared to those with high social knowledge but who used the KMS less frequently.

As robustness checks, we further examined the data to determine if the general pattern of results holds under alternate specifications of the model. As shown in Appendix BTable B.1, we first introduced alternate measures of the primary variables of interest. For usage frequency, we constructed a new measure based on the number of distinct weeks (instead of days) in which the system was accessed. For usage intensity, we calculated the average number of downloads that occurred per week (instead of day). This broader timeframe is meant to account for delayed learning effects. Consistent with the primary usage measures, these measures were log transformed to meet normality assumptions. When performing the analysis with the alternate measures, the general pattern of results held. Second, we introduced alternate measures of personal and social knowledge. An alternate measure for personal knowledge was constructed by adding the number of years that the agent held a license with the number of years that the agent was affiliated with the franchise. With respect to social knowledge, we divided team tenure by team size to account for effects that stem from a larger number of social ties within larger teams. When running the analysis with these alternate measures of the personal and social knowledge contexts, the general pattern of results held. Third, we constructed a measure for duration of use from the log files, which did not have a significant impact on performance. Lastly, we entered three-way interactions between each usage behavior, professional experience, and team tenure to determine if synergies between the personal and social knowledge contexts would further amplify the performance effects of usage frequency and intensity. None of the three-way interactions were significant.

8. Discussion

8.1. *Contributions to literature*

The aim of this study was to gain further insight into the contingent performance effects of repository KMS use. We began by recognizing the importance of personal and social knowledge and delineating between two components of usage behaviors. We then proposed a research model that examines the influence of professional experience and team tenure as well as the two components of usage, frequency, and intensity. Our findings, based on a dataset of 18,219 real-estate agents from 2743 offices nested in 1022 counties, render support for the positive impact of the two knowledge bases and the two components of usage behavior on financial performance. Furthermore, we find that there are different pathways to individual performance based on configurations of knowledge bases and usage behavior. Overall, our study provides an integrated view of the interplay between the three constituents of technology-based learning – cognition, behavior, and performance [52,83,85,86].

This study provides three major contributions to IS literature. First, it enhances our understanding of repository KMS use through the explicit recognition and conceptual development of the two knowledge bases and the two salient components of usage. In doing so, it addresses two important gaps in KMS literature. The first gap is that although prior literature in KMS has recognized the role that personal knowledge plays [35], the important role of social knowledge has not been acknowledged to the same extent. This is despite the consistent arguments that social knowledge plays an important role in the individual learning process in organizational learning literature (Reagans et al., 2005). We found no studies in prior literature that examined the influence of both knowledge bases. Instead, most prior studies emphasize either the individual's personal knowledge or highlight the role of social knowledge, but not both [19,38]. As a consequence, we only have a partial understanding of

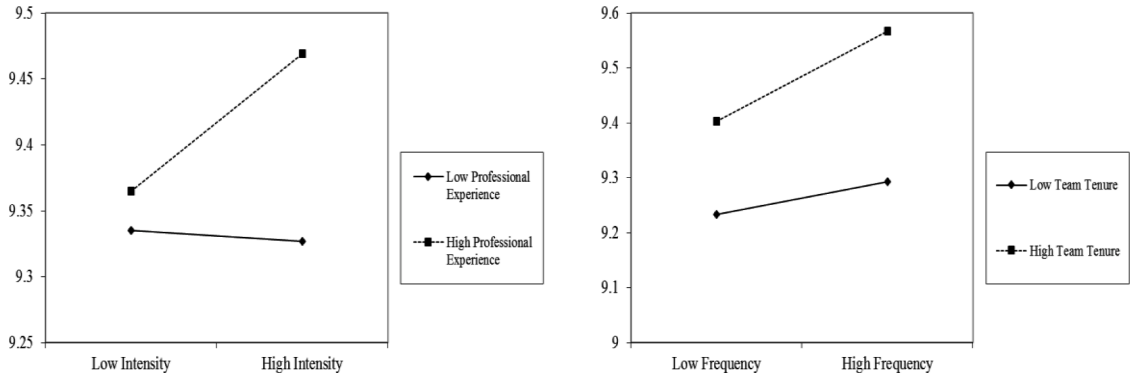

Fig. 2. Interaction Between Knowledge Bases and KMS Usage Behaviors.

how both knowledge bases influence learning through KMS. The second gap is that our assessment of prior KMS literature revealed either a general treatment of repository KMS use or an implicit focus on one behavioral component at the cost to ignore the other. This has stymied our understanding of the differential performance effects when accounting for both behaviors concurrently. This paper addresses these two gaps through the conceptual development of knowledge bases and explicit treatment of usage components, which thereby enables us to not just recognize their individual impacts on the learning process and performance, but also examine their interplay.

Second, our empirical results indicate that individuals with high levels of personal knowledge use the knowledge repository less frequently and less intensely than those that are low on personal knowledge. This result indicates that both dimensions of KMS use behavior are motivated by a lack of personal knowledge. Prior literature has argued that the individual with greater levels of personal knowledge possesses superior mental models to filter and process higher quantities of information [35]. Yet, KMS use behaviors seem to be driven by the need for knowledge, rather than any judgment of capability to process newly accessed knowledge. On the other hand, social knowledge had a positive impact on both dimensions of KMS use. This may indicate that social ties provide new information that promotes knowledge seeking behavior. Interestingly, personal and social knowledge do not interact with each other to influence frequency and intensity. These results indicate that learning from repository KMS is an active and constructive process, after reflecting upon the need for such knowledge [52,85]. Reliance on personal and social knowledge represents distinct pathways of this reflection.

Third, this study is among the first ones to examine the impact of knowledge bases and KMS use behaviors on individual performance. All four, i.e., both knowledge bases and both usage behaviors had a significant impact on individual performance after controlling for several factors. Furthermore, the interaction of knowledge bases and usage behaviors revealed important patterns. When individuals exhibit greater levels of usage intensity, a higher level of professional experience may serve to reduce the effort to process information and garner greater cognitive benefits from KMS use. That is, the individual with greater levels of personal knowledge possesses superior mental models to filter and process higher quantities of information [35]. Access to social knowledge does not provide the same synergies with intense use, perhaps because the additional overhead required to communicate and make collective sense of larger amounts of codified information [49,50] cancels out any positive effects. Alternately, the access to social knowledge functions as a complementary cognition mechanism when knowledge is acquired frequently. As such, frequent use provides greater opportunities to integrate codified knowledge with the tacit knowledge of others without the incurrence of much cognitive overhead. Additionally, such synergies do not result from usage frequency when individuals possess greater amounts of professional experience, perhaps because the metacognitive effects of frequent use allows those with less developed mental models to make rapid advancements in their learning and match the performance of experienced users over time [35].

Apart from the major contributions discussed, an additional contribution is the use of objective performance measures in this study. IS literature has often underscored the need to link information technology (IT) use to objective financial outcomes as an important aspect to understand its value within organizations [17,70]. The objective data used in this study complement prior literature by being one of the few to examine financial performance at the individual level of analysis in economic terms. As a result, we join an emerging line of research (e.g., [34,35]) which begins to provide an indication of the potential economic impact of KMS use. Compared to these studies, our results provide a finer grained view of economic benefits by not only quantifying but also contrasting the effects of the two knowledge bases and KMS use behaviors. Our results indicate that both knowledge bases have a positive impact on performance. Indeed, social knowledge (team tenure) has a greater impact on performance than experience (based on difference in coefficients test). Together, they account for approximately 16 percent increase in average commission. Similarly, for usage, a one standard deviation increase in usage frequency and intensity leads to an increase in average commissions by 5.9 percent and 2.2 percent, respectively. When totaling these effects, for an average agent (making approximately $80,000), the combined impact of a standard deviation increase in both behaviors can lead to about a $6500 increase in commissions. Accordingly, these results not only provide further counter-evidence to earlier claims that codification-based knowledge management initiatives are unlikely to generate value [36,44] but also provide an indication as to which usage behavior garners greater value.

8.2. *Implications for research*

This study has important dual implications for research. One, to a large extent, prior literature has focused on either personal cognition, or to a lesser extent, on social cognition to explain behavior toward KMS. The theoretical lens used either focuses on the individual or on the group, with very few attempts that transcend both [39]. If we want to avoid the euphemistic prophecy of the five blind men and the elephant, holistic approaches such as learning-based theories that combine behaviorism, personal cognitivism, and social cognitivism can provide key insights (Ertmer & Newby, 1993). In addition to this, SCT is particularly advantageous to combine the agentic perspective of human behavior along with the sociopsychological paradigm. For example, our results indicate that personal knowledge negatively impacts KMS use behavior. Two, few studies have examined the effects of behavior and cognition on individual performance. Our results indicate that both cognition (both personal and social) and KMS use behaviors impact performance. Furthermore, specific combinations of behavior and cognition are shown to impact performance positively. The results indicate support to contingency arguments that there may not be one

best way to use technology and may instead depend on the specific contingencies of the individual. An effective user of the KMS may therefore be the one who identifies and applies their own behavior to suit their context. More broadly, theories in KMS research that account for this contingency may help identify nuanced strategies rather than a one size fits all approach.

8.3. Implications for practice

The results of this study have three implications for practice. Organizations can create more effective knowledge repositories if they are cognizant about the motivations that drive individuals to use the system. A frequent complaint about KMS is that the knowledge contained is already known and thus, irrelevant. Managers can encourage users to use the KMS by communicating effectively about how the KMS can provide users with new knowledge. For example, managers can send out periodic emails that update users about the new information available on the KMS. Moreover, such communications are usually targeted to those who are less experienced. Second, by examining the frequency and intensity of use, managers may better cater the technology toward each usage pattern. For example, managers may encourage greater usage frequency by sending periodic notifications, by integrating the system within task workflows, and offering synchronization features. Managers may increase usage intensity to implement advanced search tools that help to identify new content, recommendation systems that offer content based on prior usage, and tag clouds, which allow for the social categorization of knowledge [42]. Finally, a great challenge with KMS is to encourage more usage. To convince users of the potential value of the KMS, organizations can provide testimonials of how KMS use helped individuals perform better in their job roles.

8.4. Limitations and future research

As is true of any research, our study is subject to certain limitations with regard to the *context* and the *data*, which future research could address in ways highlighted here. Regarding the contextual setting of this study, we examined the performance effects of repository KMS use with data gathered from a large organization in the real estate industry. Our contextual setting represents a situation wherein the use of the KMS, which is available to every agent in the organization, is completely voluntary. Future research in nonvoluntary contexts can explore how each usage component impacts performance. Furthermore, we could not examine the motivational antecedents for KMS use. Future insights into the role of incentives, rewards, and punishments, in both voluntary and nonvoluntary contexts, can lead to a finer grained understanding. Finally, there was no reasonable way for us to assess the quality of documents on the KMS repository because what one may consider useful may not be the same across individuals. While the quality of knowledge is relevant, we believe that this does not substantively alter our results for three reasons. First, the content on the KMS is created and vetted by a dedicated team of experts at the headquarters and not by users. Second, from a methodological perspective, the system is the same that is available to all agents. The only variation is in how much the system is used. Finally, our paper measures *actual* KMS use, and therefore, if the documents do not provide value, users are unlikely to use it, particularly in a voluntary situation like the setting of this study. Nonetheless, future research should examine the impact of these variables to further our understanding.

Our usage and performance data made a fine-grained examination of KMS use possible. Having said that, our usage data were limited to 10 months (i.e., from March to December) rather than the entire calendar year. While usage during the first 2 months is missing, it represents a small proportion of use for the entire year and is based on the 2 winter months where historically sales activity for residential properties is very low. Furthermore, we examined the correlation of usage behaviors across months and found that they are highly correlated, indicating that the behavior that is missing is likely to correlate highly with the data used in this study. Nonetheless, future studies that lack this limitation may serve to alleviate any concerns. In addition, we were unable to categorize the knowledge available to the agents through the KMS along relevant dimensions such as tacit/explicit because we had limited access to these documents. Future research that broadly examines the influence of these types of knowledge may help shed added light on the linkages explored in this study. Finally, we were unable to find instrumental variables to establish causality. However, causal attributions can be made for the following two reasons. Reason one, albeit in varied studies, the primary relationship between usage behaviors and outcomes are theoretically well established in IS literature. Reason two, as regards the interaction hypotheses, Bun and Harrison [11] demonstrate that the ordinary least squares (OLS) estimator of the interaction term of an endogenous regressor is consistent and standard OLS inference applies. Nonetheless, future studies that do not have this limitation may serve to underscore these results demonstrated here.

9. Conclusion

This study contributes to literature through the theoretical development and empirical investigation of repository KMS use. We recognize the role of personal and social knowledge to moderate these behaviors. We further identify the components of repository KMS use as usage frequency and usage intensity. We test the hypothesized research model on a comprehensive dataset of 18,219 real estate agents. Results indicate that both usage frequency and usage intensity influence individual financial performance. Furthermore, the efficacy of these usage behaviors differs across personal and social knowledge contexts. Our study provides a more comprehensive view of the interactions between behavior, cognition, and context in the KMS use domain. Gaining insight into this domain may be more crucial than ever before, given the ever increasing need for organizations to sustain competitive advantage by effectively disseminating knowledge to their members through technology. We hope that this study encourages the continued investigation of KMS use, its antecedents, and its outcomes.

Appendix A

Table A.1., Table A.2., Table A.3.

Table A.1
Number of Articles per Journal.

Information & Management	5
Journal of the American Society for Information Science & Technology	4
European Journal of Information Systems	3
MIS Quarterly	5
Decision Support Systems	2
Information Systems Research	2
Journal of Management Information Systems	2
Journal of Organizational & End User Computing	2
behavioral research in accounting	1
behavior & information technology	1
Communication Research	1
Communications of the Association for Information Systems	1
European Management Journal	1
Information Technology and Management	1
Journal of Computer Information Systems	1
Journal of Information Science	1
Journal of Information Systems	1
Journal of International Management	1
Journal of Knowledge Management	1
Journal of Management Studies	1
Journal of Organizational Computing & Electronic Commerce	1
Journal of the Association for Information Systems	1
Knowledge & Process Management	1
Learning Organization	1
Management Communication Quarterly	1
Online Information Review	1
Strategic Management Journal	1
Total	42

Table A.2
Repository KMS Use Constructs in Prior Research.

Study	Behavior	Construct	Method	Measures	Findings
Filieri and Willison (2016)	Effort-based	Knowledge Sourcing	Survey	The sourcing of knowledge archived into the KMS is easy. The sourcing of knowledge archived into the KMS is rapid.	*System reliability, system response time, system flexibility*, and *system integration* are positively related to knowledge sourcing.
Galunic et al. (2014)	Effort-based	Relational information Encyclopedic information, Diversity in information used	Log file Analysis	For each consultant, we classified the documents s/he used in these two categories and aggregated them into frequency counts for each year. The diversity of knowledge sources or objects accessed by each consultant was calculated as the sum of different types of knowledge objects accessed.	KMS use positively impacts *career advancement pace*, particularly for junior consultants.
Haas and Hansen (2005)	Effort-based	Utilization of codified knowledge	Survey	We asked the bid leaders to indicate on a 7-point scale (with anchors of "no documents consulted" and "a great number of documents consulted") their response to the following: "To what extent did the sales team consult documents available in Centra's electronic database."	Utilization of codified knowledge negatively impacts *team sales bid performance. Team experience* and *task competitiveness* increase the magnitude of the negative relationship.
Kankanhalli et al. (2005)	Effort-based	EKR usage for knowledge seeking	Survey	Level of usage of EKR Degree of reliance on EKR	*Perceived output quality* is positively related to EKR use. *Resource availability* is positively related *to EKR use*, particularly under conditions of *low task tacitness*. *Incentive availability* is positively related to EKR use, particularly under conditions of *high task interdependence*.
Kim et al. (2016)	Effort-based	Cumulative Repository KMS Usage	Log file Analysis	The cumulative number of knowledge documents viewed by each manager through the weekly level system-recorded repository usage	KMS usage by managers leads to *higher performance*. This relationship increases in magnitude when *sourcing from social sources* and when *task intensity* is greater – and decreases in magnitude when *sourcing from physical knowledge sources*, when *using a data warehouse*, and when *tasks change in information intensity*.
Ko and Dennis (2011)	Effort-based	KMS use	Log file Analysis	The number of knowledge documents displayed on an individual sales representative's screen in the current month and in the prior 3 months	KMS use increases performance for a short time. *Experienced* individuals gain immediate performance benefits over less experienced individuals but only temporarily.
Lai et al. (2014)	Effort-based	Knowledge seeking behavior	Survey	How many hours per week do you use the PVC for knowledge seeking?	Knowledge seeking intention is positively related to *knowledge seeking behavior*.
Poston and Speier (2005)	Effort-based	Content search and evaluation	Experiment/ Log file Analysis	Clickstream data were captured for each subject's experimental session. These data provided insight into which work plans were opened	*Ratings* influence KMS content and evaluation processes and *decision performance. Content credibility indicators* can moderate the relationship between rating validity and search and evaluation processes.
Poston and Speier (2008)	Effort-based	Search effort	Experiment/ Log file Analysis	Search effort was operationalized as the number of different work plans opened to gauge how much of the KMS content was selected	*Rating validity* differentially influences how KMS search and evaluation effort relates to *decision accuracy*.
Wang et al. (2013)	Effort-based	KMS use	Log file Analysis	The count of monthly system requests an individual made to obtain knowledge from the KMS	*Peer usage, subordinate usage*, and *prior usage* are positively related to current KMS use.
Chen et al. (2015)	Time-based	Intention to continue seeking knowledge through EKR	Survey	I intend to use the EKR system in the next 2 months I intend to use the EKR system for my work during the next 2 months I intend to use the EKR system frequently during the next 2 months	*Perceived usefulness* is positively related to intention to seek knowledge. The strength of this relationship differs across nations with varying *climato-economic characteristics*.
Child and Shumante (2007)	Time-based	Repository use	Survey	How often in the last week did you use the [Intranet database] to access a database to obtain information needed for your job that was not available elsewhere? How often in the last week did you use the [Intranet database] to access a database to obtain information needed for your job from persons you did not know?	An individual's frequency of repository use has no effect *on perceived team effectiveness*.
Choi and Durcikova (2014)	Time-based	Knowledge sourcing from knowledge repositories	Survey	I rarely use the knowledge repository as a way of acquiring knowledge (reverse coded) I frequently check in the knowledge repository when I need to improve my knowledge on a topic or issue When I am working on a challenging problem,	*Perceived usefulness* of a knowledge repository positively influences knowledge sourcing.

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Table A.2 (*continued*)

Study	Behavior	Construct	Method	Measures	Findings
				I often look in the knowledge repository to find solutions to similar problems	
Durcikova and Fadel (2016)	Time-based	KR knowledge sourcing	Survey	I rarely use the KR as a way of acquiring knowledge [reversed] I frequently check the KR when I need to improve my knowledge on a topic or issue When I am working on a challenging problem, I often look in the KR to find solutions to similar problems	Perceived knowledge repository *searchability, actionability*, and *support for contribution* are positively related to knowledge sourcing.
Durcikova and Grey (2009)	Time-based	KR knowledge sourcing	Survey	I rarely use the KBase as a way to acquire knowledge. (reversed) I frequently check in the KBase when I need to improve my knowledge on a topic or issue. When I work on a problem, I often look in the KBase to find solutions to similar problems. I often obtain knowledge through the KBase.	Knowledge sourcing is positively related to *perceived knowledge quality* and *knowledge contribution*.
Durcikova et al. (2011)	Time-based	KMS access	Survey	I rarely use KMS as a way to acquire knowledge (reverse coded). I frequently check in KMS when I need to improve my knowledge on a topic or issue. When I am working on a challenging problem, I often look in KMS to find solutions to similar problems.	There is no direct effect of KMS access on *solution reuse* or on *solution innovation*. In *innovative climates*, KMS access is positively related to solution innovation. In *autonomous climates,* KMS access is negatively related to solution innovation.
Gray and Durcikova (2005)	Time-based	Sourcing from repository	Survey	I rarely use the KM system as a way to acquire knowledge. (reverse coded) I frequently check in the KM system when I need to improve my knowledge on a topic or issue. When I am working on a challenging problem, I often look in the KM system to find solutions to similar problems.	*Learning orientation, time pressure*, and *risk aversion* are negatively related to sourcing from repository, *intellectual demand* is positively related to sourcing from repository.
He and Wei (2009)	Time-based	KMS continuance	Survey	Usage behavior data were collected by asking the respondents to report their time spent in the KMS for knowledge seeking	*Seeking intention and facilitating conditions* are positively related to seeking continuance. *Habit* positively moderates the relationship between intention and continuance.
He et al. (2009b)	Time-based	Usage Frequency	Survey	How regularly do you use KMS?	*Social relationship* is positively related to KMS usage.
Hester (2011)	Time-based	Usage	Survey	How often do you read or retrieve content available on the KMS	*Visibility* and *result demonstrability* are positively related to usage. Usage is positively related to *infusion*. The *perceived personal innovativeness in IT* of the user moderates the usage of the KMS.
Kankanhalli et al. (2011)	Time-based	Knowledge reuse	Survey	I am often able to apply the knowledge from the repository for my work I often find reuse through the repository is effective	*Intrinsic motivation* and *perceived knowledge repository capability* are positively related to knowledge reuse. Knowledge reuse is positively related to *performance benefit*.
Khedhaouria and Ribiere (2013)	Time-based	Knowledge sourcing from repositories	Survey	Members of my group "frequently check on the Internet when they need to improve knowledge on an issue"; and "often look on the Internet to find solutions to similar problems"	*Intellectual demand, risk aversion, relational capital*, and *learning orientation* are positively related to team knowledge sourcing. Team knowledge sourcing is positively related to *team creativity*.
Lin and Fan (2012)	Time-based	EKR Usage	Survey	How often do you use the [EKR] in your work? What is your frequency of using the [EKR]?	*Affective commitment* and *calculative commitment* are positively related to EKR usage.
Lin and Huang (2008)	Time-based	KMS usage	Survey	I frequently use KMSs to search knowledge in my work I regularly use KMSs to search knowledge in my work	*Task interdependence, perceived task technology fit, personal outcome expectations*, and *KMS self-efficacy* are positively related to KMS usage.
Lin and Huang. (2009)	Time-based	EKR usage for knowledge seeking	Survey	I frequently use EKRs to search knowledge in my work. I regularly use EKRs to search knowledge in my work. In general, the frequency of EKR usage for me is quite high	*Trust, task-technology fit*, and *EKR self-efficacy* are positively related to EKR usage.
Phang et al. (2009)	Time-based	Knowledge seeking	Survey	Frequently use the system to seek knowledge Regularly use the system to seek knowledge Use the system to seek knowledge [several times a day/several times a week/several times a month/once in a few months	*Perceived usability* and *perceived sociability* are positively related to knowledge seeking.
Su (2012)	Time-based	Use of digital knowledge repositories	Survey	During your last full week of work, how often did you use the organizational digital knowledge repository	Use of digital knowledge repositories is positively related to *expertise recognition* for remote workers.
Su and Contractor (2011)	Time-based	Frequency of information seeking from the digital knowledge repository	Survey	How frequent have you sought information from the intranet in each knowledge domain?	*Knowledge complexity* is negatively related to information seeking from digital knowledge sources. *Expertise recognition, accessibility*, and *social influence* are positively related to

(*continued on next page*)

Table A.2 (*continued*)

Study	Behavior	Construct	Method	Measures	Findings
					information seeking from digital knowledge sources.
Sutanto and Jiang (2013)	Time-based	Knowledge seeking	Log file Analysis	How often each knowledge item is accessed	The *average user ratings* of a shared knowledge item will positively influence the number of times it is accessed.
Teigland and Wasko (2009)	Time-based	Explicit knowledge access	Survey	Assessed by asking respondents to indicate how often they used specific knowledge sources	Greater levels of internal explicit knowledge access had no effect on either *efficient* or *creative performance*.
Watson and Hewett (2006)	Time-based	Frequency of knowledge reuse	Survey	Respondents were asked to indicate the frequency with which they access the four knowledge repositories	*Ease of access, training, trust*, and *value* are positively related to knowledge reuse. Knowledge reuse is positively related to *knowledge contribution*.
Zboralski (2009)	Time-based	Interaction frequency	Survey	How often members use different instruments and functionalities of the CoP	*Management support* is positively related to interaction frequency. Interaction frequency is positively related to *interaction quality*.
Doong and Wang (2009)	Time-and Effort-based	PKMS Usage: Number of PKMS functions Used PKMS usage frequency (distinct constructs)	Survey	How many functions supplied by Google Desktop have you used in the past month? Following the answer to the previous question, please list your frequency of use of each function you have indicated above	*User involvement* is positively related to usage frequency. *User innovativeness* is positively related to the number of functions used.
Teo and Men (2008)	Time-and Effort-based	Utilization frequency and intensity (compound construct)	Survey	On the average, how frequently do you use the K-portal in your company On the average, how much time do you spend per week using the K-portal in your company? Please indicate the extent to which you use the K-portal in your company to perform the following tasks to obtain knowledge	Utilization is positively related to *individual performance*.
Bock et al. (2006)	Unspecified	Usage of EKR for knowledge seeking	Survey	Usage of EKR for specific task Usage of EKR in general	*Collaborative norms, self-efficacy*, and *facilitating conditions* are positively related to knowledge seeking. *Future obligation* is positively related to knowledge seeking under greater collaborative norms while *perceived usefulness* is negatively related under greater collaborative norms.
Bock et al. (2010)	Unspecified	EKR continuance intention	Survey	I intend to continue using EKR rather than discontinue its use. If I could, I would like to continue my use of EKR. I will continue to use EKR in the future.	*Perceived usefulness* and *satisfaction* are positively related to EKR continuance intention.
Cheung et al. (2008)	Unspecified	Knowledge reuse	Experiment	Each of the subjects in the "without" groups was given a brief task description and a set of blank e-business model specification cards; while the "with" groups was given, in addition, access to a web-based knowledge repository.	Individuals who engage in knowledge reuse perform *less creatively* than those who do not. This negative relationship is stronger for individuals with *greater personal creativity*.
He et al. (2009a)	Unspecified	Knowledge seeking continuance intention	Survey	I intend to continue using KMS to seek knowledge in the future My intentions are to continue using KMS to seek knowledge in the next month If I could, I would like to continue using KMS to seek knowledge	*Perceived usefulness* and *satisfaction* are positively related to seeking continuance intention.
Lai (2009)	Unspecified	Intention to use KMS	Survey	Assuming that I had access to KMS, I intend to use it Given that I had access to KMS, I predict that I would use it.	*Reward, perceived usefulness, user satisfaction, ease of use*, and *perceived power security* are positively related to intention to use KMS.
Lin and Fan (2011)	Unspecified	Behavioral intention	Survey	I plan to keep using the EKR in the future. I intend to continue using the EKR in the future. I expect my use of the EKR to continue in the future	*Perceived usefulness* and *subjective norms* are positively related to behavioral intention.
McCall et al. (2008) [43]	Unspecified	Knowledge acquisition	Experiment	Participants had to access the materials provided by either the KMS or traditional reference materials to complete the task	KMS use is positively related to *performance*. KMS use is negatively related to *recall*. A user of a KMS embedded with explicit knowledge acquires more *interpretive problem-solving abilities* than an individual not using a KMS.
Wang et al. (2011)	Unspecified	Intention to use internal knowledge sources	Survey	How likely would you be to consult the knowledge repository when you need knowledge in the future	*Perceived relative value of internal knowledge* is positively related to intention to use internal knowledge sources. *Perceived image cost* is negatively related to intention to use internal knowledge sources.

Table A.3
Reviewed Articles

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Appendix B

Table B.1.

Table B.1
Alternate Specifications of the Full Model.

	Model 1 Alternate Usage Measures		Model 2 Alternate Personal Knowledge Measure		Model 3 Alternate Social Knowledge Measure	
Constant	9.374***	(0.062)	9.410***	(0.063)	9.316***	(0.064)
Population	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Per Capita Income	−0.000***	(0.000)	−0.000***	(0.000)	−0.000***	(0.000)
Med. Home Value	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)
Foreclosure Rate	−0.843	(0.541)	−0.834*	(0.540)	−0.902*	(0.558)
Office Size	0.001**	(0.001)	0.001***	(0.001)	0.002***	(0.001)
Office Age	0.002*	(0.001)	0.002*	(0.001)	0.002	(0.001)
Office Attrition	−0.005***	(0.002)	−0.006***	(0.002)	−0.004**	(0.002)
Office Expansion	0.009***	(0.002)	0.009***	(0.002)	0.010***	(0.002)
Prior Commissions	0.140***	(0.002)	0.141***	(0.002)	0.142***	(0.002)
Gender	−0.055***	(0.015)	−0.055***	(0.015)	−0.066***	(0.015)
Tenure	0.006***	(0.002)			0.008***	(0.002)
Team Size	0.006***	(0.001)	0.006***	(0.001)		
Prof. Experience	0.043***	(0.010)			0.038***	(0.008)
Team Membership	0.110***	(0.010)	0.111***	(0.010)		
Weekly Frequency	0.063***	(0.007)				
Weekly Intensity	0.019**	(0.007)				
Weekly Frequency x Prof. Experience	0.000	(0.008)				
Weekly Intensity x Prof. Experience	0.031***	(0.008)				
Weekly Frequency x Team Membership	0.024***	(0.007)				
Weekly Intensity x Team Membership	0.012	(0.008)				
Daily Frequency			0.056***	(0.007)	0.061***	(0.008)
Daily Intensity			0.024***	(0.007)	0.023***	(0.007)
(Experience + Tenure)			0.071***	(0.008)		
Frequency x (Experience + Tenure)			0.003	(0.008)		
Intensity x (Experience + Tenure)			0.026***	(0.008)		
Frequency x Team Membership			0.026***	(0.007)		
Intensity x Team Membership			0.009	(0.008)		
(Team Membership/Team Size)					0.071***	(0.007)
Frequency x Prof. Experience					0.008	(0.008)
Intensity x Prof. Experience					0.030***	(0.008)
Frequency x (Team Membership/ Team Size)					0.038***	(0.008)
Intensity x (Team Membership/ Team Size)					−0.005	(0.008)
Model degrees of freedom	20		19		19	
Log Likelihood	−25,166		−25,174		−25,339	

Standard errors in parentheses; $n = 18{,}219$; Number of groups: 1022 counties, 2743 offices; *** $p<0.01$, and ** $p<0.05$, * $p<0.1$.

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