# ON VALUE CREATION FROM KNOWLEDGE MANAGEMENT SYSTEMS

by

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## ABSTRACT

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Knowledge management systems (KMS) are a class of information systems used by organizations to support knowledge management initiatives. KMS come in many different forms, and serve multiple purposes in organizations. The pervasive implementation of KMS in practice has driven a continuing interest for information systems researchers to gain new insights into its multifaceted purpose. In theorizing the role of KMS in organizations, the majority of scholars have considered its potential in facilitating a wide range of knowledge management processes. Emerging from this early theoretical background, more recent empirical research has developed a firm understanding of the determinants of KMS use but is less clear on how KMS use influences task performance. As such, while theoretical literature has delivered valuable insights into the purposes that KMS serve, and empirical studies have revealed a broad range of antecedents of KMS usage, the central role of the human actor in using KMS to enhance performance has been underemphasized. This dissertation attempts to advance the understanding of how the use of KMS generates sustained value for organizations. In so doing, it builds from prior developments in information system use, organizational learning, and group learning literatures to draw new insights into how actors interact with technology to achieve desired task outcomes in the context of knowledge management.

This dissertation presents three papers which help to advance knowledge management research by expanding the KMS usage nomological network and identifying mechanisms which enable value creation. The first paper reviews empirical KMS articles published between 2001 and 2013 and suggests directions for future research. It presents a view of KMS as a socio-technical system with the primary purpose of transferring knowledge throughout the organization. This paper develops a guiding review framework identifying the organizational elements, behavioral actions, and knowledge outcomes that are inherent in KMS and argues that behavioral actions and knowledge outcomes may be viewed in future research as integrated parts of two value generating sub-processes: *learning from technology* and *learning from task*. I argue that the interplay between these sub-processes may present organizations with sustained value by helping to circulate knowledge between all three elements.

The second paper examines how acquisition behavior influences individual performance. Based on the assessment of acquisition constructs used in prior empirical research, and notions from self-regulation theory, I argue that acquisition behavior in the context of knowledge management consists of two primary dimensions: *acquisition frequency* and *acquisition intensity*. Furthermore, drawing from arguments in social cognitive theory, I build the case that the performance effects of each behavior are contingent on the personal knowledge (measured as professional experience) and social knowledge (measured as team participation) available to the acquiring individual. I test these hypotheses using a dataset of 18,219 real estate agents participating in a large real estate franchise through the use of hierarchical linear modelling (HLM), nesting individual agents within their franchise office and county. I find that the effects of acquisition frequency and acquisition intensity are positive and significant onto performance.

Furthermore, acquisition frequency positively interacts with team membership while acquisition intensity positively interacts with professional experience.

Lastly, the third paper examines the influence of repository KMS usage on group performance when considering the contingencies of group composition. Building from the notion of learning mechanisms, I conceptualize repository KMS usage as a group learning mechanism which increases the amount of organizational knowledge disseminating throughout the work group. Additionally, I identify three aspects of group composition which are likely to influence the learning benefits from repository KMS use by presenting barriers to the dissemination of knowledge within the group. I test the hypothesized effects using a data set of 3,092 work groups associated with the real estate franchise examined in Paper 2. I find that greater repository KMS usage by group members leads to an increase in group performance. Furthermore, I find that group size, knowledge heterogeneity, and membership change interact with repository KMS usage to reduce performance effects.

## DEDICATION

This dissertation is dedicated to my wife, Lisette,

and to my children, Caitlin, Ryan, Liam, and Ethan.

Thank you for your love and understanding.

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## INTRODUCTION

Knowledge management systems (KMS) are a class of information systems used by organizations to support knowledge management initiatives (Alavi and Leidner 2001). KMS come in many different forms, and serve multiple purposes in organizations, thus lending to the popularity of the concept in information systems research. For example, *repository KMS* are document databases designed to codify and share knowledge throughout the organization (Markus 2001). Repository KMS allow for the development and maintenance of organizational memory by facilitating the transfer of organizational knowledge across time and space (Stein and Zwass 1995). The primary purpose of repository KMS is therefore to disseminate *codified* knowledge via technology-mediated communications (Alavi and Leidner 2001). *Network KMS*, on the other hand, are designed to directly connect knowledge owners with knowledge users (Fahey and Prusak 1998). These systems are often implemented using electronic directories which map people to their domains of expertise (Alavi and Leidner 2001). As such, the intended purpose of network KMS is to facilitate the dissemination of *tacit* knowledge throughout the organization through direct person-to-person communication. Lastly, *conversational KMS* are designed to provide a virtual forum through which organizational members share implicit information and coordinate tasks (Wagner and Bolloju. 2005). Discussion forums, weblogs, and corporate wikis have emerged as conversational KMS technologies and provide individuals with a flexible knowledge sharing environment allowing for the capture of unstructured knowledge while also presenting histories of past conversations thus providing the means to share both *codified* and *tacit* forms of knowledge (Wagner 2006).

In theorizing the role of KMS in organizations, the majority of scholars have considered its potential in facilitating a wide range of knowledge management processes. Most notably, in

applying a view of organizations as knowledge systems (Holzner and Marx 1979; Pentland 1995), Alavi and Leidner (2001) argue that KMS fulfil four knowledge management processes 1) creation, 2) storage and retrieval, 3) transfer, and 4) application. They contend that the implementation of KMS may lead to knowledge creation by allowing organizational members to intermix their unique perspectives, increase storage and retrieval by supplying accessible retention facilities, enhance transfer by extending communication beyond formal lines, and facilitate application by embedding knowledge into organizational routines. Alternately, KMS are posited by Grover and Davenport (2001) to facilitate the generation, codification, and transfer of knowledge with the ultimate purpose of realizing value. Generation involves the acquisition and development of knowledge, codification entails the conversion of knowledge into reusable forms, and transfer includes the movement of knowledge from its point of origin to the point of reuse. Consistent with these studies, other researchers argue that KMS provide features which accommodate knowledge acquisition, retention, search, and retrieval (Stein and Zwass 1995), knowledge integration (Alavi and Tiwana 2002), and knowledge reuse processes (Markus 2001).

Emerging from this early theoretical background, more recent empirical research has developed a firm understanding of the determinants of KMS use but is less clear on issues faced when using KMS to influence task performance. This body of research typically leverages commonly used information system adoption theories as a basis to specify usage antecedents. From this research, we know that actors are more willing to use KMS to *contribute* knowledge when the technology is easy to use (Shin-Yuan et al. 2011), when seeking advancement in the organization (Watson and Hewett 2006), when it is enjoyable to help others (Kankanhalli et al. 2005a), when exhibiting greater self-efficacy (Chen et al. 2012), and when possessing greater

organizational tenure (Wasko and Faraj 2005). Furthermore, the use of KMS to *acquire* knowledge is shown to increase when actors perceive benefits of using the technology (Ardichvili et al. 2003; Li 2010), when motivated to learn (Chin-Yen et al. 2007), when positioned higher in the organization (Wang et al. 2013), and when perceiving greater usefulness of organizational knowledge (He et al. 2009). Relative to this streams of research, fewer empirical studies have sought to understand the purpose of the human actor in using KMS to influence performance. For example, Kim et al. (2016) and Haas and Hansen (2005) apply the situated performance perspective to posit that the use of KMS leads to positive outcomes when used appropriately. Similarly, Ko and Dennis (2011) apply the notion of learning curves to examine the performance benefits of KMS which emerge over time. Beyond a small number of empirical studies however there is not much research which explains and quantifies the learning benefits of KMS use.

In sum, while theoretical literature has delivered valuable insights into the purposes that KMS serve, and empirical studies have identified a broad range of antecedents of KMS usage, the central role of the human actor in using KMS to enhance performance has been underemphasized. As a result, several questions regarding the role of KMS usage in creating value for organizations remain unaddressed. In particular, how does the use of KMS lead to sustained value creation for organizations? How do individuals garner value from KMS use? How do groups benefit from the KMS use of its members? What contextual factors enable (or hinder) the potential benefits of KMS use for individuals and groups? It is important to answer these questions to advance the understanding of the benefits of using KMS in organizations and, as such, justify associated implementation and maintenance costs. I therefore suggest that

additional research is needed to 1) theoretically explain the role of KMS use in enhancing performance and 2) empirically examine the contingent effect of KMS usage on performance.

This dissertation attempts to advance the understanding of how the use of KMS generates sustained value for organizations. In so doing, it builds from prior developments in information system use, organizational learning, and group learning literatures to draw new insights into how actors interact with technology to achieve desired task outcomes in the context of knowledge management. Building from this research, the objectives of this dissertation are to 1) identify the behavioral actions and knowledge outcomes involved in using KMS, 2) explore the function of learning in sustaining benefits from KMS use, and 3) identify and examine important contingent factors which organizations should take into account when implementing knowledge management initiatives.

In setting out to address these objectives, this dissertation follows the three paper format. The first paper reviews empirical KMS articles published between 2001 and 2013 and suggests directions for future research. It presents a view of KMS as a socio-technical system with the primary purpose of transferring knowledge throughout the organization. This paper builds from common notions in knowledge management (Alavi and Leidner 2001; Davenport and Prusak 1998; Grover and Davenport 2001; Hansen et al. 1999; Gold and Malhotra 2001; Markus 2001) information technology use (Burton-Jones and Grange 2013; Burton-Jones and Straub 2006), and organizational learning literatures (Argote and Ingram 2000; Argote et al. 2003; Argote and Miron-Spektor 2011; Arrow et al. 2000; McGrath and Argote 2004) to develop a review framework identifying the organizational elements, behavioral actions, and knowledge outcomes that are inherent in KMS. The organizational elements consist of *actors*, *technologies*,

and *tasks*, behavioral actions entail *contribution*, *acquisition*, *application*, and *valuation* and knowledge outcomes comprise *content*, *learning*, and *performance*.

I use the guiding framework as an ontological foundation to systematically review articles sourced from management, knowledge management, and information systems journals. Using *EBSCO Business Source Complete*, *EBSCO Business Source Premier*, *EBSCO Academic Search Premier*, and *Proquest Central* as the source databases, I carefully selected 90 articles using a number of search criteria and a rigorous filtering process. Furthermore, I extracted and mapped the independent and dependent variables examined in these articles to the guiding review framework. This process resulted in the identification of 108 dependent variables, 54 of which were classified as behavioral actions and 54 of which were identified as knowledge outcomes. The process also revealed 248 independent variables, 145 of which predict a behavioral action and 103 of which predict a knowledge outcomes. Of these independent variables, 49 were classified as a behavioral action while the remainder was identified as either a characteristic of an organizational element or of the surrounding context. Furthermore, I identified 61 theoretical concepts which were used by authors to explain the hypothesized relationships between independent and dependent variables.

The further analysis of these relationships reveals several notable limitations in past research. First, the focus of prior research has particularly been on understanding the determinants of behavioral actions, with relatively less attention paid in understanding the relationships between behavioral actions and knowledge outcomes. Second, a broad spectrum of theoretical lenses from several reference disciplines are applied presenting partial explanations of the reciprocal knowledge transfers which occur between actors, technologies, and tasks. Third, within the articles focused on the antecedents of behavioral actions, research of

application and valuation behaviors is still in a developing stage. Fourth, within the articles focused on knowledge outcomes, less attention is given to content, individual learning, and individual performance outcomes. Fifth, when considering performance outcomes, the results are mixed. Overall, the review suggests that, in general, prior research is limited in its understanding of the value creating potential that results from the recurring sequences of behavioral actions and knowledge outcomes.

Taking these limitations into account I argue that behavioral actions and knowledge outcomes may be viewed in future research as integrated parts of two value generating sub-processes: *learning from technology* and *learning from task*. The learning from technology sub-process involves the linkages between *contribution*, *content*, *acquisition*, and *learning*. As such, it has the potential to generate value by continuously circulating knowledge between actors and technologies. In a similar manner, the *learning from task* sub-process closely combines task execution with the learning of actors via *application*, *performance*, *valuation* and *learning*. This sub-process therefore has the potential to add value by continuously circulating knowledge between actors and tasks. In addition to the two sub-processes, I argue that the interplay between *learning from technology* and *learning from task* may present organizations with sustained value by helping to circulate knowledge between all three elements.

Lastly, I suggest several areas for future research. First, I argue for the need to establish clear conceptual distinctions between behavioral actions and knowledge outcomes. Advancements in this area may help to determine the simultaneous role of multiple dimensions within each learning sub-process. Second, I recommend that researchers examine sequences of behavioral actions and knowledge outcomes via mediation or path analyses. Third, I suggest that researchers continue to further the understanding of how KMS can provide sustained value

within organizations by examining the role of the actor as a knowledge transfer conduit between technology and task. Lastly, I contend that more research is needed to understand the relative impact that antecedents may have across multiple behavioral actions. Such examinations would help to understand which determinants present a general effect across behavioral actions and which present an isolated effect.

The second paper in this dissertation examines how acquisition behavior influences individual performance. Based on the assessment of acquisition constructs used in prior empirical research, together with notions from self-regulation theory (Carver and Scheier 2001), I argue that acquisition behavior in the context of knowledge management consists of two primary dimensions: *acquisition frequency* and *acquisition intensity*. Furthermore, I contend that each of these behaviors influences individual performance outcomes through distinct pathways. For acquisition frequency, I suggest that individuals engage in an iterative learning cycle drawing their interaction with technology closer to their demands of the task environment (Burton-Jones and Grange 2013; Burton-Jones and Straub 2006) thus enacting an imbrication process (Leonardi 2011). This behavior allows individuals to rapidly test the usefulness of knowledge and improve the ability to use technology effectively. For acquisition intensity, I argue that individuals increase the overall set of codified resources for reuse (Tsoukas and Vladimirou 2001) thus expanding their knowledge within and across multiple domains (Zack 1999).This behavior helps individuals to equip themselves with a greater breadth and depth of knowledge to increase their communication (Carlile 2002) and innovation abilities (Majchrzak et al. 2005).

Furthermore, drawing from arguments in social cognitive theory (Bandura 1986, 2001a, 2001b), I build the case that the performance effects of each behavior are contingent on the

personal knowledge (measured as professional experience) and social knowledge (measured as team participation) available to the acquiring individual. I postulate that professional experience enhances the effects from acquisition frequency by providing individuals with greater task specific knowledge to effectively seek out and make use of knowledge within a virtuous learning cycle (Argote 2013; Pisano 1996). I also argue that professional experience positively influences the effects of acquisition intensity by reducing inefficiencies resulting from information overload (Edmunds and Morris 2000; Eppler and Mengis 2004; Kock 2000; Shick and Gordon 1990). Moreover, I contend that team membership amplifies the effects of acquisition frequency by affording individuals synergistic social learning effects (Kim et al. 2016) thus providing greater opportunities to share acquired knowledge with the team and increase the learning benefits of frequent knowledge acquisition. Lastly, I suggest that team membership enhances the effects of acquisition intensity by allowing individuals to rely on the expertise of others in the team to process greater amounts of knowledge (Wegner 1987; 1995).

I test these hypotheses using a dataset of 18,219 real estate agents participating in a large real estate franchise through the use of hierarchical linear modelling (HLM), nesting individual agents within their franchise office and county. I find that the effects of acquisition frequency and acquisition intensity are positive and significant onto performance thus supporting the first two hypotheses. Of the moderating hypotheses, only two are supported. Acquisition frequency positively interacts with team membership while acquisition intensity positively interacts with professional experience.

This paper has two important implications for research focused on acquisition behavior. First, it adds to literature that has begun to bridge the gap between the behavioristic paradigm and constructivism paradigm (Leidner and Jarvenpaa 1995). Prior literature has focused more

on understanding the behavioral aspects of the use of knowledge repositories, often concentrating on how much of a certain behavior was exhibited. The results highlight the importance of bridging the gap between understanding behavioral components, in relation to the individual cognition that these behaviors support. Second, it also serves to bridge the gap between cognitive constructivism, and collaborative constructivism (Leidner and Jarvenpaa 1995; Du and Wagner 2007). Cognitive constructivism highlights the role of individual's cognitive information processing in developing, testing, and refining mental models in the learning process. Collaborative constructivism, on the other hand, emphasizes the role of social interactions in building a shared understanding. The empirical results indicate nuance, in that, when combined with specific behaviors directed at technology, individual cognition and social interactions may represent independent pathways to individual learning.

This study holds two main implications for practice. The first practical implication from these findings is that acquiring individuals may increase the realized value of acquired knowledge by being cognizant not only of the codified knowledge which they acquire but also of the personal knowledge and social knowledge which is available to them. Second, the results from this study indicate that managers of codification-based knowledge management systems may pay heed to the acquisition behavior of individuals and seek ways to encourage favorable behavior. By examining the frequency and intensity of acquisition behavior, managers may seek ways to cater the system towards each usage pattern.

Lastly, the third paper in this dissertation examines the influence of repository KMS usage on group performance when considering the contingencies of group composition. Building from the notion of learning mechanisms (Friedman et al. 2005; Popper and Lipshitz 1998) I conceptualize repository KMS usage as a group learning mechanism which increases the

amount of organizational knowledge disseminating throughout the work group. Group members are hypothesized to increase group performance by using organizational knowledge retrieved from a repository KMS to coordinate collective action (Gruenfeld et al. 2000; Wilson et al. 2007; Van de Ven et al. 1976), and combining it with the group's tacit knowledge to generate new knowledge (Alavi and Leidner 2001; Nonaka 1994; Nonaka and Takeuchi 1995).

The activities involved in group learning, however, are likely to depend on the composition of the group (Campion et al. 1993; Guzzo and Shea 1992; Hackman and Morris 1975; Kozlowski and Bell 2013). In fact, group composition is held in prior research as "a theme in all models of effectiveness" (Campion et al. 1993, p.827). Based on this research, I identify three aspects of group composition which are likely to influence the learning benefits from repository KMS use by presenting barriers to the dissemination of knowledge within the group. First, group size is hypothesized to reduce the learning benefits of repository KMS usage by increasing freeriding and social loafing behaviors (Sheppard 1993), increasing coordination costs (O'Reilly and Roberts 1977; Steiner 1972), and increasing intragroup conflict (Steiner 1972; Valacich et al. 1995). Second, I argue that group knowledge heterogeneity attenuates learning benefits by creating multiple "thought worlds" (Dougherty 1992) and reducing the usefulness of organizational knowledge across task domains (Carlile 2002; 2004). Third, I contend that membership change decreases learning benefits by introducing inefficiencies when socializing new members (Moreland and Levine 1982, 1988) and stabilizing member relations (Arrow and McGrath 1993; Chandler et al. 2005).

I test the hypothesized effects using a data set of 3,092 work groups associated with the real estate franchise examined in Paper 2. I use HLM analysis nesting these workgroups within the county where they are located. Consistent with the hypotheses, I find that greater repository

KMS usage by group members leads to an increase in group performance. Furthermore, I find that group size, knowledge heterogeneity, and membership change interact with repository KMS usage to reduce performance effects. These results suggest that groups have the potential to use repository KMS to increase group performance but only when the number and type of group members is amenable to sharing and applying this knowledge to coordinate collective action.

The results of this study have important implications for knowledge management research. First, the results of the model support my standpoint that repository KMS usage serves as a learning mechanism to increase group performance, thus addressing a gap in prior literature. This study therefore provides a lens through which the relationship between repository KMS usage and group performance may be better understood. Second, this study suggests that each aspect of group composition presents unique challenges to the retrieval and sharing of organizational knowledge. This study therefore suggests that more research is needed to understand how such interventions help to offset the effects of each compositional aspect. Third, this paper evaluates the economic value of repository KMS usage in groups based on objective measures of usage and performance. This examination therefore presents new evidence of the differential value of repository KMS usage across groups. As a whole, this study complements past group KMS usage literature (Choi et al. 2010; Gallivan et al. 2003; Haas and Hansen 2005; Pavlou and El Sawy 2006) thus expanding the nomological network of group KMS use. Identifying this nomological network is especially important because groups have been seen across multiple literatures to play a critical role in facilitating organizational knowledge dissemination.

This study provides several implications for practice. For instance, this study suggests that by understanding that some groups benefit more from repository KMS usage than others, companies may focus their knowledge management efforts on groups which are more likely to learn from organizational knowledge. Alternately, for groups that have difficulty in learning due to their composition, companies may consider implementing a personalization knowledge management strategy (Hansen et al. 1999). This study also suggests that companies may take actions to alleviate the barriers introduced by group composition. For example, companies may increase group learning by staffing groups with members who are intrinsically motivated to share knowledge (Kankanhalli et al. 2005a; Wasko and Faraj 2005). Alternately, companies may create new roles assigned with the responsibility of retrieving and sharing knowledge throughout the group.

In summary, the purpose of the three papers in this dissertation was to advance the understanding of how the use of KMS generates sustained value for organizations. The first paper is a review paper which offers a framework to organize past empirical KMS research, identifies gaps in this research, and offers guidance on how future research may better understand how the ongoing transfer of knowledge between actors, technologies, and tasks generates sustained organizational value. The second paper proposes a model delineating two acquisition behavior dimensions: frequency and intensity, and two knowledge contexts: personal and social. The results of this paper indicate that acquisition frequency positively interacts with social knowledge (team participation) and acquisition intensity positively interacts with personal knowledge (professional experience). Finally, the third paper argues that repository KMS usage serves as a group learning mechanism to increase the performance of work groups. This paper provides an indication of the contingencies of group composition, in

particular group size, knowledge heterogeneity, and membership change. The results suggest that repository KMS usage has the potential to increase group learning but only when groups are configured to retrieve and share organizational knowledge to coordinate the collective actions of the group.

# PAPER 1: TOWARDS SUSTAINED VALUE FROM KNOWLEDGE MANAGEMENT SYSTEMS: A REVIEW AND SYNTHESIS


## ABSTRACT

Spread across several disciplines, literature on knowledge management systems (KMS) has served to further our understanding of the role of information technology in supporting organizational knowledge management initiatives. The objective of this study is to review and synthesize existing empirical literature, with the aim of furthering our understanding of how organizations can derive sustained value from KMS. We begin by developing a guiding framework for our review that establishes the ontological boundaries of the KMS concept comprised of three classes of organizational elements: actors, technologies, and tasks. Further, the transfer of knowledge between these core elements is conceptualized to occur through behavioral actions, which lead to knowledge outcomes. Next, we apply this framework to the articles on KMS that were published in information systems, knowledge management, and management journals between 2001 and 2013. Through our analysis, we find that prior KMS literature has focused on certain aspects of KMS, while ignoring others, leading to significant gaps in our understanding. Finally, we offer a view of KMS drawing attention to the importance of each action and outcome not just as independent inputs and outputs, but as links in a chain of relationships through which value is sustained.

## INTRODUCTION

Knowledge management systems (KMS) are a class of information systems that enables the creation, transfer, and application of knowledge throughout the organization (Alavi and Leidner 2001). Literature on KMS, across several disciplines, has served to further our understanding of the role of information technology in facilitating organizational knowledge management initiatives. To date, research has adopted a very flexible ontological approach to the KMS concept, applying it to understand and explain a variety of technological artifacts and their impact in the organization. For example, researchers have used the KMS concept in guiding the examination of conventional technologies such as knowledge repositories (Bock et al. 2006; Garud and Kumaraswamy 2005; Kankanhalli et al. 2005a; 2005b; Ko and Dennis 2011) and discussion forums (Van Den Hooff et al. 2010; Wasko and Faraj 2005), as well as more recent technologies such as corporate wikis (Arazy et al. 2011; Majchrzak et al. 2013; Pfaff and Hasan 2011) and blogging platforms (Wattal et al. 2010). Further, the KMS concept has been applied across a wide range of research areas including user adoption (e.g. Kankanhalli et al. 2005a), information systems success (e.g. Kulkarni 2006), decision support (e.g. Poston and Speier 2005; 2008), strategic alignment (Dulipovici and Robey 2013), technology support (Gallivan et al. 2003; Durcikova et al. 2011), new product development (Massey et al. 2002; Pavlou and El Sawy 2006), and IT value (Haas and Hansen 2005; Haas and Hansen 2007; Ko and Dennis 2011).

It has been recognized that the success of any information technology hinges on its continued use by organizational members, both in creating high quality content and also using this content to inform their work practices (Devaraj and Kohli 2003; Kankanhalli et al. 2005a). That is, the success of an information technology initiative depends on creating a critical mass

of users who are continuously engaged in the positive reinforcing cycle of content creation and use (Wang et al. 2013). Yet, literature suggests that several KMS initiatives fail to live up to their promise, and after initial excitement, often fall into disuse (Singh and Kant 2008; Lee et al. 2005; Davenport and Prusak 1998). Several potential reasons have been offered on why KMS initiatives may fail to deliver sustained value. For example, Chua and Lam (2005) review five case studies and recognize failure factors to stem not just from technology and content, but also from project management, organizational support and culture. In addition, the characteristics of the individual users such as their motivation to share knowledge, and social influences have also been argued to have an impact (Gallivan et al. 2003; Wang et al. 2013). Collectively, prior research suggests several probable reasons that may impede organizations from deriving sustained value from their KMS initiatives. In spite of the rich tradition of inquiry in KMS, how organizations can derive sustained value from their KMS initiatives, remains a lingering question. We argue here that a systematic review of KMS literature can provide insights, and thus be valuable to rejuvenate this important field of study.

The objective of this study is to review and synthesize existing empirical literature on KMS with the aim of furthering our understanding of how organizations can derive sustained value from its use. We begin by developing a guiding framework for our review that establishes the ontological boundaries of the KMS concept comprised of three classes of organizational elements: *actors, technologies, and tasks*. Further, the interplay between these core elements is conceptualized to occur through *behavioral actions*, which lead to *knowledge outcomes*. Next, we apply the review framework to guide our investigation of extant empirical research to recognize the actions and outcomes characterized in prior literature. As a result, we identify four types of actions based on the direction of knowledge transferred between the core elements;

*contribution* (from actor to technology), *acquisition* (from technology to actor), *application* (from actor to task), and *valuation* (from task to actor). We also identify the specific outcomes regarding state changes in each of the core elements; *content* (change in knowledge within technology), *learning* (change in knowledge within actors) and *performance* (change in knowledge within tasks). We recognize significant gaps in prior literature, which has led to an incomplete understanding of some of the critical aspects of KMS, while ignoring others. Finally, we offer a view of KMS that can further our understanding of how sustained value can be derived.

This study contributes to literature in three ways. First, the review framework advances the ontological and epistemological understanding of KMS. The framework draws from knowledge management (Alavi and Leidner 2001; Davenport and Prusak 1998; Grover and Davenport 2001; Hansen et al. 1999; Gold and Malhotra 2001; Markus 2001) information technology use (Burton-Jones and Grange 2013; Burton-Jones and Straub 2006), and organizational learning literatures (Argote and Ingram 2000; Argote et al. 2003; Argote and Miron-Spektor 2011; Arrow et al. 2000; McGrath and Argote 2004). It conceptualizes KMS as a socio-technical concept by placing actors as central links in the flow of knowledge between technologies and tasks (Argote and Ingram 2000) thereby enabling more holistic investigations of how human agency and material agency interrelate in the use and outcomes of technology (Leonardi 2011), thus grounding our understanding of KMS. Second, the study provides a comprehensive representation of the rich history of KMS research through its inventory of a broad article set which spans across multiple disciplines and methodological paradigms. Through the synthesis of extant empirical research, we identify its salient contributions and its limitations. Third, this

study offers a view of KMS suggesting that organizations gain value when behavioral actions and knowledge outcomes are closely interlinked.

## GUIDING REVIEW FRAMEWORK

To guide our review of empirical research, it is important to establish the things, events, and states that constitute the theoretical boundaries of KMS (Weber 2012). Setting theoretical boundaries is particularly relevant in reviews concerning a broadly defined concept, since the likelihood of synonymy and polysemy is far greater. Therefore, we begin by developing a guiding framework that recognizes the ontological boundaries of KMS and guides our assessment of empirical research. Prior research suggests that KMS phenomena are a rich confluence of social, technical, and teleological aspects of the organization (Alavi and Leidner 2001; Markus 2001; Boudreau and Robey 2005; Dishaw and Strong 1999; Goodhue and Thompson 1995; Maruping and Agarwal 2004; Orlikowski 2000; Zigurs and Buckland 1998). Three classes of elements have consistently been recognized in prior literature as human *actors*, *technologies* and *tasks*. Human actors are *organizational members who use technologies to transfer knowledge in the context of tasks* (Alavi and Leidner 2001), technologies are *the information systems used to facilitate knowledge transfer* (Alavi and Leidner 2001; Dennis et al. 2008; Stein and Zwass 1995), and tasks are *goal-directed functions performed by actors* (Zigurs and Buckland 1998; Thompson 2011).

Albeit under slightly varying labels, the recognition of actors, technologies, and tasks as the three fundamental components of an organizational system is well-established in information systems as well as organizational learning literatures. For example, some IS researchers have used the labels *users, systems* and *tasks* to explain the theoretical underpinning of effective use (Burton-Jones and Grange 2013; Burton-Jones and Straub 2006) and to examine how actors use

technologies to learn from tasks (Kuutti 1991; 1996). Others have used the labels, *people, technologies* and *tasks* in understanding how software is designed to better accommodate the collective socio-technical system allowing organizations to function (Bostrom and Heinen 1977). Similarly, in the organizational learning literature, researchers have used the labels *members, tools* and *tasks* in understanding the role that each of these elements plays in organizational learning (Argote and Ingram 2000; Argote et al. 2003; Argote and Miron-Spektor 2011; Arrow et al. 2000; McGrath and Argote 2004).

While these three classes of elements are ontologically independent, we focus on how these elements create organizational value through their interaction. In the context of KMS, we hold that value is created when knowledge transfers between each of the elements. The three elements communicate with each other through the *directional* transfer of knowledge. That is, knowledge transfers between the elements are vectors, with both magnitude and direction. When taking into consideration the directional nature of knowledge from one element to another, this allows for the identification of six knowledge transfer channels between the three elements (actors to technologies, technologies to actors, actors to tasks, tasks to actors, technologies to tasks, and tasks to technologies)[1].

Streams of information systems literature take interest in each of the six interactive relationships to various degrees. With respect to KMS literature, the relationships including actors are of greatest interest (Alavi and Leidner 2001). Given that knowledge itself originates

[1] It is possible to imagine a scenario where two actors interact with each other, without explicit use of technology. While knowledge may still be transferred between actors in this case, the phenomenon is beyond the scope of KMS literature because of the absence of technology. It is also possible to recognize knowledge transfers among technology-technology (systems integration), and task-task (organizational routines) dyads. While these are interesting phenomena and are the focus of attention in other domains, we focus on those that are of direct import to KMS literature here for the sake of brevity.

in the cognitive structures of actors (Polanyi 1966) knowledge management relies on actors as the primary active element that creates and applies knowledge. Actors cause knowledge transfers to occur thus acting as conduits through which all knowledge mobilizes throughout the organization (Nonaka 1994). The bidirectional communication channels between technologies and tasks (that do not involve actors in any way), while able to send information regarding states, properties, and events in the task environment, are unable to generate the justified true beliefs that originate in conscious thought central to the KMS domain (Alavi and Leidner 2001; Huber 1991; Nonaka 1994)[2]. Considering the active role of actors in knowledge management, we therefore hold that four interactive relationships are of interest to the human involvement in transferring knowledge: (1) actor-technology, (2) technology-actor, (3) actor-task, and (4) task-actor.

Building from this ontological foundation, we conceptualize these four actor-driven knowledge transfer relationships as *behavioral actions*, and label them as c*ontribution*, *acquisition*, *application*, and *valuation*. *Contribution* is the transfer of knowledge *from actors to technologies* that occurs when actors add and modify knowledge held in the technologies' storage media. This behavior has been labelled in prior theoretical literature as *codification* (Davenport and Prusak 1998; Grover and Davenport 2001; Hansen et al. 1999), *conversion* (Gold and Malhotra. 2001), *storing* (Alavi and Leidner 2001), and *sanitizing* (Markus 2001). *Acquisition* is the transfer of knowledge *from technologies to actors*, which occurs when actors identify and source knowledge from the technologies' storage media. This action is referred to in prior research as *retrieval* (i.e. Alavi and Leidner 2001), *selection* (Markus 2001), and

[2] Within IS literature, the direct interplay between technology and task elements has been recognized in studying alignment (Henderson and Venkatraman 1993; Reich and Benbasat 1996) and fit (Goodhue and Thompson 1995).

*searching* (Hansen and Haas 2001). *Application* is the transfer of knowledge *from actors to tasks*, which occurs when actors use knowledge in the task environment. Application is referred to in prior literature as *realization* (Grover and Davenport 2001), *doing* (Pfeffer and Sutton 2000), and *reuse* (Markus 2001). Lastly, *valuation* is the transfer of knowledge *from tasks to actors*, which occurs when actors assess the value of knowledge used during the execution of tasks. Past literature refers to this behavior as *assessment* (Hansen and Haas 2001; Malhotra 2001), *evaluation* (Grover and Davenport 2001), and *valuing* (Boisot 1998).

Knowledge management is concerned with not only the flow of knowledge between elements, but also the stocks of knowledge that form within elements because of these flows (Alavi and Leidner 2001). Through behavioral actions, knowledge transfers to each of the elements drives state changes in knowledge held within. We term such state changes collectively as *knowledge outcomes*. *Content outcomes* are state changes within knowledge embedded in technologies as assessed by changes in quantitative and qualitative properties of the knowledge content (Alavi and Leidner 2001; Alavi and Tiwana 2002; Boland and Tenkasi 1995; Carlile 2004; Stein and Zwass 1995). *Learning outcomes* are state changes within the cognitive structures of actors as measured by changes in the depth and breadth of knowledge (Alavi and Leidner 2001; Boisot 1998; Brown and Duguid 1991; Carlile 2002; Crossan et al. 1999; Carlile and Rebentisch 2003; Gray and Meister 2004; Lave and Wenger 1991; Popper 1972; Wenger et al. 2002). Lastly, *performance outcomes* are state change in knowledge situated in tasks as assessed by changes in task performance. Performance outcomes are observable through measures of task efficiency and effectiveness (Argote and Ingram 2000; Argote et al. 2003; Argote and Miron-Spektor 2011; Arrow et al. 2000; McGrath and Argote 2004).

In total, the guiding review framework provides a conceptual delineation between the organizational elements, behavioral actions, and knowledge outcomes that interrelate within the operation of a KMS thus offering a lens through which we systematically examine prior literature. This guiding framework provides a foundation upon which we first organize prior literature into distinct segments and later integrate this literature into a greater whole. The review framework used to guide the remainder of this paper is illustrated below in Figure 1.

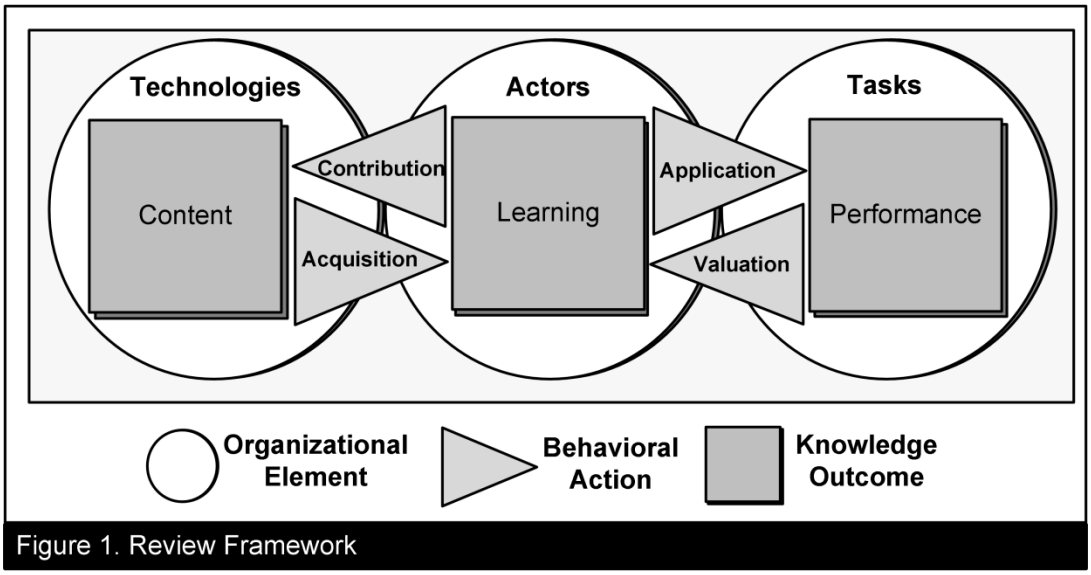


Figure 1. Review Framework

## ANALYSIS OF PRIOR RESEARCH

In the sections that follow, we apply the review framework as a lens to examine past KMS articles. In so doing, we outline the search and selection process, describe key characteristics of the selected articles, map dependent variables from the article set to the behavioral actions and knowledge outcomes defined in the guiding framework, identify the determinants of behavioral actions and knowledge outcomes, summarize prior findings, and identify the limitations of prior research.

### Search and Selection Process

In order to identify a set of articles that are representative of the general body of empirical KMS use research, we followed a search and selection process that allowed us to draw from a broad range of journals (Vom Brocke et al. 2009). During the search process we sought to identify articles that were published after the introduction of KMS by Alavi and Leidner (2001) by choosing articles published between 2001 and 2013 from within a basket of more than 130 Information System journals listed in the Association for Information Systems (AIS) journal rankings[3]. As shown in Appendix A, we generated a list of KMS-related search terms by following the procedure of Rowley and Slack (2004) wherein we included terminology used in early KMS articles.

The literature search was conducted in the *EBSCO Business Source Complete*, *EBSCO Business Source Premier*, *EBSCO Academic Search Premier*, and *Proquest Central* databases. After downloading and examining the results, we made an initial selection of candidate articles that empirically investigate behavioral actions and knowledge outcomes. The reference sections

[3] http://ais.affiniscape.com/displaycommon.cfm?an=1&subarticlenbr=208 [6-26-2013]

from these articles were then extracted and aggregated to identify instances of influential papers that fell outside the initial basket of journals. In total, 1,777 articles were downloaded and examined. After retaining empirical (quantitative and qualitative) studies that examined determinants and outcomes of behavioral actions, we honed this selection down to 124 papers.

Based on a careful reading of these 124 papers, we removed 34 papers. These papers were omitted from further analysis as they confounded multiple behavioral actions within a general construct making analysis intractable. For example, some studies aggregated contribution and acquisition behavior within the general construct of *KMS use*. Others aggregated these same behavioral actions under a general *knowledge sharing* construct. In either case, the aggregation of contribution and acquisition actions prevented the accurate identification of specific behavioral actions. When this confounding of behaviors occurred during the examination of the outcomes of behavioral actions (content, learning, and performance) we were able to construe the associated behavioral action based on the focal outcome of interest. For instance, studies that examine content outcomes were particularly concerned with the influence of knowledge contribution behavior on the content quality, those that examined learning outcomes primarily focused on the impact of knowledge acquisition, and those that examined performance outcomes highlighted the role of knowledge application. To ensure reliability in this removal process, the three authors independently identified confounded constructs and then collectively compared results until reaching full agreement. A complete list of the articles included in the review is shown in Appendix B.

## Characteristics of the Selected Articles

As summarized in Table 1 the final article set retained for analysis originated from 34 different journals spanning across strategic management, knowledge management, and information systems disciplines. Generally speaking, the strategic management discipline has shown interest in KMS as a driver of organizational learning and performance (i.e. Garud et al. 2006; Haas and Hansen 2005; Haas and Hansen 2007; Kane and Alavi 2007; Vaast 2007). The knowledge management discipline adds insights into the social and cultural determinants of behavioral actions, which allow the KMS to operate (i.e. Ardichvili et al. 2003; Ardichvili et al. 2006; Iyer and Ravindran 2009; Jeon et al. 2011; Li 2010). The information systems discipline delves further into the role of technology as a facilitating mechanism that helps to support behavioral actions and increases the occurrence of favorable knowledge outcomes (i.e. Bera et al. 2011; Choi et al. 2010; Poston and Speier 2005; 2008; Majchrzak et al. 2005; Majchrzak et al. 2013; Pavlou and El Sawy 2006).

| Table 1. Distribution of Articles Across Journals | |
|---|---|
| *MIS Quarterly* | 12 |
| *Journal of Knowledge Management* | 8 |
| *Journal of Management Information Systems* | 8 |
| *Information Systems Research* | 5 |
| *Journal of the American Society for Information Science & Technology* | 5 |
| *Decision Support Systems* | 4 |
| *European Journal of Information Systems* | 4 |
| *Information & Management* | 3 |
| *Information Resources Management Journal* | 3 |
| *Journal of Computer Information Systems* | 3 |
| *Journal of Information Systems* | 3 |
| *Journal of Organizational and End User Computing* | 3 |
| *Communications of the ACM* | 2 |
| *Information Technology & People* | 2 |
| *International Journal of Knowledge Management* | 2 |
| *Journal of Management Studies* | 2 |
| *Knowledge and Process Management* | 2 |
| *Organization Science* | 2 |
| *Strategic Management Journal* | 2 |
| *Behaviour & Information Technology* | 1 |
| *Communication Research* | 1 |
| *Computers in Human Behavior* | 1 |
| *Decision Sciences* | 1 |
| *Group Decision and Negotiation* | 1 |
| *IEEE Transactions on Knowledge & Data Engineering* | 1 |
| *Information & Organization* | 1 |
| *International Journal of Information Management* | 1 |
| *International Journal of Management Innovation Systems* | 1 |
| *Journal of Global Information Technology Management* | 1 |
| *Journal of Information Technology* | 1 |
| *Knowledge-Based Systems* | 1 |
| *Omega* | 1 |
| *Organization Studies* | 1 |
| *The Journal of Computer Information Systems* | 1 |
| ***Total*** | 90 |

To gain a sense of the technologies examined, we took note of the specific types of information systems mentioned in each article. As shown in Table 2, of the 33 different information systems mentioned within the article set, *knowledge repositories* were examined most (n = 38), followed by *discussion forums* (n = 15), *KMS applications* (n = 15), *knowledge portals* (n = 8), *email* (n = 7), *Intranets* (n = 6), and *groupware* (n = 4). A handful of specialized technologies such as *customer relationship management systems* and *learning management*

*systems* are also examined. Furthermore, several studies examined a wide range of general communication technologies such as *video conferencing*, *email*, and *instant messaging*.

The presence of such a large variety of technologies indicates that prior definitions of KMS have afforded researchers a wide berth to apply these definitions across virtually all forms of communication technology. For example, the definition of KMS provided by Alavi and Leidner (2001), which has had a considerable impact on articles from the information systems discipline establishes the general role of KMS technology but leaves characteristics of technologies unspecified. Research has begun to extend these general definitions by recognizing specific characteristics of the technological artifact that are of importance to the outcomes of interest. For example, Dudezert and Leidner (2011) hone in on the specific features of knowledge maps which are shown to impact the success of knowledge management, Majchrzak et al. (2013) identify the characteristics of corporate wikis that have an influence on the collaboration efforts of individuals, and Poston and Speier (2005, 2008) focus on the features of knowledge repositories which influence decision making.

| Table 2.Frequency of Technologies in Selected Articles | | | |
|---|---|---|---|
| 1. Knowledge Repository | 38 | 18. Blogging Platform | 1 |
| 2. Discussion Forum | 15 | 19. Bulletin Boards | 1 |
| 3. KMS Application | 15 | 20. Collaboration Technology | 1 |
| 4. Knowledge Portal | 8 | 21. Customer Relationship Management System | 1 |
| 5. Email | 7 | 22. Document Management System | 1 |
| 6. Intranet | 6 | 23. Electronic Performance Support System | 1 |
| 7. Groupware | 4 | 24. Expert Directory | 1 |
| 8. Information Technology | 3 | 25. Helpdesk Application | 1 |
| 9. Video Conferencing | 3 | 26. Intelligent Search Tool | 1 |
| 10. Virtual Team Rooms | 3 | 27. Knowledge Base | 1 |
| 11. Corporate Wiki | 2 | 28. Knowledge Sharing System | 1 |
| 12. Database | 2 | 29. Knowledge Visualization Mechanism | 1 |
| 13. Document Database | 2 | 30. Learning Management System | 1 |
| 14. Instant Messaging | 2 | 31. Multiuser Networking System | 1 |
| 15. Knowledge Directory | 2 | 32. Public Knowledge Spaces | 1 |
| 16. Knowledge Map | 2 | 33. Webpages | 1 |
| 17. Wikipedia | 2 | Total | 132 |

The article set chosen for our analysis draws upon multiple methodological paradigms across individual and collective levels of analysis. As indicated in Table 3, surveys were employed most often (n = 42) of which most focused on the analysis of individuals (n = 28), followed by organizations (n = 6), and groups (n = 6). Second to surveys were case studies (n = 25) which focused on the analysis of organizations (n = 11), individuals (n = 7), and groups (n = 5). Experiments were employed on ten occasions all focused on individuals, followed by a small number of objective data analyses focused on the behavior of individuals (n = 4) and on characteristics of the content held in technologies (n = 2). Only three studies employed multiple methods, two of which focused on individuals and one that crossed multiple levels of analysis. Finally, two studies examined organizational effects through simulation methodologies.

| Table 3. Level of Analysis and Methodology | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Methodology | | | | | | |
| | | Survey | Case Study | Experiment | Objective Data | Mixed Methods | Simulation | Total |
| Level of Analysis | Individual | 28 | 7 | 10 | 4 | 2 | 0 | **51** |
| | Organizational | 6 | 11 | 0 | 1 | 0 | 2 | **20** |
| | Group | 6 | 5 | 0 | 0 | 0 | 0 | **11** |
| | Multi-Level | 1 | 2 | 0 | 0 | 1 | 0 | **4** |
| | Content | 0 | 0 | 1 | 2 | 0 | 0 | **3** |
| | Inter-Organizational | 1 | 0 | 0 | 0 | 0 | 0 | **1** |
| | **Total** | **42** | **25** | **11** | **7** | **3** | **2** | **90** |

## Dependent Variables

Using the review framework as a guide, we further extracted and clustered the dependent variables examined in the article set into behavioral action and knowledge outcome categories. In extracting the dependent variables, we found that 74 articles examined one dependent variable, 14 articles examined two dependent variables, and 2 articles examined three dependent variables for a total of 108 dependent variables. In grouping these dependent variables, we first performed an initial sort that divided the variables into two high-level categories - *behavioral actions* and *knowledge outcomes*. As a result, we found an even split (54 each) between behavioral actions and knowledge outcomes. We then further divided these variables into the four behavioral action groups (contribution, acquisition, application, and valuation) and the three knowledge outcome groups (content, learning, and performance). To ensure the accuracy of this grouping process, we conducted this process independently between the three authors and iteratively reconciled differences until full agreement was reached. This reconciliation was especially necessary when articles used identical labels for conceptually distinct variables. For example, one study defines *knowledge reuse* as the degree to which knowledge is used to execute individual tasks (categorized as application) while in another study it is defined as the

degree to which KMS use impacts the work routines of the collective (categorized as collective learning). Further detail regarding the categorization of these variables can be found in Appendix C.

The first *behavioral action* group, *knowledge contribution*, contains 29 dependent variables (26.9 percent of all extracted dependent variables). These variables measure behaviors driving the transfer of knowledge from actors to technologies. Variables such as *adding contribution* (Majchrzak et al. 2013), *information provision* (Huang et al. 2013), *intention to share* (e.g. Chen et al. 2012), *knowledge contribution* (e.g. Kankanhalli et al. 2005a), *knowledge sharing* (e.g. Choi et al. 2010) and *shaping contribution* (Majchrzak et al. 2013) belong to this group. The second behavioral action group, *knowledge acquisition*, accounts for 14 variables (13.0 percent) measuring behaviors that cause knowledge to transfer from the technologies to actors. Examples include *content search and evaluation* (Poston and Speier 2005), *knowledge consumption* (Li 2010), *knowledge identification* (Bera et al. 2011), *knowledge seeking* (He et al. 2009), and *knowledge sourcing* (Gray and Durcikova 2005).

The third behavioral action group, *knowledge application*, contains 7 variables (6.5 percent) measuring the transfer of knowledge from actors to tasks. Examples include *knowledge application* (Choi et al. 2010) *knowledge reuse* (Watson and Hewett 2006) *knowledge use* (Kulkarni et al. 2006) *solution innovation* (Durcikova et al. 2011) and *solution reuse* (Durcikova et al. 2011). The fourth and least represented behavioral action group, *knowledge valuation*, contains four variables (3.7%) measuring the attribution of value to previously applied knowledge. Examples include *perceived benefits* (Halawi et al 2007), *perceived effectiveness* (Sabherwal and Becerra-Fernandez 2003), and *perceived productivity* (Walczak and Mann 2010).

Variables in the first *knowledge outcome* group, *content*, measure characteristics of codified knowledge held in technologies. This group contains 10 dependent variables (9.3 percent) including *helpfulness of contributions* (Wasko and Faraj 2005), *information quality* (Arazy et al. 2011), *knowledge acquisition* (Wagner 2006), *knowledge popularity* (Sha et al. 2013), *knowledge quality* (Jang-Hwan et al. 2006), and *perceived content quality* (Durcikova and Gray 2009).

Interestingly, while we did not specify level of analysis differences in learning and performance outcomes in the guiding review framework, the extraction of dependent variables revealed clear conceptual differences between individual and collective levels of analysis. To account for these distinctions throughout the remainder of our analysis, we further separated these groups into individual and collective subgroups. The *individual learning* subgroup accounts for five variables (4.6 percent), which measure changes to individual cognitive structures and abilities. Example variables include *expertise recognition* (Su 2012), *learning outcome* (Chin-Yen et al. 2007), and *knowledge attainment* (Majchrzak et al. 2005). The *collective learning* subgroup contains 17 (15.7 percent) variables that measure changes in collective knowledge structures and capabilities. Example variables include *dynamic capabilities* (Pavlou and El Sawy 2006), *knowledge dissemination* (Garud et al. 2006), and *KMS success* (Kamla Ali and Olfman 2005).

The *individual performance* subgroup accounts for nine individual level variables (8.3 percent) measuring changes in individual task performance such as *creative performance* (Cheung et al. 2008), *decision making performance* (Poston and Speier 2008), and *job performance* (Ko and Dennis 2011). The *collective performance* subgroup contains 13 variables (12.0 percent) measuring changes in collective tasks such as *financial performance* (Feng et al.

2004), *organizational performance* (Lee and Choi 2003) and *team performance* (Haas and Hansen 2005). A summary of example behavioral action and knowledge outcome variables can be seen in Table 4.

| Table 4. Example Behavioral Action and Knowledge Outcome Variables | | | | |
|---|---|---|---|---|
| | **Construct** | **Definition** | **Example Variables** | **Source Studies** |
| **Behavioral Actions** | Contribution n=29 *(26.9%)* | The transfer of knowledge from actors to technologies which occurs when actors add and modify knowledge content | Adding contribution<br>Information provision<br>Intention to share<br>Knowledge contribution<br>Team knowledge sharing<br>Shaping contribution | Majchrzak et al. (2013)<br>Huang et al. (2013)<br>Chen et al. (2012)<br>Kankanhalli et al. (2005a)<br>Choi et al. (2010)<br>Majchrzak et al. (2013) |
| | Acquisition n=14 (13.0%) | The transfer of knowledge from technologies to actors which occurs when actors identify and source knowledge content | Content search<br>Knowledge consumption<br>Knowledge identification<br>Knowledge seeking<br>Knowledge sourcing | Poston and Speier (2005)<br>Li (2010)<br>Bera et al. (2011)<br>He et al. (2009)<br>Gray and Durcikova (2005) |
| | Application n=7 (6.5%) | The transfer of knowledge from actors to tasks which occurs when actors use knowledge in the task environment | Team knowledge application<br>Knowledge reuse<br>Knowledge use<br>Solution innovation<br>Solution reuse | Choi et al. (2010)<br>Watson and Hewett (2006)<br>Kulkarni et al. (2006)<br>Durcikova et al. (2011)<br>Durcikova et al. (2011) |
| | Valuation n=4 (3.7%) | The transfer of knowledge from tasks to actors which occurs when actors assess the value of applied knowledge | Perceived benefits<br>Perceived effectiveness<br>Perceived productivity | Halawi et al. (2007)<br>Sabherwal and Becerra-Fernandez (2003)<br>Walczak and Mann (2010) |
| **Knowledge Outcomes** | Content n=10 (9.3%) | State changes within knowledge embedded in technologies as assessed by changes in quantitative and qualitative properties of knowledge content | Helpfulness of contribution<br>Information quality<br>Knowledge acquisition<br>Knowledge popularity<br>Knowledge quality<br>Quality of response<br>Perceived content quality | Wasko and Faraj (2005)<br>Arazy et al. (2011)<br>Wagner (2006)<br>Sha et al. (2013)<br>Jang-Hwan et al. (2006)<br>Hahn and Wang (2009)<br>Durcikova and Gray (2009) |
| | Individual Learning n=5 (4.6%) | State changes within individual cognitive structures as observed in changes in the depth and breadth of individual knowledge | Expertise recognition<br>Learning outcome<br>Knowledge attainment | Su (2012)<br>Chin-Yen et al. (2007)<br>Majchrzak et al. (2005) |
| | Collective Learning n=17 (15.7%) | State changes within collectives as measured by changes in the depth and breadth of collective knowledge | Dynamic capabilities<br>KMS success<br>Knowledge dissemination<br>Knowledge sharing practices<br>Knowledge reuse | Pavlou and El Sawy (2006)<br>Kamla Ali and Olfman (2005)<br>Garud et al. (2006)<br>Dulipovici and Robey (2013)<br>Majchrzak et al. (2013) |
| | Individual Performance n=9 (8.3%) | State changes in situated knowledge as assessed by changes in the efficiency and effectiveness of performance at the individual level of analysis | Creative performance<br>Decision accuracy<br>Decision performance<br>Job performance<br>Problem resolution performance | Cheung et al. (2008)<br>Poston and Speier (2008)<br>Poston and Speier (2005)<br>Ko and Dennis (2011)<br>González et al. (2005) |
| | Collective Performance n=13 (12.0%) | State changes in situated knowledge as assessed by changes in the efficiency and effectiveness of performance at collective levels of analysis | Financial performance<br>Organizational performance<br>Organizational productivity<br>Team Performance | Feng et al. (2004)<br>Lee and Choi (2003)<br>Jennex (2008)<br>Haas and Hansen (2005) |

## Independent Variables

We further extracted the independent variables for which studies indicated an effect on the dependent variables previously extracted. In the case of quantitative studies, this effect was based on statistical significance. In the case of qualitative studies, this effect was based on case evidence. The independent variable extraction process resulted in the identification of 248 variables - 145 predicting a behavioral action and 103 predicting a knowledge outcome. In an effort to organize these variables into coherent categories, we grouped them based on whether they measure one of the four behavioral actions (contribution, acquisition, application, or valuation), a characteristic of one of the three classes of elements (i.e., properties of actors, technologies, or tasks), or a factor related to the broader social and organizational contexts within which knowledge transfer between the organizational elements occurs (Argote and Miron-Spektor 2011). For simplicity, we grouped interaction effects as a separate category since these interactions often cross multiple categories.

As Table 5 indicates, within the examination of behavioral actions, researchers have primarily examined determinants of contribution (n = 82), followed by acquisition (n = 32), application (n = 20), and valuation (n = 11). The majority of these variables are characteristics of actors (n = 39) followed by organizational factors (n = 29), social factors (n = 24), interactions (n = 23), characteristics of technologies (n = 19), characteristics of tasks (n = 7), and other behavioral actions (n = 4). Within the examination of knowledge outcomes, researchers focused mainly on the determinants of collective learning (n = 33), followed by collective performance (n = 27), content (n = 18), individual performance (n = 16), and individual learning (n = 9). Across these variables, most fall within the behavioral action category (n = 45) followed by organizational factors (n = 16), characteristics of technologies (n

= 18), interactions (n = 11), characteristics of actors (n = 5), characteristics of tasks (n = 5), and social factors (n = 3).

Table 5.Determinants of Behavioral Actions and Knowledge Outcomes

| | | Behavioral Actions | | | | | Knowledge Outcomes | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contribution | Acquisition | Application | Valuation | **Subtotal** | Knowledge Content | Individual Learning | Collective Learning | Individual Performance | Collective Performance | **Subtotal** | **Total** |
| **Actions** | Contribution | *0* | *0* | *0* | *0* | ***0*** | *0* | *0* | *2* | *0* | *0* | ***2*** | ***2*** |
| | Acquisition | *0* | *0* | *1* | *0* | ***1*** | *0* | *4* | *16* | *0* | *0* | ***20*** | ***21*** |
| | Application | *0* | *0* | *0* | *3* | ***3*** | *0* | *0* | *0* | *10* | *13* | ***23*** | ***26*** |
| | Valuation | *0* | *0* | *0* | *0* | ***0*** | *0* | *0* | *0* | *0* | *0* | ***0*** | ***0*** |
| | **Subtotal** | ***0*** | ***0*** | ***1*** | ***3*** | ***4*** | ***0*** | ***4*** | ***18*** | ***10*** | ***13*** | ***45*** | ***49*** |
| **Elements** | Actor | *19* | *11* | *7* | *2* | ***39*** | *5* | *0* | *0* | *0* | *0* | ***5*** | ***44*** |
| | Technology | *5* | *5* | *5* | *4* | ***19*** | *5* | *3* | *6* | *1* | *3* | ***18*** | ***37*** |
| | Task | *4* | *3* | *0* | *0* | ***7*** | *1* | *0* | *1* | *1* | *2* | ***5*** | ***12*** |
| | **Subtotal** | ***28*** | ***19*** | ***12*** | ***6*** | ***65*** | ***11*** | ***3*** | ***7*** | ***2*** | ***5*** | ***28*** | ***93*** |
| **Context** | Social | *19* | *3* | *1* | *1* | ***24*** | *3* | *0* | *0* | *0* | *0* | ***3*** | ***27*** |
| | Organizational | *22* | *4* | *3* | *0* | ***29*** | *3* | *0* | *7* | *0* | *6* | ***16*** | ***45*** |
| | Interactions | *13* | *6* | *3* | *1* | ***23*** | *1* | *2* | *1* | *4* | *3* | ***11*** | ***34*** |
| | **Subtotal** | ***54*** | ***13*** | ***7*** | ***2*** | ***76*** | ***7*** | ***2*** | ***8*** | ***4*** | ***9*** | ***30*** | ***106*** |
| | **Total** | ***82*** | ***32*** | ***20*** | ***11*** | ***145*** | ***18*** | ***9*** | ***33*** | ***16*** | ***27*** | ***103*** | ***248*** |

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## Theoretical Concepts

To understand the theoretical underpinnings of prior literature, we note the theoretical concepts that authors applied. As a result, we identified 61 unique theoretical concepts used on 134 occasions. As shown in Table 6, many of these concepts originate from the information systems and strategic management disciplines as well as broader reference disciplines such as sociology, psychology, and economics. A large share of the theoretical concepts applied in the article set are used to identify characteristics of actors, technologies, and tasks that drive behavioral actions (e.g. the cognitive affective model of communication, knowledge sourcing,

task-technology fit theory, the technology acceptance model, and the theory of planned behavior). A second set of theoretical concepts are used to identify the social, cultural, and organizational factors that facilitate behavioral actions (e.g. Hofstede's cultural dimensions, Schein's cultural model, social exchange theory, social capital theory, and social influence theory). A third set of theoretical concepts are used to explain how behavioral actions may lead to knowledge outcomes at individual (e.g. learning curve and information processing theory) and collective levels of analysis (e.g. boundary spanning, transactive memory systems, communities of practice, dynamic alignment, dynamic capabilities, the knowledge based view, organizational learning theory).

In examining the use of theories within studies, we find that authors follow two general approaches. The first approach has been to combine technology acceptance theory with social or cultural theory to identify the individual, social, and organizational conditions under which actors are more likely to perform behavioral actions. The second approach has been to integrate knowledge management literature with organizational learning theory to understand the drivers of knowledge outcomes.

| Table 6. Application of Theoretical Concepts in Past KMS Use Research | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Behav. Actions | | | | Knowledge Outcomes | | | | | | | Behav. Actions | | | | Knowledge Outcomes | | | | | | |
| | Contribution | Acquisition | Application | Valuation | Content | I. Learning | C. Learning | I. Performance | C. Performance | Total | | Contribution | Acquisition | Application | Valuation | Content | I. Learning | C. Learning | I. Performance | C. Performance | Total |
| 1. Activity Theory | | | | | | | 1 | | | **1** | 32. Knowledge Sourcing Theory | | 1 | | | | 1 | 1 | | | **3** |
| 2. Act-R Theory | | | | | | | | 1 | | **1** | 33. Knowledge Transfer Literature | | | | 1 | | | | | | **1** |
| 3. Agency Theory | 1 | | | | | | | | | **1** | 34. Learning Curve | | | | | | | | 1 | | **1** |
| 4. Altruism | 1 | | | | | | | | | **1** | 35. Multimedia Learning Theory | | 1 | | | | | | | | **1** |
| 5. Appraisal Theory | | 1 | | | | | | | | **1** | 36. Natural Language Processing | | | | | | | | 1 | | **1** |
| 6. Boundary Spanning | | | | | | | 1 | | | **1** | 37. Network of Practice | | | | | | | | 1 | | **1** |
| 7. Bunge's Ontology | | 1 | | | | | | | | **1** | 38. Open Source Literature | | | | | 1 | | | | | **1** |
| 8. Cognitive Affective Model of | | | | | | 1 | | | | **1** | 39. Organizational Learning | | | | 1 | 1 | | 1 | | | **3** |
| 9. Cognitive Fit Theory | | 1 | | | | | | | | **1** | 40. Psychological Climate | | | 1 | | | | | | | **1** |
| 10. Cognitive Integration | 1 | 1 | | | | | | | | **2** | 41. Reinforcement Theory | 1 | | | | | | | | | **1** |
| 11. Cognitive Load Theory | | | | | | | | 1 | | **1** | 42. Schein's Cultural Model | 2 | | | | 1 | 1 | 1 | | | **5** |
| 12. Communities of Practice | 2 | 1 | | 1 | | | 1 | | | **5** | 43. Signaling Theory | | | | | 1 | | | | | **1** |
| 13. Creativity Literature | | | | | | | | 1 | | **1** | 44. Situated Learning | | | | | | | 1 | | | **1** |
| 14. Critical Social Theory | 1 | | | | | | | | | **1** | 45. Situated Performance | | | | | | | | | 1 | **1** |
| 15. Culture Literature | | | | | 1 | | | | | **1** | 46. Social Capital Theory | 1 | 1 | | | 1 | | 1 | | | **4** |
| 16. Differentiated Productivity Framework | | | | | | | | | 1 | **1** | 47. Social Cognitive Theory | 2 | | | | | | | | | **2** |
| 17. Dynamic Alignment | | | | | | | 1 | | | **1** | 48. Social Exchange Theory | 8 | 1 | 2 | | 1 | | | | | **1** |
| 18. Dynamic Capabilities | | | | | | | 1 | | | **1** | 49. Social Identification Theory | 2 | | | | | | | | | **2** |
| 19. Expectancy Theory | 1 | | 1 | | | | | | | **2** | 50. Social Influence Theory | 1 | 1 | | | | | | | | **2** |
| 20. Group Composition Literature | | | | | 1 | | | | | **1** | 51. Social Loafing | 1 | | | | | | | | | **1** |
| 21. Hofstede's Cultural Dimensions | 1 | 1 | | | | | | | | **2** | 52. Social Representation | | | | | | | 1 | | | **1** |
| 22. Impression Management Literature | | | | | 1 | | | | | **1** | 53. Social Theory | | | | | | | 1 | | | **1** |
| 23. Information Processing | | 2 | | | | | | 2 | | **4** | 54. Socio-Technical System | | | | | | | 1 | | | **1** |
| 24. Information Systems Success | | | 1 | 1 | | | | | | **2** | 55. System Dynamics | | | | | | | | | 1 | **1** |
| 25. Information Visualization | | | | | | | | 1 | | **1** | 56. Systems Perspective of Knowledge | | | | | 1 | | | | | **1** |
| 26. Institutional Theory | 1 | | | | 1 | | | | | **2** | 57.Task-Technology Fit | | 1 | | | 1 | | | 1 | | **3** |
| 27. Intrinsic Motivation | 1 | | | | | | | | | **1** | 58. Technology Acceptance | 5 | 2 | 1 | | | | | | | **8** |
| 28. IS Continuance | 1 | 1 | | | | | | | | **2** | 59. Technology Diffusion | | | 1 | | | | | | | **1** |
| 29. Knowledge Based View | 2 | | | 1 | | 1 | 2 | | 2 | **8** | 60. Theory of Planned Behavior | 1 | 2 | | | | | | | | **3** |
| 30. Knowledge Creation Theory | | | | 1 | 1 | | | | | **2** | 61. Transactive Memory System | 2 | | 1 | | 1 | 1 | 1 | | 1 | **7** |
| 31. Knowledge Management Literature | | | | 1 | | 1 | 2 | 1 | 6 | **11** | | | | | | | | | | | |

## Determinants of Behavioral Actions

To build towards a better understanding of behavioral actions as parts of a value-creation system we summarize the determinants of each behavioral action within brief narratives. In so doing, we emphasize the role that each behavioral action plays in producing value for the organization. A list of the determinants of behavioral actions is shown in Table 7. Further detail including references to source articles can be found in Appendix D.

### Contribution

Contribution produces organizational value by acting as a knowledge generation mechanism wherein tacit knowledge is codified into reusable form. It is therefore important that organizations identify and influence the determinants that encourage actors to increase contribution levels. Researchers have examined a wide range of determinants, most of which are characteristics specific to actors themselves. This research highlights the prior knowledge of actors as a main driver of contribution behavior. For example, experience (Majchrzak et al. 2013; Watson and Hewett 2006), tenure (Wasko and Faraj 2005), advancement in the organization (Watson and Hewett 2006), self-efficacy (Chen et al. 2012; Kankanhalli et al. 2005a), and prior knowledge reuse (Watson and Hewett 2006) are shown to increase contribution levels. Interestingly, the positive influence of these variables does not hold across all situations. For example, the influence of experience on contribution behavior is shown to depend on the presence of a transactive memory system (Majchrzak et al. 2013), on the level of task interdependence (Huang et al. 2013) and the level of trust in the organization (Huang et al. 2013).

Prior research also indicates that the motivations of actors drive contribution behavior. For example, knowledge contribution is driven by an enjoyment in helping others (Kankanhalli et al. 2005a), knowledge sharing attitudes (Chen et al. 2012) intention to share (He and Wei 2009; Jeon et al. 2011; Vitari et al. 2007), performance expectancy (Li 2010), perceived benefits (Huang et al. 2013) and perceived usefulness in sharing knowledge (Shin-Yuan et al. 2011).

Second to characteristics of actors, organizational factors are shown to play a substantial role in encouraging contribution. Past research indicates that organizations facilitate contribution through training and technical support (He and Wei 2009; Jeon et al. 2011) and are further able to foster contribution by establishing a culture that is conducive to knowledge sharing (Alavi et al. 2005; Ardichvili et al. 2006; Hara and Hew 2007; Jeon et al. 2011; Young et al. 2012). Managers are particularly important to contribution behavior as they establish a leadership role (Alavi et al. 2005), set clear contribution expectations (Huang et al. 2013), actively prompt contribution (Marks et al. 2008), and create conditions with greater contribution opportunities (Subramanian and Soh 2009). Furthermore, social factors are shown to influence contribution behavior by imparting actors with a sense of shared normative beliefs. Contribution behavior is influenced by social reputation (Ardichvili et al. 2006; Wasko and Faraj 2005), altruism (Shin-Yuan et al. 2011), pro-social value orientation (Ardichvili et al. 2003; Marks et al. 2008; Wolfe and Loraas 2008), reciprocity (Wasko and Faraj 2005), social influence (Wattal et al. 2010), and social ties (Li 2010; Wasko and Faraj 2005).

Past research indicates that organizations may further influence contribution behavior by selecting technologies that reduce the effort required to codify knowledge. For instance, technology that affords asynchronous communication positively affects contribution (Hara and Hew 2007) while technology with restricting validation routines hinders contribution

(Durcikova and Gray 2009). Characteristics of tasks are also suggested to play a role in contribution. For instance, contribution levels decrease when actors experience greater time pressure (Bansler and Havn 2003; Li 2010) or when actors were unsuccessful in their task assignment (Huerta et al. 2012).

Interestingly, only two studies examine the determinants of contribution at a collective level of analysis. These studies find that team contribution levels increase when the team uses technology designed to support knowledge management activities (Choi et al. 2010), when teams establish a transactive memory system (ibid), and when teams are committed to organizational goals (Jang-Hwan et al. 2006).

**Acquisition**

Acquisition produces value by converting codified knowledge into tacit form. Past research suggests that acquisition behavior is largely driven by the motivations of actors to seek out and attain new knowledge. For instance, actor characteristics such as learning motivation (Chin-Yen et al. 2007), level in the organization (Wang et al. 2013), and ability to seek-out new knowledge (Bera et al. 2011) are shown to influence acquisition. Past research shows that acquisition behaviors are further driven by cost and benefit trade-offs. For example, the positive influence of seeking intention (He and Wei 2009), perceived benefits (Ardichvili et al. 2003; Li 2010), perceived usefulness (He et al. 2009), and self-efficacy (Bock et al. 2006) are balanced against the negative influence of risk aversion (Gray and Durcikova 2005).

Past research also highlights the importance of social factors in acquisition behavior. Greater acquisition is more likely when social conditions are favorable to knowledge sharing (Pfaff and Hasan 2011; Sherif et al. 2006) and when actors have greater social ties (Su 2012).

Other social factors such as social influence (Wang et al. 2013) and collaborative norms (Ardichvili et al. 2006; Bock et al. 2006) positively influence acquisition behavior. Further, significant interactions between social factors and the characteristics of actors indicate that social norms are only effective when actors are predisposed towards acquiring knowledge (Bock et al. 2006; Wang et al. 2013).

Organizational interventions are shown to play a further role in supporting acquisition behavior. For example, knowledge seeking incentives (Kankanhalli et al. 2005b), facilitating conditions (Bock et al. 2006; He and Wei 2009), collaborative leadership (Alavi et al. 2005), knowledge management strategy (Kamla Ali and Olfman 2005; Massey et al. 2002), and management support (Zboralski 2009) increase acquisition behavior. Organizations can further influence acquisition behavior through the choice of technologies. For instance, technologies equipped with knowledge quality indicators (Kankanhalli et al. 2005b, Poston and Speier 2005, 2008; Sutanto and Jiang 2013) and guided ontologies (Bera et al. 2011) improve the degree to which actors identify and acquire content.

Lastly, the structure of tasks plays a further role in shaping acquisition behavior. For instance, when the time pressure of a task is too great, actors have little opportunity to use technology for knowledge acquisition purposes (Gray and Durcikova 2005; Li 2010). Tasks with high intellectual demands, on the other hand, provide actors with a greater motivation to acquire and integrate new knowledge into their work practices (Gray and Durcikova 2005). Likewise, interdependent tasks are shown to lead to a greater need to seek out knowledge (Kankanhalli et al. 2005b).

**Application**

Application produces value by bringing knowledge to where it is needed in the task environment. Past research suggests that the application of knowledge to tasks is largely driven by the personal characteristics of actors. For example, prior experience (Desouza et al. 2006a), perceived risk of consuming knowledge (Desouza et al. 2006b), perception of the organizational climate (Durcikova et al. 2011), and training in how to use knowledge (Watson and Hewett 2006) are shown to influence application behavior.

Prior research also suggests that organizational factors play role in application by helping to guide and shape the manner in which knowledge is applied. Organizations may encourage knowledge application by offering financial incentives to actors (Iyer and Ravindran 2009; Kulkarni et al. 2006) and by supporting actors through leadership (Kulkarni et al. 2006). Technology plays a supporting role in knowledge application whereby technologies which are easy to access (Watson and Hewett 2006), those that reduce the complexity of codified knowledge (Desouza et al. 2006b), and those which are perceived to hold useful knowledge (Desouza et al. 2006b; Iyer and Ravindran 2009; Watson and Hewett 2006; Lin 2011) lead to greater application levels.

At the collective level of analysis, one study examines application behavior of teams and indicates that team application increases when knowledge management technology is used in the team, when the team develops a transactive memory system, and when knowledge is shared within the team (Choi et al. 2010).

**Valuation**

Valuation behaviors produce value for the organization by acting as a validation mechanism wherein situated knowledge is assessed for further reuse. Only a handful of studies

have sought to understand the factors that influence valuation behavior. These studies suggest that actor characteristics such as a positive knowledge sharing attitude (Walczak and Mann 2010) and satisfaction with technologies (Halawi et al. 2007) lead to favorable valuation assessments. Furthermore, these studies show that characteristics of the content acquired from technology has an influence on valuation. For example, the complexity of content is shown to negatively impact the perceived benefits of use (Boh 2008). Positive valuations occur more often when technology is well designed for the knowledge creation needs at individual, group, and organizational levels such that technologies with knowledge externalization and internalization features increase perceived individual-level effectiveness, technologies with knowledge socialization features increase perceived group-level effectiveness, and technologies with knowledge combination features increase perceived organizational-level effectiveness (Sabherwal and Becerra-Fernandez 2003).

| Table 7. Determinants of Behavioral Actions | | | | | | |
|---|---|---|---|---|---|---|
| **Category** | **Variable** | **Contribution** | **Acquisition** | **Application** | **Valuation** | **Total** |
| **Actor Characteristics** | Advancement in the Organization | 1 | | | | 1 |
| | Enjoyment in Helping Others | 1 | | | | 1 |
| | Experience | 1 | | 1 | | 3 |
| | Knowledge Breadth | 1 | | | | 1 |
| | Knowledge Depth | 1 | | | | 1 |
| | Knowledge Sharing Attitude | 1 | | | 1 | 2 |
| | Learning Motivation | | 1 | | | 1 |
| | Learning Orientation | | 1 | | | 1 |
| | Level in the Organization | | 1 | | | 1 |
| | Perceived Benefits | 1 | 2 | | | 3 |
| | Perceived Climate for Autonomy | | | 1 | | 1 |
| | Perceived Climate for Innovation | | | 1 | | 1 |
| | Perceived Ease of Use | 1 | | | | 1 |
| | Perceived Risk of Consumption | | | 1 | | 1 |
| | Perceived Usefulness | 1 | 1 | 1 | | 3 |
| | Performance Expectancy | 1 | | | | 1 |
| | Prior KMS Use | | 1 | | | 1 |
| | Prior Knowledge Reuse | 1 | | | | 1 |
| | Risk Aversion | | 1 | | | 1 |
| | Seeker Knowledge Growth | | 1 | | | 1 |
| | Seeking Intention | | 1 | | | 1 |
| | Self-Efficacy | 3 | 1 | | | 4 |
| | Sharing Intention | 3 | | | | 3 |
| | Tenure | 1 | | | | |
| | Training in Knowledge Reuse | | | 1 | | 1 |
| | Trust | 1 | | | | 1 |
| | User Satisfaction | | | 1 | 1 | 2 |
| **Technology Characteristics** | Asynchronous Communication Features | 1 | | | | 1 |
| | Average Content Rating | | 1 | | | 1 |
| | Ease of Knowledge Access | | | 1 | | 1 |
| | Guided Ontology Features | | 1 | | | 1 |
| | Knowledge Combination Features | | | | 1 | 1 |
| | Knowledge Externalization Features | | | | 1 | 1 |
| | Knowledge Internalization Features | | | | 1 | 1 |
| | Knowledge Socialization Features | | | | 1 | 1 |
| | Perceived Content Complexity | | | 1 | | 1 |
| | Perceived Content Quality | 1 | | | | 1 |
| | Perceived Output Quality | | 1 | | | 1 |
| | Perceived Relative Advantage | | | 1 | | 1 |
| | Rating Validity | | 2 | | | 2 |
| | Support for Knowledge Management | 1 | | 1 | | 2 |
| | Validation Restrictiveness | 1 | | | | 1 |
| | Validation Transparency | 1 | | | | 1 |
| | Value of Knowledge | | | 1 | | 1 |
| **Task Characteristics** | Intellectual Demands | | 1 | | | 1 |
| | Task Interdependence | 1 | | | | 1 |
| | Time Pressure | 2 | 2 | | | 4 |
| | Type of Knowledge | 1 | | | | 1 |
| **Contribution** | Knowledge Sharing | | | 1 | | 1 |
| **Application** | Technology Use | | | | 3 | 3 |
| **Valuation** | Perceived Content Quality | 1 | | | | 1 |

| Table 7. Determinants of Behavioral Actions (Continued) | | | | | | |
|---|---|---|---|---|---|---|
| **Category** | **Variable** | **Contribution** | **Acquisition** | **Application** | **Valuation** | **Total** |
| **Social Factors** | Altruism | 1 | | | | 1 |
| | Collaborative Norms | | 2 | | | 2 |
| | Experts' Information Retrieval | 1 | | | | 1 |
| | In-Group Orientation | 1 | | | | 1 |
| | Manager Posts | 1 | | | | 1 |
| | Member Feedback | 2 | | | | 2 |
| | Pro-Social Value Orientation | 3 | | | | 3 |
| | Provision by Peers | 1 | | | | 1 |
| | Reciprocity | 1 | | | | 1 |
| | Reputation | 2 | | | | 2 |
| | Shared Perspective | | | | 1 | 1 |
| | Social Norms | 1 | | | | 1 |
| | Social Ties | 4 | | | | 4 |
| | Transactive Memory System | 1 | | 1 | | 2 |
| | Usage of Reference Groups | | 1 | | | 1 |
| **Organizational Factors** | Authority | 1 | | | | 1 |
| | Competitiveness | 1 | | | | 1 |
| | Employees' Commitment | 1 | | | | 1 |
| | Facilitating Conditions | 2 | 2 | | | 4 |
| | Hierarchy | 1 | | | | 1 |
| | Incentive | 3 | 1 | 1 | | 5 |
| | Knowledge Sharing Culture | 3 | | | | 3 |
| | Leadership | 1 | | 2 | | 3 |
| | Management Expectations | 1 | | | | 1 |
| | Managerial Prompting | 1 | | | | 1 |
| | Moderator Support | 1 | | | | 1 |
| | Non-competitive Environment | 1 | | | | 1 |
| | Opportunity to Contribute Knowledge | 1 | | | | 1 |
| | Organizational Climate | 1 | | | | 1 |
| | Organizational Value Systems | 1 | | | | 1 |
| | Perceived Organizational Support | 1 | | | | 1 |
| | Resource Availability | | 1 | | | 1 |
| | Supervisory Control | 1 | | | | 1 |
| **Interactions** | Age x Network Externalities | 1 | | | | 1 |
| | Assessment of TMS x Knowledge Breadth | 1 | | | | 1 |
| | Assessment of TMS x Knowledge Depth | 1 | | | | 1 |
| | Codification Effort x Generalized Trust | 1 | | | | 1 |
| | Experts' Retrieval x Task Interdependence | 1 | | | | 1 |
| | Experts' Retrieval x Trust | 1 | | | | 1 |
| | High Ambiguity Tolerance x Usefulness x Incentives | 1 | | | | 1 |
| | Low Ambiguity Tolerance x Incentives | 1 | | | | 1 |
| | Reward x Exchange Ideology x Sharing Visibility | 1 | | | | 1 |
| | Reward x Identification | 1 | | | | 1 |
| | Reciprocity x Pro-Sharing Norms | 1 | | | | 1 |
| | Sufficient Knowledge Incentives x Lack of Reciprocity | 1 | | | | 1 |
| | Type of Knowledge x Collectivist Culture | 1 | | | | 1 |
| | Future Obligation x Collaborative Norms | | 1 | | | 1 |
| | Incentive Availability x Task Interdependence | | 1 | | | 1 |
| | Influence of Other Users x Level in the Organization | | 1 | | | 1 |
| | Low Rating Validity x Low Content Credibility | | 1 | | | 1 |
| | Perceived Usefulness x Collaborative Norms | | 1 | | | 1 |
| | Resource Availability x Task Tacitness | | 1 | | | 1 |
| | KMS Access x Climate for Autonomy | | | 1 | | 1 |
| | KMS Access x Climate for Innovation | | | 1 | | 1 |
| | Low Ambiguity Tolerance x Incentives | | | 1 | | 1 |
| | Asset Complexity x Seeking Assistance from Author | | | | 1 | 1 |
| | **Total** | **82** | **32** | **20** | **11** | **145** |

## Determinants of Knowledge Outcomes

To build towards a better understanding of knowledge outcomes as parts of a value-creation system we further summarize the determinants of each knowledge outcome within brief narratives. As in the previous section, we emphasize the role of each knowledge outcome as value creation indicators. A full list of the determinants of these knowledge outcomes is shown in Table 8. Further detail including references to source articles is found in Appendix E.

### Content

The quality of content held in technologies is commonly viewed as an indicator of value resulting from contribution behaviors. Past research indicates that it is difficult to reliably increase the stocks of content while simultaneously maintaining the accuracy, relevancy, and timeliness of these stocks (Garud and Kumaraswamy 2005). This research has shown that characteristics of actors, technologies, and tasks have an influence not only on levels of contribution behavior but also on the potential of this behavior to create value. For example, content orientation of actors (Arazy et al. 2011), enjoyment in helping others (Wasko and Faraj 2005), and power of communication (Sha et al. 2013) lead to positive content quality outcomes while the commitment of actors (Wasko and Faraj 2005) and strategic self-presentation (Leonardi and Treem 2012) have a negative influence.

Technologies therefore play a considerable role in managing content outcomes whereby technologies with an open knowledge sharing architecture (Wagner 2006), which support collaboration processes (Hahn and Wang 2009) and which allow for the validation of knowledge (Durcikova and Gray 2009) positively impact content quality. The structure of tasks

also plays an important role in content quality. For example, one article indicates that task conflict causes disagreement driving the quality of content downwards (Arazy et al. 2011).

Past literature also indicates that social forces influence content outcomes wherein factors such as reputation (Wasko and Faraj 2005) and social ties (Sha et al. 2013) have a positive influence on content quality. Interestingly, prior research suggests that while the creation of content is partially driven by extrinsic motivation factors such as financial incentive, a reduction in quality is likely to result from these incentives. While useful in increasing the overall level of contribution behavior, these incentives can negatively influence the quality of content by inadvertently rewarding actors for producing poor quality content (Garud and Kumaraswamy 2005; Ravishankar 2008).

**Learning**

A small number of studies examine the influence of acquisition on individual learning (i.e. Alavi et al. 2005; Chin-Yen et al. 2007; Griffith and Sawyer 2006; Majchrzak et al. 2005). This research suggests that learning is an indicator of value resulting from acquisition behavior. Actors learn by integrating organizational knowledge with their individual knowledge to influence the capacity to solve problems, perform standard procedures, and generate new ideas. Prior literature suggests that learning is dependent on the degree to which technology supports the acquisition of knowledge by allowing for knowledge contextualization (Majchrzak et al. 2005) and the accrual of content (Griffith and Sawyer 2006). Literature also suggests that the routineness of tasks (Majchrzak et al. 2005), and social ties (Su 2012) play a role in individual learning.

At collective levels of analysis, research suggests that collective knowledge acquisition leads to a wide range of positive learning effects for the organization. For example, the acquisition of knowledge is shown to increase knowledge accumulation (Ryu et al. 2005), improve knowledge management practices, increase knowledge exchange (Pfaff and Hasan 2011), aid in organization-wide knowledge sharing (Pemberton et al. 2002), foster organizational capabilities (Garud et al. 2006; Levina and Vaast 2005; Pavlou and El Sawy 2006; Sherif et al. 2006; Vaast 2007; Zboralski 2009) and drive organizational learning (Kane and Alavi 2007). As such, learning features available in technologies supporting the collective ability to coordinate action allow further learning to occur (Kane and Alavi 2007; Ryu et al. 2005) especially when the use of technology is well integrated with work practices (Vaast 2007) and when organizations face high environmental turbulence (Kane and Alavi 2007). Prior research suggests that organizations increase collective learning by developing collaborative leaders (Alavi et al. 2005; Zboralski 2009) and by establishing a clear knowledge management strategy (Garud et al. 2006; Kamla Ali and Olfman 2005; Massey 2002).

**Performance**

Lastly, literature positions performance as an indicator of value from knowledge application. In most cases, past literature indicates that individual knowledge application behavior has a positive performance effect. Studies indicate that knowledge application leads to improved decision making performance (Poston and Speier 2005; 2008), problem solving performance (McCall et al. 2008), and overall job performance (González et al. 2005; Ko and Dennis 2011; Teo and Men 2008; Van Den Hooff et al. 2010). One study in the article set, however, demonstrates a decrease in creative task performance when actors reuse codified knowledge (Cheung et al. 2008) indicating that KMS do not generate value under all

circumstances. The value gained from application varies between individuals and is dependent on individual experience (Ko and Dennis 2011), individual creativity (Cheung et al. 2008), and task tacitness (Teo and Men 2008). To increase the likelihood of attaining positive performance outcomes, organizations may provide technology with advanced features (Hou and Tsai 2008) and ensure that the use of technology is well integrated with work practices (Van Den Hooff et al. 2010).

Further, past research indicates a positive influence of knowledge application on the performance of workgroups (i.e. Choi et al. 2010; Liang et al. 2009; Malhotra et al. 2001) and organizations (i.e. Feng et al. 2004; Gottschalk 2007; Jennex 2008; Lakshman and Parente 2008; Lee and Choi 2003). A small handful of studies, however, show a damaging effect of knowledge application (Gallivan et al. 2003; Haas and Hansen 2005; Haas and Hansen 2007) suggesting that performance is likely to decrease when applied knowledge is not well suited to the needs of the task. Further, past research indicates that the linkage between knowledge application and collective performance is highly sensitive to the environmental context within which this application occurs. For instance, positive performance gains depend on the amount of competition (Haas and Hansen 2005), environmental turbulence (Pavlou and El Sawy 2006), and technological dynamism (Lakshman and Parente 2008). In order to attain performance gains from knowledge application, organizations may seek to maintain a high level of system quality (Lin 2011), restructure work practices to accommodate knowledge transfer (Liang et al. 2009; Malhotra et al. 2001), and maintain high quality content (Haas and Hansen 2007). Further measures can be taken by instilling leadership (Gottschalk 2007) establishing a knowledge management strategy (Malhotra et al. 2001), providing management support (Lin 2011) and developing clearly defined knowledge management roles (Liang et al. 2009).

| Table 8. Determinants of Knowledge Outcomes | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Category** | **Variable** | **Content** | **Individual Learning** | **Collective Learning** | **Individual Performance** | **Collective Performance** | **Total** |
| **Actor Characteristics** | Commitment | 1 | | | | | 1 |
| | Content Orientation | 1 | | | | | 1 |
| | Enjoyment in Helping Others | 1 | | | | | 1 |
| | Power of Communication | 1 | | | | | 1 |
| | Strategic Self-Presentation | 1 | | | | | 1 |
| **Technology Characteristics** | Degree of IT Support for Contextualization | | 1 | | | | 1 |
| | Document Quality | | | | | 1 | 1 |
| | Document Rework | | | | | 1 | 1 |
| | Electronic Community of Practice Features | | | 1 | | | 1 |
| | Knowledge Repository Features | | | 1 | | | 1 |
| | Knowledge Visualization Features | | | | 1 | | 1 |
| | Learning by Doing Features | | | 1 | | | 1 |
| | Learning by Investment Features | | | 1 | | | 1 |
| | Learning from Others Features | | | 1 | | | 1 |
| | Open Knowledge Sharing Architecture | 1 | | | | | 1 |
| | Support for Embedded Accrual of Content | | 1 | | | | 1 |
| | Support of Collaboration Processes | 1 | | | | | 1 |
| | Support for Proactive Accrual of Content | | 1 | | | | 1 |
| | System Quality | | | | | 1 | 1 |
| | Validation Duration | 1 | | | | | 1 |
| | Validation Restrictiveness | 1 | | | | | 1 |
| | Validation Transparency | 1 | | | | | 1 |
| | Virtual Team Room Features | | | 1 | | | 1 |
| **Task Characteristics** | Integration of Use with Work Practices | | | 1 | 1 | | 2 |
| | Task Conflict | 1 | | | | | 1 |
| | Work Restructuring | | | | | 2 | 2 |
| **Contribution** | Adding Contribution | | | 1 | | | 1 |
| | Shaping Contribution | | | 1 | | | 1 |
| **Acquisition** | KMS Use | | 4 | 16 | | | 20 |
| **Application** | KMS Use | | | | 10 | 13 | 23 |
| **Social Factors** | Reputation | 1 | | | | | 1 |
| | Social Ties | 2 | | | | | 2 |
| **Organizational Factors** | Alignment | | | 1 | | | 1 |
| | Collaborative Leadership | | | 1 | | | 1 |
| | Decision Leadership | | | | | 1 | 1 |
| | Democratic Culture | | | | | 1 | 1 |
| | Employees' Commitment | 1 | | | | | 1 |
| | Incentive | 2 | | | | 1 | 3 |
| | Knowledge Management Strategy | | | 3 | | 1 | 4 |
| | Leadership | | | 1 | | | 1 |
| | Management Support | | | 1 | | 1 | 2 |
| | Role Development | | | | | 1 | 1 |
| **Interactions** | Task Conflict x Cognitive Diversity | 1 | | | | | 1 |
| | Knowledge Reuse x Task Non-Routineness | | 1 | | | | 1 |
| | Social Ties X Technology Use | | 1 | | | | 1 |
| | Compatibility x Knowledge Tacitness | | | | 1 | | 1 |
| | Knowledge Reuse x Experience | | | | 1 | | 1 |
| | Knowledge Reuse x Individual Creativity | | | | 1 | | 1 |
| | Output Quality x Knowledge Tacitness | | | | 1 | | 1 |
| | Use of Technology x Environmental Turbulence | | | 1 | | | 1 |
| | Use of Technology x Number of | | | | | 1 | 1 |
| | Use of Technology x Task Experience | | | | | 1 | 1 |
| | Knowledge Sharing x Technological Dynamism | | | | | 1 | 1 |
| | **Total** | **18** | **9** | **33** | **16** | **27** | **103** |

## Analysis of Prior Research: Summary and Takeaway

As a whole, the above analysis of the selected articles offers initial insights into prior empirial KMS literature. First, the analysis shows that this literature is broadly distributed across levels of analysis and methodologies. Second, the focus of prior research has particularly been on understanding the determinants of behavioral actions, with relatively less attention paid to understanding the relationships between behavioral actions and knowledge outcomes. Third, a broad spectrum of theoretical lenses from several reference disciplines are applied presenting partial explanations of the system of knowledge transfers between actors, technologies, and tasks.

When considering the articles focused on the drivers of behavioral actions, it is evident that the characteristics of actors, more so than of technologies or tasks determine behavior. It is therefore critical for organizations to encourage these actions not only by carefully choosing technologies and designing tasks for knowledge reuse but also by cautiously shaping the social and organizational contexts to suit the needs of actors. Further, the understanding of contribution and acquisition behaviors in prior research is relatively mature. Research of application and valuation behaviors, however, is still in a developing stage with only a handful of studies examining the determinants of each behavior.

Concerning articles focused on knowledge outcomes, authors place greater attention on collective learning and collective performance with less attention given to content, individual learning, and individual performance outcomes. This research indicates that the value created from behavioral actions may be greater when organizations concurrently pay heed to organizational factors, the motivations of actors, the features of technologies, and the design of

tasks. Very few studies consider social factors as determinants of knowledge outcomes. Further, when examining content and learning outcomes clear benefits are shown. However, when considering performance outcomes however, there appears to be equivocality in the results.

Interestingly, when considering the linkages between behavioral actions and knowledge outcomes, most studies examine single action-outcome pairs. When taken in its entirety, the literature therefore views actions and outcomes as loosely-coupled constructs. As such, prior research is limited in its understanding of the value creating potential that results when behavioral actions and knowledge outcomes are tightly coupled to one another. Taking this limitation into account we argue below that behavioral actions and knowledge outcomes may be viewed in future research as integrated parts of value generating processes. We hold that this perspective may be advantageous in discovering how the operation of KMS leads to sustained organizational value.

## KMS AND SUSTAINED VALUE

As indicated above, prior studies have examined the direct influence of individual behavioral actions on knowledge outcomes but have not looked into the wider implications when multiple actions and outcomes interrelate. This may be due, in part, to a lack of available theory that outlines the role that actions and outcomes play when positioned in larger processes. To address this limitation, we draw upon the analysis of prior research and suggest that sustained value from KMS is achieved when behavioral actions and knowledge outcomes are tightly intertwined within two value-creating sub-processes: *learning from technology* and *learning from task*, as depicted below in Figure 2. The figure encapsulates behavioral actions and knowledge outcomes as deeply intertwined components that drive sustained value within organizations. By focusing on sustained value, we draw attention to the importance of each

behavioral action and knowledge outcome not only as independent inputs and outputs, but as links in an integrated chain of relationships through which individual and organizational knowledge circulates.

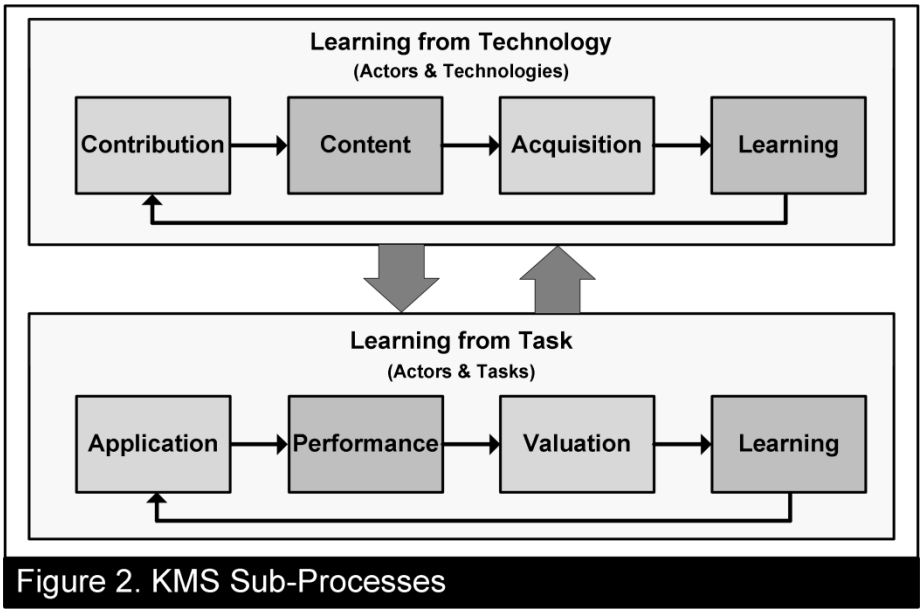

Figure 2. KMS Sub-Processes

The *learning from technology* sub-process involves the linkages between contribution, content, acquisition, and learning. This sub-process entails the recurrent integration of technology use with learning outcomes. As such, it has the potential to generate value by continuously circulating knowledge between actors and technologies. In a similar manner, the *learning from task* sub-process closely combines task execution with the learning of actors via application, performance, valuation and learning. This sub-process therefore has the potential to add value by continuously circulating knowledge between actors and tasks. Further, in addition to the two sub-processes, we hold that the interplay between *learning from technology* and *learning from task* presents organizations with value by helping to circulate knowledge held across all three elements.

Our perspective of KMS as a sustained source of organizational value offers four main implications that may help to guide future research. First, the assertion that behavioral actions and knowledge outcomes reside within broader processes draws attention to the need to establish clear conceptual distinctions between each action and outcome. The guiding framework used in this review offers an ontological basis to delineate actions and outcomes at a high level thus helping towards this end. As seen in our review however, the general actions and outcomes identified in the guiding framework map to several constructs. For example, contribution behavior is associated with knowledge sharing, knowledge contribution, and information provision. Further effort is needed to establish the dimensionality of behaviors and associate past constructs with these dimensions. Advancements in this area may help to determine the simultaneous role of multiple dimensions within each learning sub-process. Majchrzak et al. (2013), who compare two types of contribution behavior - adding and shaping, have made initial efforts towards this end in the context of wikis. Following this example, further distinctions of the dimensionality of behavioral constructs across different usage contexts may be beneficial. For instance, researchers may identify the key dimensions of acquisition behavior when actors use relatively static technologies such as repository-based KMS as opposed to highly dynamic sources such as blogs or wikis. Future analyses of the dimensionality of application and valuation behaviors across multiple task environments may provide equally valuable insights.

Advancements in identifying construct dimensionality may also prove beneficial in understanding the role of knowledge outcomes within each sub-process. In the case of content outcomes, some developments have already been made. For example, content held in technologies is shown to consist of quantitative and qualitative dimensions (Garud and

Kumaraswamy 2005; Wasko and Faraj 2005). Researchers, however, have yet to examine the dimensionality of learning and performance outcomes. Attaining a clear understanding of learning and performance dimensions can help to gain a richer sense of the challenges faced within each learning sub-process. It may be fruitful, for example, to examine the depth and breadth of learning within and across knowledge domains or to examine improvements in the effectiveness (accuracy and completeness in achieving goals) vs. efficiency (the resources spent in achieving goals) of task execution.

Second, the acknowledgement of two learning sub-processes offers a basis to examine chains of actions and outcomes as parts of greater value-creation sequences. The sub-processes offer future researchers with a grounded basis to examine sequences of behavioral actions and knowledge outcomes via mediation or path analyses. For example, if the content held in technology is irrelevant or out-dated, it is unlikely that organizations will derive sustained value. Future research may provide insights on which content outcomes are important when coupling the activities of content producers with the demands of content consumers. Towards this end, the above conceptualization of the learning from technology sub-process may provide a basis upon which future research examines content outcomes as mediators between contribution and acquisition behaviors. Such an examination could ultimately help to understand the role of content quality across various system contexts.

Similar advancements may be possible by positioning performance as a mediator between application behavior and valuation behavior. It is evident in our review that prior research has paid comparatively limited attention to constructs within the learning from task sub-process (application, performance, and valuation) perhaps because they do not involve technology directly, and thus there may be some reticence in focusing on them. As it currently stands in

prior research, very little is known about how application behaviors influence valuation behaviors through performance outcomes. The equal importance that we place on both the learning from technology and learning from task sub-processes may act as a basis to help future researchers make inroads in addressing these gaps.

Third, the interplay between *learning from technology* and *learning from task* presents the potential to further our understanding of how KMS can provide sustained value within organizations. We emphasize the importance of the central role of actors, i.e., the human element in garnering value from technologies and tasks through learning. We argue that through their goal-directed actions, actors drive the outcomes necessary for sustaining value from the KMS. Actors therefore serve as the primary channel transferring knowledge between the technology and task by acquiring codified knowledge, internalizing it in cognitive structures, and applying it in the task environment. The cycle continues when actors intertwine learning from task experience back to their learning from technologies, and contribute this knowledge back to the technology.

Given this perspective, two areas that represent the interfaces between *learning from technology* and *learning from task* may be crucial. First, research that addresses the impediments between acquisition and application behaviors could have a significant impact on furthering our understanding. Acquisition allows actors to broaden their general knowledge base while application requires a deeper sense of the context in which knowledge is situated. Future research that examines how actors switch between the cognitive imperatives of the two behaviors can provide useful insights. Second, a deeper understanding of the consequences of valuation behavior is crucial in sustaining the feedback loop. For example, valuation behaviors can drive sustained use from actors, in either motivating their continued use of technology for

their knowledge needs or perhaps even overcome their instrumentality and potentially contribute to technologies, thereby feeding a virtuous cycle of knowledge transfer between technologies and tasks, through actors.

Lastly, our conceptualization of the two learning sub-processes provides a basis to examine the determinants of behavioral actions in a new light. As indicated in our review, individual studies have either confounded multiple behavioral actions within a general KMS use construct, or have examined the determinants of a single behavioral construct. We argue that each one of the behavioral actions may be important in driving sustained value, such that the absence of any one would mean that the intricate link that sustains KMS value is broken. For example, a technology that fails to promote acquisition behavior may quickly fall into disuse despite a high degree of contribution. When considering the equal importance of multiple behaviors within each sub-process, organizations may benefit by designing and implementing an environment wherein the enactment of these behaviors is possible.

It is therefore important for future research to examine the relative impact that determinants may have against multiple behavioral actions. Such examinations would help to understand which determinants present a general effect across behavioral actions and which present an isolated effect. The inventory of determinants found in our review may serve as a basis upon which to construct new antecedent models. Speaking generally, the review indicates that actor characteristics, social factors, and organizational factors influence multiple behavioral actions diffusely while technology characteristics and task characteristics affect individual behaviors. This suggests that organizations may facilitate overall learning by establishing broad social norms and facilitating conditions while concurrently designing the technology and task elements to accommodate specific behaviors.

## CONCLUSION

This paper begins to establish a view of KMS as a system comprised of actors, technologies, and tasks, which has the primary purpose of transferring knowledge within the organization. This perspective is useful in drawing distinct behavioral actions together as components of a cohesive and renewable system. Thus, we draw attention to the importance of knowledge outcomes as not only outputs of behavioral actions but also as links in a sequential chain of action-outcome relationships through which individual and organizational knowledge circulates. This paper helps to emphasize the importance of learning as a key mechanism in knowledge management and guides researchers away from the surface-level examination of why actors decide to engage in behavioral actions to a deeper understanding of how behavioral actions interrelate to derive value throughout the organization. We hope that this review will help to further enrich the KMS concept and bring new insights into the value of KMS, and how such value can be sustained.

## PAPER 2: THE COMPONENTS, CONSEQUENCES, AND CONTINGENCIES OF TECHNOLOGY-BASED KNOWLEDGE ACQUISITION BEHAVIOR


### ABSTRACT

Technology-based acquisition behavior, defined as the individual's act of acquiring electronic documents from knowledge repositories, has been posited to play a vital role in knowledge transfer among members within an organization. While prior research has laid the foundations, what still remains elusive is a nuanced understanding of acquisition behaviors and the contingencies that impact their efficacy. The purpose of this study is twofold. First, it addresses the need to recognize and clarify the dimensionality of acquisition behavior. Based on prior literature, we identify two components of acquisition behavior, *frequency* and *intensity*. Further, we recognize the role of personal and social knowledge in moderating the relationships between acquisition behaviors and performance outcomes. Second, the study develops a research model hypothesizing that acquisition frequency and acquisition intensity each influence individual performance. Further, it also hypothesizes that professional experience and team membership moderates these relationships. We test the hypothesized research model on a comprehensive dataset of 18,219 real estate agents in the United States. Results indicate that both acquisition frequency and intensity influence individual agent's financial performance. Interestingly, acquisition frequency is shown to interact with social knowledge whereas acquisition intensity interacts with personal knowledge, indicating a nuanced interplay between each component of acquisition behavior and the context. Theoretical and practical implications of the study are discussed.

## INTRODUCTION

Since the turn of the century, knowledge has been recognized as the most important organizational resource impacting its competitiveness (Argote 2013). Organizations continue to invest in technologies such as knowledge repositories, which play a vital role in the capture and distribution of knowledge to its members (Alavi and Leidner 2001; Sambamurthy and Subramani 2005). Further, literature has recognized that the individual's act of acquiring electronic documents from these knowledge repositories, i.e., their technology-based *acquisition behavior*, as a key variable impacting effectiveness and success.[4] Therefore, organizations continue to seek innovative ways to promote acquisition behavior by its members, such as incentivizing member acquisition behaviors (Kankanhalli et al. 2005a), and through increased member training in using these technologies effectively (Hung et al. 2005; Kamla Ali and Olfman 2005; Malhotra et al. 2001). Given its relevance to organizational knowledge management practice, a burgeoning stream of literature over the past decade has begun to explore the consequences of individual acquisition behavior (Durcikova et al. 2011; Kankanhalli et al. 2011; Kim et al. 2016; Ko and Dennis 2011; Teo and Men 2008; etc.). Yet, in spite of the increasing attention, our understanding of acquisition behavior and its performance implications remains stymied due to two reasons.

First, as our review shows, prior literature has treated acquisition behavior at a broad level, often failing to recognize its underlying dimensionality. As a result, empirical studies have tended to either conceptualize acquisition behavior as being implicitly unidimensional, or have focused exclusively on one component of acquisition ignoring others. Consequently, a nuanced

[4] Henceforth, we refer to technology-based acquisition behavior simply as acquisition behavior, for the sake of brevity.

understanding of the differential impact of the components of acquisition behavior on the individual's performance is missing. Further, these broad and implicit treatments of acquisition behavior may be responsible for the apparent equivocality in prior research that examines the impact of acquisition behavior on performance. While some have found a positive direct relationship between acquisition behavior and performance outcomes (Kim et al. 2016; Kankanhalli et al. 2011; Ko and Dennis 2011; McCall et al. 2008; Teo and Men 2008), others have found a nonsignificant (Child and Shumante 2007; Durcikova et al. 2011; Teigland and Wasko 2009), or negative effect (Cheung et al. 2008). Second, literature has recognized that personal and social factors are likely to influence the relationship between acquisition behavior and individual performance (Cheung et al. 2008; Durcikova et al. 2011; Kim et al. 2016; Ko and Dennis 2011). Although prior research has examined either the personal or the social factors which moderate the relationship between acquisition behavior and individual performance outcomes, to our knowledge, none have considered the simultaneous effects of both. Therefore, while prior research has laid the foundations, what still remains elusive is a nuanced understanding of acquisition behaviors and the contingencies that impact their efficacy. Thus, by treating acquisition as a monolith without an explicit delineation of its underlying components, and the contingencies involved, the existing literature has created an important gap which has stymied our understanding.

The purpose of this study is twofold. First, we address the need to recognize and clarify the dimensionality of acquisition behavior. Using the staged approach (Burton-Jones and Straub 2006), we identify two components of acquisition behavior, *acquisition frequency* and *acquisition intensity*. We also recognize the role of *professional experience and team membership* in moderating the relationships between acquisition behaviors and performance

outcomes. Second, we develop our research model and hypothesize that acquisition frequency and acquisition intensity each influence individual performance, and further, that the individual's professional experience and team membership moderates these relationships. We test the research model on a comprehensive dataset of 18,219 real estate agents in the United States. Results indicate that both acquisition frequency and intensity influence individual agent's financial performance. Interestingly, acquisition frequency is shown to interact with social knowledge whereas acquisition intensity interacts with personal knowledge, indicating a nuanced interplay between each component of acquisition behavior and the context.

This study contributes to literature by providing a conceptual development and empirical examination of acquisition behavior. There are three main contributions. First, we heed the call of prior literature (Burton-Jones and Straub 2006) to theoretically and empirically delineate between the components of acquisition behavior as acquisition frequency and intensity. In doing so, the study presents a finer-grained approach towards understanding acquisition behavior, one that moves beyond *how much* of the behavior was exhibited, to focus on *how* behaviors are exhibited. Second, through the inclusion of objective financial outcomes, this study improves our understanding of how investments in technology-based knowledge management within organizations, can provide a significant value to the users of these technologies. Third, our results not only serve to highlight the importance of personal and social knowledge, and also underscore their differential impacts on each acquisition behavior. Therefore, this study advances the nuanced idea that the impact of technology may not just be about understanding an active process such as behaviors directed toward technology, but also a cognitively and socially constructed process.

The layout of the paper is as follows. In the next section, we lay out the arguments that support frequency and intensity as the components of acquisition behavior. Further, we also recognize the role of experience and team membership in the nomological network of acquisition and performance. Next, we apply our conceptualization to derive our research model and support our hypotheses. In the research method section, we describe the setting, data collection and analysis. Finally, we conclude by discussing our contributions and implications.

## THEORETICAL BACKGROUND

### The Components of Acquisition Behavior

To aid in our conceptual development of acquisition behavior, we rely on the advice of Burton-Jones and Straub (2006). Commenting on the conceptualization of the broader system use construct in IS literature, Burton-Jones and Straub (2006) highlight that system use has often been treated in implicit ways, wherein the construct has been conceptualized and operationalized in unsystematic ways. 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." (Burton-Jones and Straub 2006, p.231). Further, they propose a two-step, staged approach for reconceptualizing system usage in different contexts. Stage one begins with defining the distinguishing characteristics of system use in the context. Stage two pertains to selecting the usage measures that are pertinent.

Here, we follow the staged approach to conceptualize and select the dimensions of acquisition behavior such that they are content-valid but also contextualized (Burton-Jones and

Straub 2006). First, we define acquisition behavior as the individual's act of acquiring electronic documents from electronic knowledge repositories. Electronic knowledge repositories contain knowledge in explicit form, stored as documents which are downloaded by individual users. The individual's behavior of acquiring knowledge from these knowledge repositories is therefore a specific conception of the broader construct of system usage that is pertinent within the context of knowledge repositories. Knowledge repositories differ from other types of technology based systems in fundamental ways. For one, 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 enable her to increase performance. Further, this behavior is voluntary, self-directed and self-regulated by the focal individuals that are once-removed from the performance of their task. In other words, acquisition behavior directed toward a knowledge repository focuses on the extent to which the user employs the system, and thus is a rich conceptualization of system use involving the user and system (Burton-Jones and Straub 2006).

Second, to select the dimensions of acquisition behavior, we followed a two-pronged approach. In the initial step, we examined the diversity of the broader system use measures, provided by Burton-Jones and Straub (2006). Discarding coarse binary measures of use (such as use/non-use), as well as those that pertained to the use of the information rather than system use itself, we narrowed the pertinent dimensions of acquisition behavior to frequency and intensity of acquisition behavior.[5] As a next step, we conducted a literature review of prior empirical

[5] Note that Burton-Jones and Straub (2006) 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 Venkatesh et al. 2008). 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.

acquisition literature. As a result of our selection process[6], we identified 42 articles originating from 27 journals. Of these studies, 33 employed surveys, 5 used system log files, 2 conducted experiments, and 2 utilized a combination of experiments and log file analysis. For the sake of brevity, we list some examples in Table 9. The full listing can be found in Appendix F.

While examining the knowledge acquisition constructs from prior literature, we found that most construct names indicate a broad/implicit treatment of acquisition behavior focusing on general use. In some cases, the construct names indicate specific behaviors. For example, two studies employ effort-based names such as *search effort* (Poston and Speier 2008) and *PKMS usage intensity* (Doong and Wang 2009) while other studies employ time-based names such as *frequency of information seeking* (Su and Contractor 2011), *frequency of knowledge reuse* (Watson and Hewett 2006), *interaction frequency* (Zboralski 2009), and *PKMS usage frequency* (Doong and Wang 2009).

An examination of the specific measures associated with each construct revealed that 24 studies measure a time-based behavior as indicated by the use of measurement item terminology such as "frequently", "rarely", and "often" (i.e. Choi and Durcikova 2014; Durcikova et al. 2011; Gray and Durcikova 2005; Kankanhalli et al. 2011; Su 2012; Teigland and Wasko 2009; Watson and Hewett 2006; Zboralski 2009) and in the construction of usage log measures which determine the download frequency across time periods (i.e. Sutanto and Jiang 2013). An additional 11 studies examine an effort-based behavior as indicated by measurement item

[6] 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 to articles examining acquisition behavior, 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 which examined either the antecedents or outcomes of knowledge acquisition. We then read through the full text of these articles and identified relevant studies which were not in the original search results.

terminology such as “intensity”, “extent”, “level”, and “degree” (i.e. Haas and Hansen 2005; Kankanhalli et al. 2005b; Teo and Men 2008) or alternately by constructing usage log measures which determine the download intensity within time periods (i.e. Kim et al. 2016; Ko and Dennis 2011; Poston and Speier 2005; 2008; Wang et al. 2013). In one study, both effort-based and time-based measures are used but are aggregated into a single construct (Teo and Men 2008). To our knowledge, only one study examines both effort-based and time-based measures simultaneously, but focused on the antecedents driving these behaviors (Doong and Wang 2009). In 8 studies, a specific behavior is not clearly specified in the construct name or in the associated measures. Taken together, prior research suggests that acquisition behavior has two underlying dimensions, one related to the effort-based (i.e., intensity) component of the acquisition behavior, and the other related to the time-based (i.e., frequency) of the behavior.

| Table 9. Examples of Knowledge Acquisition Constructs in Prior Research | | | | |
|---|---|---|---|---|
| **Study** | **Behavior** | **Construct Name** | **Method** | **Measures** |
| 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 |
| Kankanhalli et al. (2005b) | Effort-based | EKR usage for knowledge seeking | Survey | Level of usage of EKR<br>Degree of reliance on EKR |
| 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 three months |
| 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 |
| 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 |
| Gray and Durcikova (2005) | Time-based | Sourcing from repository | Survey | I rarely use the KM system as a way of acquiring knowledge. (reverse coded)<br>I frequently check in the KM system when I need to improve my knowledge on a topic or issue.<br>When I am working on a challenging problem, I often look in the KM system to find solutions to similar problems. |
| Teigland and Wasko (2009) | Time-based | Explicit knowledge access | Survey | Assessed by asking respondents to indicate how often they used specific knowledge sources |
| 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 |
| Doong and Wang (2009) | Time-based and Effort-based | PKMS Usage:<br>Number of PKMS functions used<br>PKMS usage frequency (distinct constructs) | Survey | How many functions supplied by Google Desktop have you used in the past month?<br>Following the answer to the previous question, please list your frequency of use of each function you have indicated above |
| Teo and Men (2008) | Time-based and Effort-based | Utilization frequency and intensity (compound construct) | Survey | On the average, how frequently do you use the K-portal in your company<br>On the average, how much time do you spend per week using the K-portal in your company?<br>Please indicate the extent to which you use the K-portal in your company to perform the following tasks for obtaining knowledge |

Following the process outlined above, we conceptualize acquisition behavior as reflected by two components: acquisition frequency and acquisition intensity. The first behavioral component, acquisition frequency, focuses on the temporal regularity with which the focal actor performs acquisition actions. The second behavioral component, acquisition intensity, is an effort-based construct focused on the extent to which an actor acquires knowledge from the repository.[7] Thus, independent from the repeated access behavior captured by acquisition

[7] For example, consider the hypothetical example of the use of a journal database like EBSCO by a doctoral student in a year who visited the database on 12 distinct days in the year to download a total of 120 articles. Frequency

frequency, acquisition intensity captures the degree of effort expressed within each interaction. This conceptualization is consistent with notions from self-regulation theory which emphasizes time and effort as important factors needed for behavioral actions to lead to outcomes (Carver and Scheier 2001). Self-regulation theory holds that individual learning occurs within a cycle of goal-directed efforts conducted over time. The time-based component, i.e., frequency, of behavioral self-regulation is critical to individual learning as repeated behavior across time allows actors to draw correlations between previous actions and present outcomes. On the other hand, the effort-based component of individual behavior indicates the extent of use to garner a greater amount of information, and thus enable the actor to guide their future behavior. As such, while both behavioral components may impact learning from technology and performance, each behavioral component serves a distinct role in creating value from knowledge acquisition behavior of the individual.[8]

### The Role of Professional Experience and Team Membership

Acquisition behavior is a form of learning from the knowledge repository. Prior literature has acknowledged that learning processes are highly context dependent (Argote and Miron-Spektor 2011). That is, individuals learn from their own experiences, as well as from others in their social context. Yet, apart from a few exceptions, the acknowledgement of the contextual influences on acquisition behavior and its consequences has been relatively sparse in IS literature. To gain further insight, here we draw upon arguments from social cognitive theory (SCT) (Bandura 1986, 2001a, 2001b), which argues that human behavior is "… regulated by an

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would pertain to how many days she visited the database in the year (i.e., 12), whereas intensity would pertain to the average number of articles she downloaded in each visit (120/12 = 10).

[8] Frequency and intensity have also been argued as the sub dimensions of positive and negative affect (Diener et al. 1985) and fitness behavior (Nader, 2003), among other contexts.

interplay of self-generated and external sources of influence" (Bandura 1991; p.249). SCT explains the interplay between an individual's behavior and the psychological underpinnings of how personal and environmental factors influence this behavior. Although acquisition frequency and intensity represent specific behaviors of learning directed toward the knowledge repository, as argued by SCT, the individual's personal knowledge and access to social knowledge are likely to exert their influence (Bandura 2001a). Therefore, we argue that the impacts of acquisition behavior components are contingent on the context, in particular, the personal and social knowledge contexts.[9] In this study, we focus on the facets of personal and social knowledge which are highly relevant in knowledge acquisition, professional experience and team membership.

Professional experience is the accumulation of "actions, thinking, and conversations" (Wenger et al. 2002 p.9) enacted in prior work practices. As such, professional experience is representative of the individual's personal knowledge structures in enacting their work practices (Brown and Duguid 1991). These knowledge structures built through professional experience may influence not just the assessment of new information, but also their reactions to it (Venkatesh et al. 2008). There is overwhelming conceptual and empirical evidence of the importance of experience in literature. Indeed, the role of experience is supported by all models of learning including constructivism, collaborativism, cognitive information processing and socioculturism (Leidner and Jarvenpaa 1995). Prior empirical research indicates that actors who

[9] 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) (Polanyi 1966). 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 so that the focal individual can access another's personal knowledge.

possess larger amounts of professional experience are equipped with superior cognitive resources to attain, process, and apply new knowledge. For instance, actors with greater domain knowledge are more effective in identifying information which is useful to their needs (McDonald and Stevenson 1998). Those with more experience are more effective in solving problems by understanding the deeper structure of problems whereas novices are limited to the identification of surface structure characteristics (Sweller 1988). Moreover, experienced actors benefit from the development of automated rules allowing for less conscious cognitive processing and greater assimilation of new information while performing complex tasks (Sweller 1989). Consistent with these studies, recent knowledge acquisition literature provides further empirical support indicating that the performance outcomes from knowledge acquisition behavior depend on the level of prior job-specific knowledge held by actors (Haas and Hansen 2005; Ko and Dennis 2011).

Team membership may be particularly useful to the individual actor in gaining access to social knowledge. Teams are formal structures that tie its members with a collective identity and promote trust (Costa 2003; Friedlander 1970). Team membership may foster closer bonds and increase knowledge sharing among individuals because of the collective identity (Wenger 1998). With membership of the team, the individual actor may gain greater access to "informal learning processes such as storytelling, conversation, coaching, and apprenticeship" (Wenger et al. 2002 p.9) which may help in understanding ambiguous cause and effect relationships (Brown and Duguid 1991). When participating in a team, individuals can socialize their tacit knowledge with others (Nonaka 1994; Nonaka and Takeuchi 1995) to shape their own understanding. For instance, communities of practice literature (Brown and Duguid 1991; Lave and Wenger 1991; Thompson 2005; Wenger et al. 2002) and networks of practice (Brown and Duguid 2001;

Ormrod et al. 2007; Vaast 2007) holds that individual learning is enhanced when individuals socially interact with others within a particular shared practice. Actors who participate on a team therefore benefit from social forms of knowledge transfer combining personal learning activities with learning from others (Levitt and March 1988). Recent knowledge acquisition research supports this standpoint indicating that the performance effects of knowledge acquisition are enhanced when individuals concurrently source knowledge from social knowledge sources (Kim et al. 2016). This research emphasizes that actors "may further learn through social interactions how to contextualize and fine-tune codified knowledge for application to local and specific environments" (Kim et al. 2016 p.138).

## RESEARCH MODEL AND HYPOTHESES

In this section, we build on the prior recognition of the components of acquisition behavior and the influence of professional experience and team membership to develop our research model. Our research model hypothesizes the independent effects of acquisition frequency and acquisition intensity on individual's job performance. Further, we hypothesize that professional experience and team membership further amplify the performance effects of each type of behavior. The research model is represented below in Figure 3.

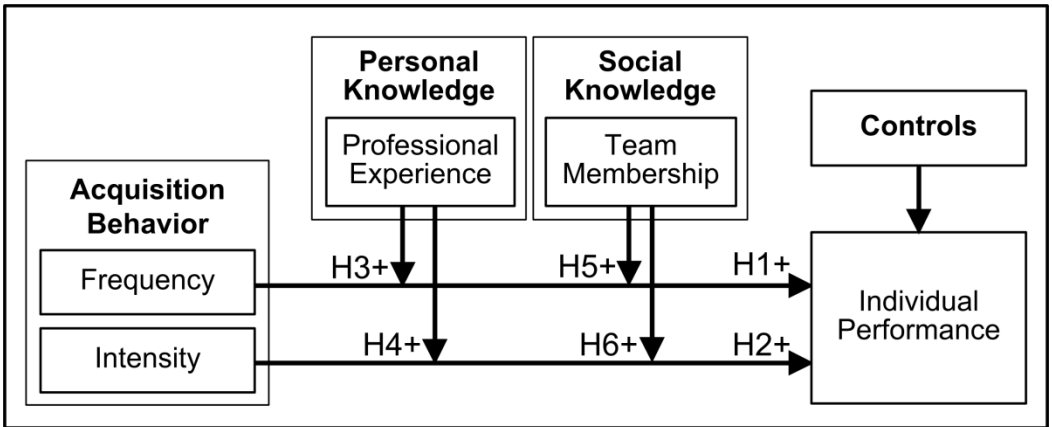

Figure 3. Research Model

## Acquisition Behaviors and Performance

Acquisition frequency may impact individual job performance for at least two reasons. First, individuals need to transfer knowledge from the technology to their task environment (Alavi and Leidner 2001). As such, the transfer occurs via two disparate interaction events – one in which actors use the technology to acquire new knowledge, and the other in which actors use this knowledge to influence task performance (Ko and Dennis 2011). Actors who frequently acquire knowledge from the technology attain greater performance benefits by establishing an iterative learning cycle which draws their interactions with technology more closely to their demands of the task environment (Burton-Jones and Grange 2013; Burton-Jones and Straub 2006). The frequent transfer of knowledge to the task environment may allow the actor to rapidly test the usefulness of knowledge in an emergent learning process (Carver and Scheier 2001). Leonardi (2011) describes this as a process of 'imbrication', in which human and material agencies are interwoven into broader routines to attain desired outcomes (Giddens 1984; Leonardi 2011). Second, actors who frequently use the repository may improve their ability to use the technology effectively to seek out useful knowledge. Actors are likely to gain greater familiarity with technological interface through repeated use (Rosenfeld and Morville 2006) therefore increasing their ability to accurately identify and obtain electronic documents which are both current and relevant for their needs. Over time, as acquisition is frequently repeated and improved as a standard practice, actors improve their effectiveness and efficiency in finding useful documents from the knowledge repository. Therefore, we hypothesize that,

*H1: Greater acquisition frequency leads to greater job performance.*

Over and above the learning benefits gained from acquisition frequency, we expect that acquisition intensity plays a further role in enhancing job performance by increasing the individual's depth and breadth of understanding. First, when individuals place greater effort in acquiring knowledge, they increase their set of available codified resources for reuse (Tsoukas and Vladimirou 2001). The codified resources represent the tacit knowledge structures held across the organization over a wide range of domains (Zack 1999). When actors intensely acquire new knowledge from knowledge repositories, they internalize the acquired content by developing a greater number of internal representations of important concepts and procedures (Lindsay and Norman 1977). This increase in the depth of their knowledge through acquisition intensity, may have a positive impact on their job performance (Ko and Dennis 2011). Second, acquisition intensity may also allow the focal actor to increase the breadth of understanding of the collective practices that constitute her work practice. For example, those who intensely acquire electronic documents are likely to develop a broader lexicon leading to improved communication with others (Carlile 2002). Further, acquisition intensity may allow the individual unique opportunities to expand and recombine their own knowledge, thus extending their expertise (Boland and Tenkasi 1995). For example, individuals may increase their understanding of causal relationships in their context allowing them to identify new areas for innovation (Majchrzak et al. 2005). In summary, acquisition intensity is likely to positively impact job performance by increasing the breadth and depth of the individual's understanding. Therefore, we hypothesize that,

*H2: Greater acquisition intensity leads to greater job performance.*

### The Moderating Role of Professional Experience

While acquisition frequency may present learning benefits by establishing an iterative learning cycle between technology and the execution of tasks, it may also present some challenges that the individual has to overcome to establish this virtuous cycle. Two of these challenges have been highlighted in prior research. Firstly, the focal actor is faced with judging the usefulness of the electronic documents in the repository (Poston and Speier 2005). Secondly, the codified knowledge often lacks important contextual information needed to adapt this knowledge before using it in the focal actor's context (Haas and Hansen 2005; Kim et al. 2016; Szulanski 1996; 2000; Tsoukas and Vladimirou 2001; Uzzi 1997). Here, we argue that experienced actors are more likely to mitigate the challenges when frequently acquiring knowledge, and thus derive greater benefit than inexperienced actors.

With greater experience, actors increase their stock of tacit knowledge (Nonaka 1994). As a result of this knowledge, experienced actors may more effectively identify useful knowledge from the knowledge repository pertinent to their task domain. On the other hand, inexperienced actors may inadvertently incur greater error and rework, either by failing to acquire useful documents (McDonald and Stevenson 1998), or by acquiring those documents that are poorly suited for their purpose (Sweller 1988, 1989). In addition, experienced actors are equipped with a deeper understanding of the task environment (Haas and Hansen 2005; Ko and Dennis 2011). Experienced actors may have greater success in recognizing opportune moments to acquire new knowledge and repeatedly seek out, identify, and apply electronic documents that are useful to the task. By using the right documents at the right time, actors with greater experience are thus, more likely to establish a virtuous knowledge transfer cycle aligning their actions with

technology to the task, thereby improving their performance (Argote 2013; Pisano 1996). Consistent with these arguments, we hypothesize that,

> *H3: Professional experience will moderate the relationship between acquisition frequency and performance such that for those with higher levels of professional experience, acquisition frequency will have a greater effect on job performance.*

Although we expect a positive effect of acquisition intensity by increasing the depth and breadth of internalized knowledge, we expect experience to play a moderating role on its relationship with job performance. Knowledge held in repositories is likely to exist in various symbolic forms (Boland et al. 1994) or become widely disbursed across the organizational structure of the knowledge repository (Majchrzak et al. 2013; Wagner 2004; Wagner and Bolloju 2005; Yates et al. 2010). The variety and dispersion of codified knowledge may prevent actors from assimilating sufficient amounts of relevant knowledge to increase performance outcomes (Markus 2001; McDermott 1999). Further, when acquiring a large quantity of documents in short periods of time, information overload inefficiencies may emerge whereby the amount of useful knowledge is outweighed by an inundation of irrelevant information (Edmunds and Morris 2000; Eppler and Mengis 2004; Kock 2000; Shick and Gordon 1990).

We expect that experienced actors are more likely to derive benefits when intensely acquiring knowledge, through their increased capacity for processing the knowledge and also their ability to identify useful knowledge. First, because of their tacit knowledge, experienced actors are more adept at carefully processing, synthesizing, and integrating knowledge to gain benefits from acquisition intensity (Ko and Dennis 2011). Experienced actors are also more likely to apply heuristic techniques to effectively assimilate new knowledge. For example, by employing schemas and automated rules which allow for greater information processing with

lower cognitive effort (Sweller 1988; Sweller 1989). In contrast, inexperienced actors lack the deep understanding of the task domain necessary to effectively assimilate and apply large quantities of knowledge (Markus 2001; Ko and Dennis 2011). Second, experienced actors are also better equipped to identify useful and relevant knowledge (Shanteau 1992) and are likely to mitigate potential information overload problems by more effectively separating pertinent knowledge from useless or redundant items (Edmunds and Morris 2000; Eppler and Mengis 2004). This recognition of pertinent knowledge, helps experienced actors solve a greater number of problems with increased accuracy (McCall et al. 2008). We therefore hypothesize that,

*H4: Professional experience will moderate the relationship between acquisition intensity and performance such that for those with higher levels of professional experience, acquisition intensity will have a greater effect on job performance.*

## The Moderating Role of Team Membership

We expect that team membership will moderate the relationship between frequency and job performance. While individuals learn from technology, they also observe and learn from others, often modeling their behavior after those who perform well (Lave and Wenger 1991; Wenger et al. 2002). Recent literature suggests that greater access to social knowledge is useful for the actor to overcome challenges in internalizing codified knowledge (Kim et al. 2016). Belonging to teams, may ascribe certain advantages to the focal actor from frequent knowledge acquisition in establishing an iterative learning cycle between technology and job performance. Actors who frequently acquire codified knowledge from the repository may benefit from greater opportunities to share this knowledge with others in the team. By discussing with other team members, either formally in meetings or informally, actors can rapidly determine its usefulness in the task environment and thus establish the virtuous iterative cycle between acquisition and

task performance. Comparatively, actors who operate independently from a collaborative team do not stand to benefit from such synergistic social learning effects. Without a rich social knowledge context to draw from, these actors are left to learn how to imbricate their technology use into their task environment (Leonardi 2011), only relying on their direct personal experiences thus introducing the potential for error. As such, when accounting for individual differences in access to social knowledge we expect that individuals participating in a team will be in a better position to leverage the learning attained from frequent acquisition, as compared to those who do not belong to a team. Therefore, we hypothesize that,

> *H5: Team membership will moderate the relationship between acquisition frequency and performance such that for those who work on a team, acquisition frequency will have a greater effect on individual job performance.*

Finally, we expect that team membership will moderate the relationship between acquisition intensity and job performance. While individuals increase the depth and breadth of their expertise through acquisition intensity, team membership may have a synergistic impact. This standpoint is supported by transactive memory system literature which holds that the team operates as a collective cognitive unit to share expertise (Wegner 1987, 1995). Access to the expertise of other team members may prove useful to actors in their efforts to absorb and make use of larger quantities of acquired codified knowledge, thereby increasing the focal actor's depth of understanding. It is also likely that team members have a diverse and rich understanding of their domain. Individuals participating in teams may benefit from the diversity of expertise through collective sensemaking activities (Boland and Tenkasi 1995; Carlile 2004). This may further help the actor to generate new ideas and test these ideas against the varied understanding of the group (Majchrzak et al. 2005). This vetting process through socialization is likely to

increase the breadth of understanding of the focal actor (Nonaka 1994; Nonaka and Takeuchi 1995). In comparison, individuals operating independently from a collaborative setting are less likely to attain value from the efforts spent in intensely acquiring knowledge. Without access to a collective sounding board to help make sense of codified knowledge and test new ideas, intensely acquiring documents may not prove to be as effective. Therefore, in considering the differential access to social knowledge across conditions of team membership we expect that individuals who intensely acquire documents while participating as a member of a team will attain greater performance levels than those who operate independently. Thus, we hypothesize that,

*H6: Team membership will moderate the relationship between acquisition intensity and performance such that for those who work on a team, acquisition intensity will have a greater effect on individual job performance.*

## RESEARCH METHOD

### Research Setting

To test the hypothesized model, we sought a setting wherein the performance of individual actors is primarily a function of their efforts to self-regulate behavior towards greater learning. The real estate context provides a rich setting within which to examine the influence of knowledge acquisition behavior on individual performance outcomes for three reasons. First, individual agents are highly responsible for continuously updating 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 making knowledge acquisition an important part of work routines. Second, the work activities required to conduct real estate transactions are conducted at an individual level which allows for

greater variation to examine the performance effects of individual acquisition behavior. Third, the real estate industry has gone through dramatic changes over the past decade resulting in a greater need for agents not only to rely on accrued professional experience, but to collaborate in teams to gain social knowledge.

As evidence of the dynamic and knowledge intense nature of the real estate industry, between 2000 and 2010 the real estate industry has endured a radical expansion and rationalization cycle. Membership in the National Association of Realtors (NAR) grew from roughly .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[10]. Between 2006 and 2009; home sales declined drastically with the number of new home sales decreasing from 1.05 million to 374,000[11]. 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 wherein commissions are earned by leading negotiations between banks, defaulting mortgage holders, and prospective buyers. Other agents entered emerging markets such as eco-friendly green housing and housing for senior citizens which require specialized training. Further, as the industry entered a digital marketing era, agents adopted new work routines to integrate their property listings with listing aggregation websites such as Zillow and Trulia. Each of these changes required knowledge that was not previously available thus prompting the need for agents to acquire new knowledge.

[10] http://www.realtor.org/membership/historic-report Accessed Jan 10th 2016
[11] http://www.census.gov/housing Accessed Jan 10th 2016

To examine the effects of acquisition behavior on individual job performance, we gathered data from one of the largest real estate organizations in the United States. This organization 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. Agents in the franchise network are highly autonomous and are therefore free to choose their domains of expertise, retain any revenues that exceed the membership fee, and use franchise resources as needed. While all agents are affiliated with offices which coordinate common practices as a group many agents in these offices have opted to work as part of a formal team. These team members openly share expertise as part of a formal collaboration structure which combines less experienced agents with more experienced agents who adopt a mentoring role. These teams allow agents who specialize in a particular domain to closely interact and collaborate with other specialists. Team membership also allows individuals to broaden their network and create business opportunities by matching inventory with prospective buyers.

To remain valuable to its constituency, the headquarters established codification routines to collect and distribute information of market trends, emerging business practices, and technological advancements. The main channel through which the headquarters transfers documents to its network of agents is via a web based electronic repository – a codification-based knowledge management system. In maintaining the repository, the headquarters maintains a dedicated team of content providers to provide daily updates to the system with the goal of keeping the content current with industry changes. The repository offers agents a wide range of content including marketing advice, competitive reports, sales presentations, and specialized training courses provisioned by the franchise headquarters and the NAR.

## Data Collection

We collected data through two primary data files, the first containing individual-agent usage logs from the electronic repository and the second containing individual-agent records from the franchise membership database – both accessed from the franchise headquarters. The usage log file contains document download metrics covering individual download activity from March 1st until December 31st of 2010. The usage log provided us with attributes of each download event including the user's unique login, the file name of the document, and the date that the document was downloaded. From this data we were able to measure the frequency in which downloads occurred as well as the number of documents that agents downloaded. The membership data file contains current and prior year annual sales commissions and demographic data regarding the individual agent. The membership file also provides attributes that allowed us to associate the agent's download activity with their personal demographics, place of business (office and state) and their sales commissions.[12]

## Measures

In the subsections below, we describe the measures used for the dependent variable, individual performance, the independent variables, acquisition frequency and acquisition intensity, the moderating variables, professional experience and team membership, and the controls.

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

**Dependent Variable**

We measured individual performance, the dependent variable, as the natural log of the individual agent's sales commissions for 2010. These commissions are the real earnings that an agent generated throughout the calendar year through all operational activities such as facilitating the selling and buying of properties, property management, and referring customers to other agents. Given that individual performance is measured as the actual number of dollars earned by agents, the data set therefore provides a unique opportunity to examine the economic value of technology use.

**Acquisition Frequency and Acquisition Intensity**

To construct the independent variables used in the analysis, we merged the usage log and membership data files based on unique identifiers. To construct acquisition frequency, we recorded the number of distinct days on which an agent downloaded content from the electronic repository. The sequence of 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, when negotiating the conditions of sale, and when aiding the buyer in seeking out financial assistance from lending institutions. The need to frequently acquire knowledge is therefore driven by daily communication and decision-making events that lead to the finalization of the transaction. The behavior across days is therefore deemed appropriate to measure the effects of knowledge acquisition behavior in this contextual setting. Acquisition intensity was measured as the average number of documents downloaded across all days. Consider the following example of an agent who acquired 30 electronic documents over a ten-month period in 5 daily visits. The acquisition frequency is measured as 5 and the intensity is measured as 6 (30 divided by 5). This measure of intensity provides an indication as to the

average level of acquisition behavior expressed within a daily period. We also included the total acquisition as a control variable in our model. Overall acquisition was measured as the total number of downloaded documents across the ten-month period. In the above example, the value for this measure is 30.

**Professional Experience and Team Membership**

The moderating variables were constructed from the membership data file. To measure professional experience, we used the number of concurrent years that the agent has held a real estate license. This is a more inclusive measure of professional experience as it includes prior professional experience developed from before entering the focal franchise network. Team membership was measured with a dummy variable based on a team status variable available in the membership data file (0 = not affiliated with a team).

**Controls**

We further operationalized a set of control variables characterizing the market within which the agent competes, the franchise office with which the agent is affiliated, and the agents themselves – all factors which 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[13]. These measures provide an indication of the size and munificence of the market in which agents are situated. Further, we included a 2008 estimate of the county foreclosure rate sourced from the U.S. Department of Urban Housing[14]. This measure is intended to capture the housing market

[13] http://www.census.gov/2010census/data Accessed Jan 10th 2016
[14] https://www.huduser.gov/portal/datasets/nsp_foreclosure_data.html Accessed Jan 10th 2016

turbulence experienced from 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 the competitive advantage that agents working in established offices may gain. 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 individual 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 team size with which the agent is associated. We included a contrast code to control for gender effects (0 = male).

## Data Analysis

Hierarchical Linear Modelling (HLM) was used as the primary analysis technique. HLM allows for the explicit modelling of hierarchical data thus accommodating non-independence in the error term (Raudenbush and Bryk 2002; Snijders 2011). We chose HLM due to the nested nature of the data. Individual real estate agents are nested in the franchise office with which they are associated. Further, individual agents are subject to the market forces at play in their geographic location thus requiring 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 kept as fixed effects as there was no theoretical reason to expect that these coefficients are heterogeneous across office and market.

We introduced the hypothesized variables in a step-wise comparison approach (Judd et al. 2009) by first establishing a baseline model containing the controls at all three levels and the main effects of the moderators, professional experience and team membership. We then introduced the hypothesized variables in a progressive manner by first adding acquisition frequency followed by acquisition intensity. To test the interaction hypotheses, we first introduced the interactions between each acquisition behavior and professional experience followed by interactions between each acquisition behavior and team membership. The final model contains all simultaneous effects.

## RESULTS

Our data consists of 18,219 individual agents nested in 2,743 franchise offices. These offices are located in 1,022 counties spread across 50 states. The average agent competes in a county consisting of roughly 1 million people with a per capita income of $29,785, a median home value of $206,981 and a foreclosure rate of 4%. On average, an agent is affiliated with an office holding 44.51 agents which has been in business for 14.98 years. The average office lost 8.87 agents and recruited 4.67 new agents during 2010.

The average agent earned $80,355 in 2010 and $73,026 in 2009. Agents possess an average of 15.8 years of professional experience and were affiliated with the franchise for 6.68 years. 19% of the agents work on a team with an average team size calculated across all agents of 3.43.[15] 61% of the agents are female. On average, agents accessed the electronic repository on 3.06 distinct occasions (acquisition frequency). The average agent downloaded 3.53 documents

[15] This team size statistic is calculated based on all agents regardless of team membership. Those who did not work on a team were assigned a value of zero. When considering only the agents who work on a team, the average team size is 17.70

per download event (acquisition intensity). A full listing of the summary statistics and correlations is shown in Table 10.

| Table 10. Summary Statistics and Correlations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1. Annual Commissions | 80,355 | 101,650 | 1 | | | | | | |
| 2. Population | 1,023,633 | 1,650,183 | 0.05*** | 1 | | | | | |
| 3. Per Capita Income | 29,785 | 7,062 | 0.09*** | -0.07*** | 1 | | | | |
| 4. Med. Home Value | 206,981 | 99,560 | 0.10*** | 0.18*** | 0.66*** | 1 | | | |
| 5. Foreclosure Rate | 0.04 | 0.02 | -0.03*** | 0.23*** | -0.40*** | -0.38*** | 1 | | |
| 6. Office Size | 44.51 | 32.11 | 0.09*** | 0.12*** | 0.21*** | 0.09*** | 0.00 | 1 | |
| 7. Office Age | 14.98 | 8.65 | 0.08*** | 0.04*** | 0.14*** | 0.06*** | -0.07*** | 0.36*** | 1 |
| 8. Office Attrition | 8.87 | 8.37 | 0.06*** | 0.13*** | 0.14*** | 0.04*** | 0.01** | 0.75*** | 0.17*** |
| 9. Office Expansion | 4.67 | 5.15 | 0.00 | 0.05*** | 0.00 | -0.05*** | 0.16*** | 0.55*** | 0.00 |
| 10. Prior Commissions | 73,026 | 101,716 | 0.84*** | 0.06*** | 0.09*** | 0.09*** | -0.02*** | 0.09*** | 0.11*** |
| 11. Gender | 0.61 | 0.49 | -0.08*** | -0.04*** | -0.02*** | -0.04*** | -0.01 | -0.03*** | -0.04*** |
| 12. Tenure | 6.68 | 6.15 | 0.23*** | 0.06*** | 0.14*** | 0.08*** | -0.04*** | 0.14*** | 0.29*** |
| 13. Team Size | 3.43 | 9.81 | 0.22*** | 0.02*** | 0.08*** | -0.01 | 0.01 | 0.28*** | 0.05*** |
| 14. Professional Experience | 15.80 | 9.80 | 0.16*** | 0.05*** | 0.11*** | 0.08*** | -0.01* | 0.10*** | 0.18*** |
| 15. Team Membership | 0.19 | 0.40 | 0.24*** | 0.00 | 0.04*** | -0.01 | 0.01* | 0.06*** | -0.01 |
| 16. Overall Acquisition | 11.52 | 22.18 | 0.05*** | -0.01 | 0.00 | -0.01* | 0.00 | -0.02*** | -0.04*** |
| 17. Acquisition Frequency | 3.06 | 3.36 | 0.11*** | -0.02** | 0.01 | -0.01 | 0.01* | -0.03*** | -0.06*** |
| 18. Acquisition Intensity | 3.40 | 5.32 | 0.01 | 0.00 | 0.01 | 0.00 | -0.01* | -0.01* | 0.00 |

n= 18,219; * p < .1; ** p < .05; *** p < .01

| Table 10. Summary Statistics and Correlations (Continued) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| | | | | | | | | | | |
| 8. Office Attrition | 1 | | | | | | | | | |
| 9. Office Expansion | 0.52*** | 1 | | | | | | | | |
| 10. Prior Commissions | 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 Membership | 0.07*** | 0.05*** | 0.22*** | -0.05*** | 0.06*** | 0.71*** | 0.02*** | 1 | | |
| 16. Overall Acquisition | -0.009 | 0.03*** | 0.03*** | -0.02** | -0.06*** | 0.00 | -0.06*** | 0.02*** | 1 | |
| 17. Acquisition Frequency | -0.01 | 0.03*** | 0.08*** | -0.03*** | -0.06*** | 0.02*** | -0.06*** | 0.04*** | 0.66*** | 1 |
| 18. Acquisition Intensity | -0.01 | -0.01 | 0.01 | 0.00 | -0.03*** | -0.01 | -0.03*** | 0.00 | 0.57*** | 0.06*** |

n= 18,219; * p < .1; ** p < .05; *** p < .01

To test for the presence of office and county level effects on individual-level commissions, we calculated the intraclass correlation (ICC) using these grouping variables. ICCs of .05 at the office level and .1 at the county level suggest that substantial heterogeneity exists at these levels

(Hofmann 1997; Snijders 2011). We performed an additional check using the state grouping variable but the ICC of .02 indicated that individual commissions are relatively homogenous across states. We therefore kept to a three level HLM model using office and county as the grouping variables. The HLM analysis was conducted with Stata 14 (StataCorp 2015) using the *mixed* command. To reduce multicollinearity and increase the interpretability of the interaction effects, we standardized all variables that were included in the interactions prior to the analysis. Variance inflation factors were all below four which fall below the established thresholds (Menard 2002; Myers 2000), the average variance inflation factor was below two. This suggests that multicollinearity was not a threat to our results.

After establishing the baseline control model (Model 1 in Table 11), we followed the step-wise comparison approach as described earlier. Models 2 and 3 in Table 11 introduce the individual main effects of frequency and intensity respectively. Our analysis shows that the effect of acquisition frequency on commissions is positive and significant ($p < 0.01$) thus supporting hypothesis 1. The coefficient estimate in model 3 indicates that, controlling for acquisition intensity, a one standard deviation increase in acquisition frequency increases average commissions by 8.2 percent. Hypotheses 2 is also supported as evidenced by the significant ($p < 0.01$) and positive effect of acquisition intensity on commissions. As seen in model 3; controlling for acquisition frequency, a one standard deviation increase in acquisition intensity is estimated to increase commissions by an average of 3.0 percent.

Hypotheses 3 and 4 predict that the performance effects of acquisition frequency and acquisition intensity depend on the professional experience of the agent such that agents with greater professional experience will achieve greater benefits from both behaviors. The results from the analysis indicate support for hypothesis 4 but not hypothesis 3. As evidenced in model

7; once controlling for the effects of the other interactions, the interaction between acquisition frequency and the agent's professional experience is not significant. The interaction between acquisition intensity and the agent's professional experience on the other hand is shown to be positive and significant ($p < 0.01$). The coefficient in model 7 indicates that agents with one standard deviation greater professional experience are estimated to achieve an average performance increase from acquisition intensity of 2.1 percent.

Hypotheses 5 and 6 argue that the positive effects of acquisition frequency and acquisition intensity are further contingent on the social context in which the agent is embedded such that agents operating in a rich social context will gain additional synergies from both acquisition behaviors. The results of our analysis indicate support for hypothesis 5 but fail to support hypothesis 6. With respect to hypothesis 5, once controlling for the other interaction effects, the interaction between acquisition frequency and team membership is positive and significant ($p < 0.01$). Actors who work on a team are estimated to gain an additional 5.5 percent increase in commissions when frequently acquiring electronic documents. The results from all hypothesis tests are summarized in Table 12. The simple slopes analysis chart for the two significant interactions are shown below in Figure 4.

| Table 11. Results of HLM Analysis | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model 1 Controls | | Model 2 Acquisition Frequency | | Model 3 Acquisition Intensity | | Model 4 Frequency x Professional Experience | | Model 5 Intensity x Professional Experience | | Model 6 Frequency x Team Membership | | Model 7 Intensity x Team Membership | |
| Constant | 9.296*** | (0.063) | 9.296*** | (0.062) | 9.297*** | (0.062) | 9.298*** | (0.062) | 9.300*** | (0.062) | 9.301*** | (0.062) | 9.301*** | (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) |
| 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) |
| 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) |
| Foreclosure Rate | -0.920* | (0.543) | -0.953* | (0.541) | -0.945* | (0.541) | -0.938* | (0.541) | -0.939* | (0.540) | -0.945* | (0.540) | -0.944* | (0.540) |
| 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) |
| 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) |
| Office Attrition | -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) |
| Office Expansion | 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 | 0.142*** | (0.002) | 0.142*** | (0.002) | 0.142*** | (0.002) | 0.141*** | (0.002) | 0.141*** | (0.002) | 0.141*** | (0.002) | 0.141*** | (0.002) |
| Gender | -0.057*** | (0.015) | -0.055*** | (0.015) | -0.054*** | (0.015) | -0.054*** | (0.015) | -0.054*** | (0.015) | -0.053*** | (0.015) | -0.053*** | (0.015) |
| Tenure | 0.008*** | (0.002) | 0.008*** | (0.002) | 0.008*** | (0.002) | 0.008*** | (0.002) | 0.008*** | (0.002) | 0.008*** | (0.002) | 0.008*** | (0.002) |
| Team Size | 0.004*** | (0.001) | 0.004*** | (0.001) | 0.004*** | (0.001) | 0.004*** | (0.001) | 0.004*** | (0.001) | 0.004*** | (0.001) | 0.004*** | (0.001) |
| Professional Experience | 0.039*** | (0.010) | 0.040*** | (0.010) | 0.040*** | (0.010) | 0.041*** | (0.010) | 0.041*** | (0.010) | 0.041*** | (0.010) | 0.041*** | (0.010) |
| Team Membership | 0.323*** | (0.027) | 0.319*** | (0.027) | 0.318*** | (0.027) | 0.319*** | (0.027) | 0.319*** | (0.027) | 0.315*** | (0.027) | 0.315*** | (0.027) |
| Overall Acquisition | 0.002*** | (0.000) | -0.000 | (0.000) | -0.002*** | (0.001) | -0.002** | (0.001) | -0.001** | (0.001) | -0.001** | (0.001) | -0.001** | (0.001) |
| Acquisition Frequency | | | 0.065*** | (0.010) | 0.082*** | (0.011) | 0.082*** | (0.011) | 0.080*** | (0.011) | 0.064*** | (0.012) | 0.065*** | (0.012) |
| Acquisition Intensity | | | | | 0.030*** | (0.010) | 0.030*** | (0.010) | 0.031*** | (0.010) | 0.031*** | (0.010) | 0.029*** | (0.010) |
| Frequency x Professional Experience | | | | | | | 0.014* | (0.007) | 0.013* | (0.007) | 0.012 | (0.007) | 0.012 | (0.007) |
| Intensity x Professional Experience | | | | | | | | | 0.021*** | (0.008) | 0.021*** | (0.008) | 0.021*** | (0.008) |
| Frequency x Team Membership | | | | | | | | | | | 0.055*** | (0.016) | 0.055*** | (0.016) |
| Intensity x Team Membership | | | | | | | | | | | | | 0.015 | (0.020) |
| Model degrees of freedom | 15 | | 16 | | 17 | | 18 | | 19 | | 20 | | 21 | |
| Log Likelihood | -25219 | | -25196 | | -25191 | | -25189 | | -25185 | | -25180 | | -25179 | |

Standard errors in parentheses; n = 18,219; Number of groups: 1,022 counties, 2,743 offices; *** p<0.01, ** p<0.05, * p<0.1

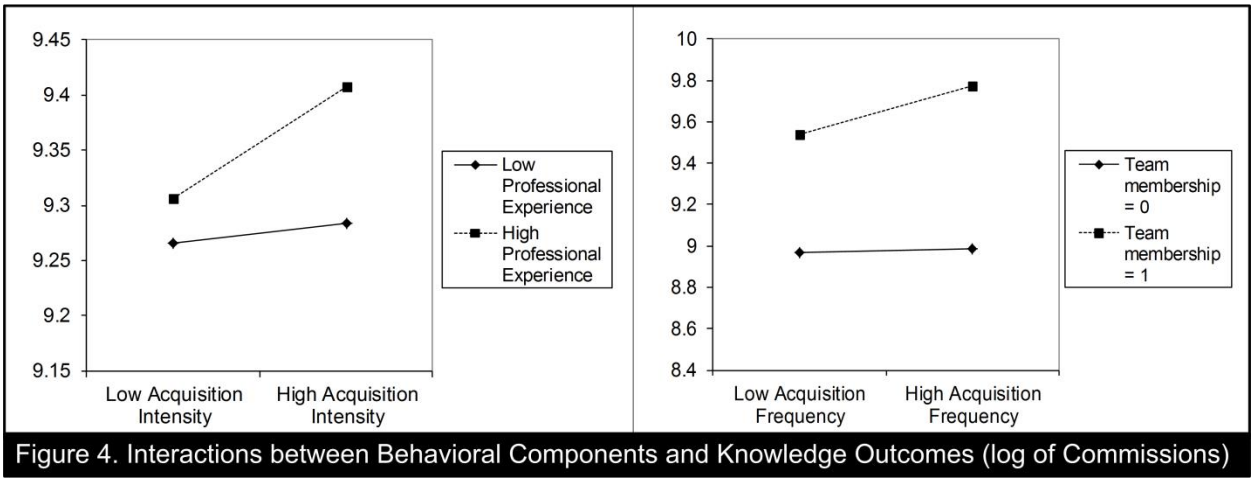


Figure 4. Interactions between Behavioral Components and Knowledge Outcomes (log of Commissions)

Table 12. Summary of Hypothesis Tests

| Hypothesis | Result |
|---|---|
| H1: Greater acquisition frequency leads to greater performance outcomes. | Supported |
| H2: Greater acquisition intensity leads to greater performance outcomes. | Supported |
| H3: Professional experience will moderate the relationship between acquisition frequency and performance such that for those with higher levels of professional experience, acquisition frequency will have a greater effect on performance. | Not Supported |
| H4: Professional experience will moderate the relationship between acquisition intensity and performance such that for those with higher levels of professional experience, acquisition intensity will have a greater effect on performance. | Supported |
| H5: Team membership will moderate the relationship between acquisition frequency and performance such that for those who work on a team, acquisition frequency will have a greater effect on performance. | Supported |
| H6: Team membership will moderate the relationship between acquisition intensity and performance such that for those who work on a team, acquisition intensity will have a greater effect on performance. | Not Supported |

As robustness checks, we further examined the data to determine if the general pattern of results holds under alternate specifications of the model. In so doing, we first reran the analysis using the robust option in the mixed command which produced nearly identical results. Second, as shown in Appendix G, we introduced alternate measures of the primary variables of interest. To test broader measures of acquisition frequency, we constructed two new measures based on

the number of distinct weeks and distinct months in which downloads occurred. Alternate measures of acquisition intensity were constructed based on the average number of downloads that occurred within the specified timeframe (i.e., week or month). When performing the analysis with these alternate measures of acquisition behavior, the general pattern of results held. Third, 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. As an alternative measure for social knowledge, we used the team size measure (i.e., the number of members in the team that the focal actor belongs to) rather than the team membership binary indicator. When running the analysis with these alternate measures of the personal and social contexts, the general pattern of results held. Next, 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 acquisition behavior, professional experience, and team membership to determine if synergies between the personal and social contexts would further amplify the effects of frequency and intensity. None of the three-way interactions were significant.

## DISCUSSION

### Contributions and Implications

The aim of this study was to gain further insights into acquisition behavior. We began by conceptually delineating between the two components of acquisition behavior, i.e., acquisition frequency and acquisition intensity and recognized the importance of personal and social knowledge. We then proposed a research model that examined the influence of frequency and intensity on individual performance, as well as the moderating effect of personal experience and team membership. Our findings, based on a comprehensive dataset of 18,219 real-estate agents

from 2,743 offices nested in 1,022 counties of the U.S., render support for the impact of the two components of acquisition behavior on financial performance. Furthermore, we find that professional experience and team membership have differential impacts on the influence of the two acquisition behavior components.

This study provides three main contributions to IS literature. First, it enhances our understanding of acquisition behavior through the recognition of its components as acquisition frequency and intensity. The conceptual and empirical delineation of acquisition behavior into a time-based component and an effort-based component offers a finer-grained view of acquisition, one that goes beyond how much knowledge acquisition behavior was exhibited but also to consider how these behaviors were exhibited. Our assessment of prior literature revealed either a loosely defined general treatment of acquisition, or an implicit focus on one behavioral component at the cost of ignoring the other. This has stymied our understanding in at least two ways. Firstly, it may have led to equivocal results about the impact of acquisition behavior on individual learning and performance. Secondly, we have failed to gain insights into the differential impacts of these behaviors and how they interact with the context. Thus, the implicit treatment of acquisition behavior may have impacted both pillars of scientific research, explanation and prediction. Through the conceptual development and explicit treatment of the components of acquisition behavior, we answer the call from system use literature for the establishment of user behavior constructs in the knowledge management setting that are theoretically justified (Burton-Jones and Straub 2006). Our results indicate that acquisition frequency and acquisition intensity have an independent impact on individual performance, beyond the impact of overall acquisition. Further, overall acquisition has a negative impact on performance when frequency and intensity are considered. These results support the standpoint

that, how individuals exhibit and self-regulate acquisition behavior may be even more important to consider than just how much of the behavior they exhibit (Carver and Scheier 2001).

Second, IS literature has often underscored the need to link IT use to objective financial outcomes as an important aspect of understanding its value within organizations (Devaraj and Kohli 2003; Tanriverdi 2005). The objective data used in this study complements 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 (i.e. Kim et al. 2016; Ko and Dennis 2011) which begins to provide an indication not only of the theoretical importance of technology-based acquisition behavior as a mechanism for gaining knowledge, but also of its potential economic impact. Our results indicate that overall acquisition significantly impacts agent financial performance. Furthermore, our results also show that both acquisition frequency and acquisition intensity have an independent and significant impact on agent financial outcomes. A standard deviation increase in acquisition frequency and intensity increases an agent's commission by 8.2% and 3.0% respectively. For an average agent (making around $80,000) the combined impact of a standard deviation increase in both behaviors can lead to about a $9,000 increase in commissions. As such, these results provide detailed counter-evidence to earlier claims that codification-based knowledge management initiatives are unlikely to generate value (Kogut and Zander 1992; McDermott 1999).

Third, our empirical results reaffirm broader notions that personal and social knowledge play a direct role in impacting individual performance (Bandura 1986, 2001a, 2001b). Furthermore, while frequency of acquisition interacted with access to social knowledge to impact performance, intensity of acquisition interacted with personal knowledge. The differential impact of personal and social knowledge on the relationship between acquisition behavior components

and individual performance suggests a nuanced interplay between behavior and cognition, not as substitutes but as complements. Learning from technology provides for great degrees of freedom in terms of time and effort, wherein individuals can regulate frequency and intensity behavioral components of acquisition. However, learning from technology is also an active and constructive process, wherein new information from behaviors is reflected and evaluated upon (Bandura 2001a). Reliance on personal and social knowledge represent distinct pathways of this reflection. When individuals exhibit greater levels of acquisition intensity, a high level of personal knowledge may serve to reduce the effort in information processing, and as such, enables the individual's intensity behaviors to be more effective. That is, the individual with greater levels of personal knowledge may be able to process higher quantities of information. On the other hand, access to social knowledge functions as complementary cognition mechanism for the focal individual (Nooteboom 1999). However, since it may not be possible to process large amounts of information using this complementary cognition, the individual may resort to processing smaller amounts of information more frequently. Thus, the results of this study build upon the insights of social cognitive theory to understand the influence and interactions of the three constituents of acquisition (behavior, cognition and environment).

Overall, the results of this study have two important implications for research focused on acquisition behavior. First, this study adds to more recent literature that has begun to bridge the gap between behavioristic paradigm and constructivism paradigm (Leidner and Jarvenpaa 1995). Prior literature has focused more on understanding the behavioral aspects of the use of knowledge repositories, often focusing on how much of a certain behavior was exhibited. On the other hand, constructivism highlights the role of the individual's cognition in developing their own understanding and mental schema while exhibiting learning behaviors. Although more

recent literature has moved toward understanding behaviors in the light of the individual cognition (Venkatesh et al. 2008; Kankanhalli et al. 2011; Ko and Dennis 2011), our understanding has been stymied because of the lack of conceptualization of acquisition behavior. Our results highlight the importance of bridging the gap between understanding behavioral components, in relation to the individual cognition that these behaviors support. Second, the study also serves to bridge the gap between cognitive constructivism, and collaborative constructivism (Leidner and Jarvenpaa 1995; Du and Wagner 2007). Cognitive constructivism highlights the role of individual's cognitive information processing in developing, testing, and refining mental models in the learning process. Collaborative constructivism, on the other hand, emphasizes the role of social interactions in building a shared understanding. The results of this study indicate support for both perspectives in regards to acquisition behavior. Perhaps more interestingly, our empirical results indicate nuance, in that, when combined with specific behaviors directed at technology, individual cognition and social interactions may represent independent pathways to individual learning. While these results are rooted in the context of this study, future research can further our understanding of the interplay between technology-focused behaviors, individual cognition and social cognition.

This study holds two main implications for practice. The first practical implication from these findings is that acquiring actors may increase the realized value of acquired knowledge by being cognizant not only of the codified knowledge which they acquire but also of the personal knowledge and social knowledge which is available to them. This self-awareness may aid actors in judging how and when electronic documents may be acquired. To increase performance levels, actors who work in a team setting may steer their acquisition behavior towards greater frequency and seek ways to integrate newly acquired knowledge with the existing knowledge of

team members. Alternately, actors with greater levels of professional experience are better served to expand into deeper and broader domains by intensely acquiring knowledge and seeking new opportunities to innovate. Second, the results from this study indicate that managers of codification-based knowledge management systems may pay heed to the acquisition behavior of acquiring actors and seek ways to encourage favorable behavior. By examining the frequency and intensity of acquisition behavior, managers may seek ways to cater the system towards each usage pattern. For example, managers may encourage greater amounts of acquisition frequency by sending automatic notifications when new content is available, by incorporating the system into task workflows, and offering synchronization features which offer actors offline content (Ko and Dennis 2011). An increase in acquisition intensity may be fostered by implementing advanced search tools that help to identify new content, recommendation systems which offer content based on prior usage, and tag clouds which allow for the social categorization of knowledge (see McAfee 2006). Moreover, efforts placed in training actors to utilize these features may decrease barriers to increase overall acquisition effectiveness.

## Limitations and Future Research

As with any study, our study is subject to limitations that future research may address. First, we examined the performance effects of acquisition behavior using data from a single organization in the real estate industry. While our contextual setting made it possible to obtain objective data in a knowledge intensive context, it also represents a situation wherein use of the technology is completely voluntary. As such, the results of this study may not be generalizable to settings where the individual actors do not have the freedom to regulate their own behavior toward technology. Future research in non-voluntary contexts can explore how acquisition behaviors impact performance. Second, although the detailed document download and

performance data made a fine-grained examination of acquisition behavior possible, they also introduced some limitations. Our acquisition data was limited to ten months (i.e., from March to December), rather than the entire calendar year. While the data from the first two months are missing, we do not believe that this would systematically jeopardize our findings for two reasons. One, it represents a smaller proportion of the behaviors for the entire year. Two, we examined the correlation of download behavior across months and found that they are highly correlated, indicating that the download behavior that is missing for the first two months 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.

Third, while we explore the impacts of acquisition behavior, we do not examine the motivational antecedents of each acquisition behavior (Bandura 2001b). Future insights into the role of incentives, rewards and punishments, in both voluntary and non-voluntary contexts, can lead to a finer grained understanding of the motivations driving acquisition behavior. Furthermore, research in multiple settings could exploit industry differences and measure the relative impact of frequency and intensity across various industries. For example, examinations of creative settings such as new product development (Pavlou and El Sawy 2006) could provide interesting insights. Fourth, this study examined the acquisition of electronic documents only from within the organization. In many cases, individuals draw upon knowledge from outside of organizational boundaries (Wang et al. 2011). Future research may delve further into the performance effects which emerge when actors distribute their acquisition behavior across internal and external knowledge sources. Given the proliferation of knowledge sources available through industry associations, educational institutions, and via publicly available internet services, actors are inundated with a broad choice of content. An examination of the comparative

frequency and intensity in which actors acquire from internally managed knowledge sources as opposed to externally available sources could help to identify the relative efficacy of each. Finally, while the secondary data provided rich information regarding individual agent's acquisition behavior, the contextual setting did not allow us to gather data on the qualitative aspects of how the knowledge acquired was being used. It can perhaps be argued that some agents are better at effectively using knowledge acquired. Future research set in contexts that enable richer investigations into the qualitative aspects of how acquired knowledge is used, may serve to further our understanding of technology-based knowledge acquisition.

## CONCLUSION

This study contributes to literature through the theoretical development and empirical investigation of individual's technology-based acquisition behavior. In doing so, we identify the components of acquisition behavior as acquisition frequency and intensity. We further recognize the role of personal and social knowledge in moderating these behaviors. We test the hypothesized research model on a comprehensive dataset of 18,219 real estate agents in the United States. Results indicate that both acquisition frequency and intensity influence individual agent's financial performance. Further, personal and social knowledge have differential impacts on frequency and intensity. Our findings begin to bridge the gap between behavior and cognition that underlies the use of technology for managing knowledge. 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 its members through technology. We hope that this study encourages the continued investigation of technology-mediated knowledge acquisition, its antecedents and its outcomes.

## PAPER 3: REPOSITORY KMS USE AND GROUP PERFORMANCE: THE CONTINGENT ROLE OF GROUP COMPOSITION


### ABSTRACT

Previous research has only recently begun to examine the effects of knowledge management system (KMS) usage on work group outcomes. As a result, little is known about the conditions under which the usage of repository KMS increases group performance. In response to this gap, this study examines the contingencies of group composition. We conceptualize repository KMS usage as a learning mechanism that positively impacts group performance. Further, we identify group size, knowledge heterogeneity, and membership change as important aspects of group composition which moderate the usage - performance relationship. We analyzed a unique dataset composed of objective measures of repository KMS usage and sales commissions of 3,092 work groups within a large franchise company. The results indicate that when ignoring group composition effects, repository KMS usage has a positive effect on group performance. This positive impact is greatly diminished however for groups with a greater number of members, with greater knowledge heterogeneity, and with greater membership change. Our results suggest that the implementation and usage of knowledge management technology alone is not sufficient to generate value for groups. Instead, measures should also be taken to address barriers which inhibit group learning.

## INTRODUCTION

Organizations increasingly rely on work groups to conduct critical tasks (Argote 2013; Kane and Borgatti 2011; Marks et al. 2001). Work groups add value to organizations on multiple fronts; for example by developing strategies, producing products, and delivering services (Edmondson et al. 2007). To perform these functions effectively, groups make use of a large variety of knowledge resources (Guzzo and Shea 1992). To increase group effectiveness, organizations therefore implement knowledge management strategies which support the knowledge activities of the group (Choi et al. 2010). In particular, information technology (IT) is increasingly used as a tool to increase the depth and breadth of group knowledge (Alavi and Leidner 2001). For instance, by facilitating within-group communication, providing information to the group, supporting communication with those outside the group, and structuring group task processes (McGrath and Hollingshead 1993; 1994). Indeed, "the very essence of the knowledge management challenge is to amalgamate knowledge across groups for which IT can play a major role" (Alavi and Leidner 2001, p.112). As such, the need to examine the IT usage behavior and its knowledge-related outcomes in groups has become highly important both to research and practice.

Despite this recognition, prior information systems (IS) research remains relatively limited in its understanding of the potential benefits of knowledge management system (KMS) usage in groups. To date, only a small handful of studies examine the impact of KMS usage at the group level of analysis (i.e. Choi et al. 2010; Gallivan 2003; Haas and Hansen 2005; Pavlou and El Sawy 2006). As a result, it is not yet clear as to how and when KMS usage consistently leads to positive performance outcomes. For instance, while Haas and Hansen (2005), and Gallivan (2003) note a negative impact of KMS usage on group performance, the more recent work of

Choi et al. (2010) and Pavlou and El Sawy (2006) indicate a positive influence of KMS usage on group process outcomes which in turn increase performance. Further, only two studies have considered the contingencies of KMS usage. In particular, Haas and Hansen (2005) examine the moderating effects of group experience and task competitiveness while Pavlou and El Sawy (2006) examine the moderating effects of environmental turbulence. This suggests that further research is needed to identify the boundary conditions of effective KMS usage in groups. Indeed, research in this area "has given little attention to theoretical or conceptual issues about information acquisition, processing, and integration, and even less attention to… the conditions under which information is easily shared among group members" (Hollingshead and Contractor 2002, p.231).

We argue here that a further examination of the group performance outcomes of KMS usage may shed new light on the challenges that organizations face when managing knowledge. The study of group performance outcomes allows for the examination of important factors which are not apparent at lower levels of analysis (Morgeson and Hofmann 1999). Given that knowledge management entails social processes which depend largely on the willingness and ability of individuals to share knowledge (Alavi and Leidner 2001; Nonaka 1994) we contend that group composition, or the number and type of people who are members of a group, plays a vital role in garnering group value from KMS usage. Group composition has been shown to play an important role in group communication (Levine and Resnick 1993) and incur a powerful influence on group outcomes (Campion et al. 1993; Gladstein 1984; Hackman and Morris 1975). Organizations therefore strive to construct and maintain an optimal mixture of group members who work collectively to enhance and sustain overall group effectiveness (Kozlowski and Bell 2013).

In this paper, we study the conditions under which the use of a repository KMS leads to differential performance outcomes for work groups. We therefore identify important aspects of group composition which we expect to regulate the performance outcomes of repository KMS usage. Drawing from prior literature as well as insights gained through discussions with managers in a large real estate franchise, we first hypothesize that repository KMS usage influences group performance by serving as a group learning mechanism. We then hypothesize that group size, knowledge heterogeneity, and membership change attenuate this relationship by erecting communication and coordination barriers. Consistent with our predictions, we find that repository KMS usage has an overall positive effect on group performance. This positive effect is diminished for groups with a greater number of members, for groups with greater knowledge heterogeneity, and for groups with greater membership change.

This paper contributes to research on three fronts. First, it furthers our understanding of the group performance effects of repository KMS usage thus addressing a gap in prior research. As such, we provide evidence that repository KMS usage serves as a learning mechanism to increase group performance outcomes. Second, it identifies and examines moderating aspects of group composition that are salient in the context of repository KMS usage. These aspects are common across all groups and should therefore factor into the decision of when and how to implement repository KMS to disseminate organizational knowledge to work groups. Third, it quantifies the economic value of repository KMS usage in groups based on objective measures of usage and performance. This study therefore advances prior knowledge management research by examining actual usage and group performance outcomes in a real world setting rather than in artificial conditions. In total, our findings take an important step toward discovering how

organizations increase group effectiveness by implementing interventions to overcome barriers to group learning from repository KMS usage.

The remainder of this paper is organized as follows. We first briefly introduce the research setting used to inform and validate our research model. Second we develop a research model which links repository KMS usage to group performance and identifies aspects of group composition which are hypothesized to play a contingent role in this relationship. We then introduce the research methodology used in this study and describe the data and operationalized measures. We present our results and finally discuss their implications for research and practice.

## RESEARCH SETTING

This study examines the contingent impact of repository KMS usage on the performance of work groups in a large real estate franchise. The real estate franchise has been in business for over 40 years, has more than 3,000 work groups[16] distributed throughout the United States and maintains a membership base of more than 50,000 real estate agents and managers. This study is part of a larger research program examining the relationships between IT usage, learning, and performance. As part of this research program, we collected archival data from the franchise headquarters, interviewed managers working with the franchise, and gathered objective data of IT usage and membership metrics. This data was used to inform this study and validate its proposed research model.

[16] Work groups are colloquially referred to as offices within the franchise

## RESEARCH MODEL AND HYPOTHESES

### Group Learning

Work groups are collections of individuals who are interdependent in their tasks, who see themselves and are seen by others as an intact social entity, and who are embedded in a larger social system (Cohen and Baily 1997). The boundaries of groups are permeable thus allowing for the two-way interchange of members, resources, and knowledge between the work group and the organizational context (Arrow et al. 2000; Ziller 1965). Groups perform a key role in organizations by linking individual actions with collective goals (Gladstein 1984; Newton and Levinson 1973). The social interaction between group members allows for the conversion of individual inputs into group outputs thus generating organizational value (Guzzo and Shea 1992). Inputs consist of the things which group members bring into the group such as expertise, status, personality attributes, abilities, and experience. Outputs consist of the ideas, plans, decisions, products, or services yielded by groups (Guzzo and Shea 1992).

Prior research argues that work groups increase their effectiveness through learning (e.g. Argote et al. 2001; Edmonson 1999; Wilson et al. 2007). Group learning entails "the activities through which individuals acquire, share, and combine knowledge through experience with one another" (Argote et al. 2001, p. 370) and is an "ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results and discussing errors" (Edmonson 1999, p.353). Through the collective experiences of its members, groups build an understanding of the capabilities of individuals, increase the coordination of activities, and use technologies more effectively to enhance group output (Argote 2013). It is further noted that group learning entails changes in collective actions, not just in individual behaviors (Wilson et al. 2007). As such, improvements in group tasks result not simply from the

additive changes in individual member behavior but from changes in the patterning of collective behavior (Arrow et al. 2000).

Past research has established that group learning consists of several distinct yet interrelated processes (see Wilson et al. 2007 for a review). This body of research offers several characterizations of the number and type of processes which facilitate group learning. For example, according to Argote (2013), groups learn through four processes. First, by sharing existing knowledge between members, second by generating new knowledge through interactions between members, third by evaluating the usefulness of shared knowledge, and fourth by combining knowledge into collective products. Gruenfeld et al. (2000) view group learning as a collection of knowledge acquisition, persistence, diffusion, and deprecation processes. Further, Wilson et al. (2007) argue that group learning consists of three processes: storage, retrieval, and sharing. Storage is a process by which "knowledge that has been learned by the group comes to be stored and retained in memory repositories" (Wilson et al. 2007, p.1047). Retrieval requires that group members find and access stored knowledge for subsequent inspection or use (Wilson et al. 2007). Sharing is a process by which "new knowledge, routines or behavior becomes distributed among group members and members understand that others in the group possess that learning" (Wilson et al. 2007, p.1044). When taken as a whole, this research suggests that, at a minimum, groups learn when knowledge is retrieved from knowledge repositories in order to influence the collective actions of the group.

### Repository KMS Use as a Group Learning Mechanism

To facilitate the dissemination and use of organizational knowledge, organizations employ learning mechanisms (Popper and Lipshitz 1998). Learning mechanisms are "observable

organizational structures through which organization members interact for the purpose of learning" (Friedman et al. 2005, p.26). Organizational learning literature discusses several learning mechanisms. For example, job rotation (O'Leary et al. 2011; Ortega 2001), research and development departments (Dodgson 1993; Mowery and Rosenberg 1991), post project reviews (Schindler and Epler 2003; Von Zedtwitz 2002) and IT usage (Iyengar et al. 2015). The concept of learning mechanisms has also influenced group literature (Goodman et al. 2001). For example, groups are shown to improve the common understanding of who knows what in the group via training (Edmondson et al. 2000). Training serves as a learning mechanism to enhance transactive memory. Another example of a group learning mechanism is the informal observation of member actions. Informal observations between group members increase the learning of stable work groups whose members interact within a shared location (Goodman et al. 2001).

Drawing from this line of research, we conceptualize the usage of repository KMS as a group learning mechanism. Repository KMS are specifically designed for the purpose of storing and transferring knowledge between organizational members (Alavi and Leidner 2001; Markus 2001). These systems preserve codified knowledge which is made available to groups through maintenance, search, and retrieval functions (Stein and Zwass 1995). Documents stored in repository KMS contain information of best practices and solutions to common problems intended to reduce rework and increase task efficiency (Alavi and Leidner 2001). As such, the use of knowledge from repositories has the potential to positively influence task performance across multiple usage situations (Markus 2001). Repository KMS usage is therefore suited to facilitate group learning processes. One form of group learning occurs when group members

retrieve organizational knowledge resources and use these commonly held resources to coordinate collective action.

### Repository KMS Use and Work Group Performance

Building from our conceptualization of repository KMS usage as a group learning mechanism we hypothesize that the greater usage of repository KMS by group members leads to greater group performance by enhancing group learning. Prior research indicates that individuals may use repository KMS to develop and enrich their knowledge of task domains and improve performance. For example, in a study of pharmaceutical sales representatives, greater use of electronic documents depicting drug information, competitive sales information, sales techniques, and lessons learned is shown to increase individual sales performance (Ko and Dennis 2011). Likewise, a study of grocery store department managers provides evidence that the greater use of information on product display plans, advertising campaigns, and promotion programs obtained from a repository KMS leads to greater department sales performance (Kim et al. 2016). When these individuals participate as part of a group, individual learning may emerge into group learning via the social interactions between group members. This notion is supported in recent research indicating that the use of KMS leads to an increase in group knowledge sharing which in turn increases knowledge application and performance (Choi et al. 2010).

Once organizational knowledge is retrieved from a repository, it can lead to the coordination of collective action thus increasing group performance. The knowledge obtained from repository KMS can serve to increase group coordination by disseminating “pre-established plans, schedules, forecasts, formalized rules, policies and procedures” (Van de Ven et al. 1976, p.323).

Further, organizational knowledge may be converted into new knowledge once it is socialized throughout the group (Alavi and Leidner 2001; Nonaka 1994; Nonaka and Takeuchi 1995). The creation of knowledge may therefore help groups to find novel uses for existing knowledge and innovate new routines. By coordinating collective action and innovating new routines, work groups may adapt better to dynamic environments and sustain competitive advantage (Argyris and Schön 1974; Cohen and Levinthal 1990; Fiol & Lyles 1985).

In the real estate franchise setting, each work group performs a wide range of services for both residential and commercial real estate customers such as property appraisal, sales, leasing, management, and auctioning. These services are highly knowledge intensive requiring a current understanding of industry regulations, market conditions, mortgage procedures, and sales and marketing practices. Collective activities primarily include attracting new customers, marketing properties, negotiating terms of sale, and executing the transfer of ownership. These activities are time-sensitive requiring the synchronized participation of multiple group members to ensure successful completion.

Responsibilities in these work groups are divided across three primary roles: 1) managers, 2) agents and 3) licensed assistants. *Managers* hire, train, and retain group members and engage in the operations of the work group by coordinating transactions across agents and implement strategic initiatives. *Agents* handle customer-facing sales activities and facilitate real estate transactions. *Licensed assistants* play a supporting role in the sales process by preparing legal documents and coordinating with customers. Each role therefore has its own purpose and

limitations[17] which are complementary in design. As such any breakdown in the coordination between roles could lead to the loss of commissions[18].

Our conversations with managers suggested that there is an ongoing need for the work groups to learn to meet the needs of the changing environment. As such, the work groups continually seek ways to share knowledge internally to establish and sustain competitive advantage. For example, managers arrange focus groups and sales meetings on a regular basis to share new ideas and improve business practices. Moreover, panels of agents meet frequently to discuss personal accounts of which practices are working and which are becoming obsolete. This sharing of knowledge also occurs when new members are introduced to the group. It is common practice for experienced agents to act as mentors to new agents to ensure continuity in group functioning. It is also common for new members to provide assistance to each other and discuss how to resolve complex issues. These interactions are generally ad-hoc and not set to a fixed group of members thus allowing for knowledge to circulate freely within the group.

Given the broad geographic distribution of work groups, the franchise headquarters collects and distributes knowledge via a centrally managed repository KMS. The repository KMS is a document management and storage system which facilitates the transfer of electronic documents via the Internet. Franchise members located across the country are able to access the system through a web browser interface. A dedicated team of content administrators regularly collects and publishes information with the goal of keeping the repository current with market changes.

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[17] A state-issued license is required to perform each role. As such, agents are not allowed to perform the roles of managers and licensed assistants are not allowed to perform the role of agents without first passing the required exam.

[18] To ensure that individuals are incentivized to effectively coordinate behavior, sales commissions generated by agents are shared with managers and licensed assistants. This commission split varies within and across offices and ranges from 15 to 50% of agent commissions.

The repository KMS contains a wide variety of documentation including training guides, operational procedures, sales scripts, market reports, marketing campaigns, and technical manuals.

There are several ways in which group members share knowledge obtained from the repository KMS with the group. First, managers seek out and access knowledge on behalf of the group. For instance by bringing marketing campaigns to the attention of the group and coordinating individual marketing efforts towards these campaigns. Managers also disseminate competitive reports with the group to decide upon collective sales strategies. Second, licensed assistants draw upon technical manuals and operational procedures to streamline their interactions with agents. By instilling these best practices during the course of sales transactions, licensed assistants disseminate procedural knowledge throughout the group. Third, agents share knowledge such as training guides and sales scripts amongst each other to increase the chances of selling and buying properties. These documents are collectively scrutinized, compared, and tested to determine which are most effective in generating new customers and closing sales transactions. Finally, multiple forms of knowledge are shared and integrated within groups during staff meetings. All members of the work group meet on a regular basis to share best practices and decide upon operational goals. As such, through these interactions between group members, individual learning from repository KMS usage aggregates to collective learning thus increasing group performance.

Based on the above discussion, we therefore hypothesize:

*H1: Greater repository KMS usage by group members leads to greater group performance.*

## The Contingent Role of Group Composition

The examination of group composition is of interest to research and practice because the number and type of members in a group has a powerful influence on group process and outcomes (Kozlowski and Bell 2013). According to Campion et al. (1993), group composition is "a theme in all models of effectiveness" (p.827). Group composition influences group effectiveness through multiple paths. For instance by altering group cohesiveness (Haythorn 1968) and driving member turnover (Jackson et al. 1991; O'Reilly et al. 1989). Group composition has also been shown to impact effectiveness by affecting the coordination of cognitive tasks. For example, group composition influences decision making performance (Gruenfeld et al. 1996) and impacts creative decision making and problem solving (Jackson 1992). As such, given that the examination of group composition is long-standing tradition in group research, we consider it as an important factor in this study.

Prior group research suggests that the efficacy of group learning processes depends on the quality of social interactions between group members (Edmondson et al. 2007; Goodman et al. 2001; Wilson et al. 2007). At the same time, past reviews of group effectiveness highlight group composition as a key factor that greatly influences the quality of group social interactions (Argote 2013; Campion et al. 1993; Gladstein 1984; Guzzo and Shea 1992; Hackman and Morris 1975; Kozlowski and Bell 2013). Moreover, group composition is believed to play a key role within group knowledge sharing (Argote 2013). This point is further supported by Hackman and Morris (1975) who argue that group composition strongly determines group effectiveness for tasks involving the utilization of knowledge and skill. Likewise, Guzzo and Shea (1992) contend that group composition determines the resources available to a group working on intellective tasks. Given the support for group composition as critical factor in knowledge-based tasks, we

argue that group composition is likely to play a contingent role in the context of repository KMS use.

Past research has examined many aspects of group composition such as knowledge, beliefs, attitudes, and values held across group members as well as broader compositional aspects such as group size, flexibility, and stability. Given the wide range of compositional aspects studied in past research, we draw from the work of Campion et al. (1993) and Guzzo and Shea (1992) to identify aspects which are proximal to the processes involved in group learning and are observable in actual work group settings. We therefore excluded aspects of group composition which are primarily examined in controlled laboratory settings, and are more distal to group learning processes (such as attitudes, values, gender, race, personality, background, etc.). As such, based on the work of Campion et al. (1993) and Guzzo and Shea (1992), we recognize *group size*, *knowledge heterogeneity*, and *membership change* as compositional aspects which have the potential to moderate the group performance effects of repository KMS usage.

**Group Size**

*Group size* has been well recognized in prior literature to influence group effectiveness (e.g. Campion et al. 1993; Guzzo and Shea 1992; Kozlowski and Bell 2013). When the size of a group increases, "the number of possible ties among members grows much more quickly than the number of members" (Arrow et al. 2000, pp.74-75). The increase in ties between group members erects several barriers. For one, larger groups experience greater freeriding and social loafing (Sheppard 1993) thus decreasing the level of productive social interaction between group members. Second, the increase in ties between group members introduces coordination difficulties (Arrow et al. 2000). Larger groups experience a coordination decrement whereby the job of getting all members functioning together in a coordinated fashion increases in difficulty

(Gladstein 1984; Hackman and Morris 1975; O'Reilly and Roberts 1977; Steiner 1972). Groups therefore aim to maintain a size which is sufficient to the needs of tasks without becoming too large to effectively coordinate member activities (Gladstein 1984; O'Reilly and Roberts 1977; Steiner 1972). Third, prior research indicates that larger groups tend to only share commonly held knowledge (Stasser and Titus 1987; Stasser et al. 1989) and are resistant to new knowledge (Argote 2013). Finally, group size is found to increase the degree of intra-group conflict (Steiner 1972; Valacich et al. 1995) and decrease the generation of new ideas (Gallupe et al. 1992; Valacich et al. 1995). Given these communication and coordination barriers that larger groups face, we speculate that larger work groups will gain fewer learning benefits from repository KMS usage relative to smaller work groups.

In the real estate franchise setting, group size is likely to play a considerable role such that learning from repository KMS usage is hindered in larger groups. First, as the number of sales agents increases, additional managers and licensed assistants are needed to facilitate sales transactions. This leads to a greater number of ties not only between roles but also within roles thus introducing a greater potential for coordination costs. Such coordination costs may hinder the information processing ability of the group and limit knowledge sharing. Second, groups with a greater number of agents are likely to experience more conflict and competition. This competition can lead to knowledge hoarding and other unproductive behaviors which limit learning. Third, free riding can occur in larger groups whereby a lower proportion of members actively use the repository KMS and disseminate knowledge. As such, with fewer members using the repository, less collective learning is likely to occur. When taking these issues into account, we expect that repository KMS usage in larger groups will have a lower impact on group learning thus hindering the influence on group performance. We therefore hypothesize:

*H2: The group performance effects of repository KMS usage are contingent upon group size such that for larger groups, repository KMS usage will have a lower impact on performance.*

**Knowledge Heterogeneity**

Prior research has established member heterogeneity as an important aspect of group composition which affects the social interaction of group members (Bettenhausen 1991; Jackson et al. 1995; Ophir et al. 1998; Williams and O'Reilly 1998). Within the context of knowledge-based tasks, *knowledge heterogeneity*, the dispersion of task-specific knowledge, plays a considerable role (Bittner and Leimeister 2014; Campion et al. 1993; Hackman and Morris 1975). Although knowledge heterogeneity brings positive benefits to groups by allowing for greater adaptability (Galunic and Rodan 1998; Smith et al. 2005), it also presents gaps in shared understandings (Williams and O'Reilly 1998). As such, heterogeneity in group knowledge has been found to hinder knowledge sharing (Wittenbaum and Stasser 1996), increase disagreement (Souder 1987), and increase the time to make decisions (Hambrick et al. 1996). Further, groups with greater knowledge heterogeneity are shown to experience greater interpretive conflicts (Dougherty 1992), and have lower cohesion than groups possessing homogeneous knowledge (Ancona and Caldwell 1992).

We anticipate that greater knowledge heterogeneity will reduce potential learning benefits from repository KMS usage for two reasons. For one, prior literature indicates that greater heterogeneity in task specific knowledge creates multiple "thought-worlds" between individuals (Dougherty 1992). As a result, groups experience greater difficulties in establishing common understandings of the task environment. The development of common perspectives is highly important to communication and thus to sharing knowledge within the group (Klimoski and Mohammed 1994). Second, greater knowledge heterogeneity can reduce the usefulness of

knowledge acquired from the repository. Codified knowledge lacks contextual information (Polanyi 1966; Nonaka 1994) thus hindering its transfer across task domains. As such, greater contextual barriers may limit the use of codified knowledge across domains (Carlile 2002; 2004). Groups which possess knowledge spread across functional areas are therefore likely to incur greater costs when using organizational knowledge across a variety of functional needs (Szulanski 1996).

In the real estate franchise setting sales agents within the same work group operate across various areas, each with their own rules, guidelines, and need for specialized knowledge. For instance, the sale of a property which is in the foreclosure process[19] involves specific knowledge of how to negotiate with the lienholder to agree on a price lower than the remaining balance of the mortgage[20]. Additionally, the sale of commercial properties requires knowledge of due diligence and vetting procedures which differ greatly from those in residential sales. Furthermore, the sale of eco-friendly housing requires specialized knowledge of its unique benefits to effectively market properties to potential buyers. Due to important nuances in the sales process, organizational knowledge obtained from the repository KMS which is useful in one area will not be suited for others. This compartmentalization of knowledge not only reduces its overall value but also makes it more difficult to integrate and validate organizational knowledge as a means to enhance collective learning. Given these constraints, we expect that groups with greater knowledge heterogeneity gain fewer learning benefits from repository KMS usage thus attenuating the impact on group performance. We therefore hypothesize:

[19] Referred to as 'distressed properties'
[20] Referred to as a 'short sale'

*H3: The group performance effects of repository KMS usage are contingent upon knowledge heterogeneity such that for groups with greater knowledge heterogeneity, repository KMS usage will have a lower impact on performance.*

**Membership Change**

*Membership change* presents unique barriers which influence group social processes over and above group size and knowledge heterogeneity. Indeed, "when the membership of a group changes… other aspects of the group's functioning are bound to change as well" (Arrow and McGrath 1993 p.335). Organizational work groups are open systems which are in a continuous state of membership flux (Ziller 1965). When groups change members, the group as a whole undergoes a socialization process wherein group norms are examined and renegotiated (Moreland and Levine 1982, 1988). Changes in membership incur several group impacts such as shifting leadership dynamics, altering role structures, reconfiguring status structures, and reducing group cohesiveness (Arrow and McGrath 1993; Arrow and McGrath 1995). Further, membership change has a pervasive effect on the interaction between members (Chandler et al. 2005) thus hindering the open discussion of new ideas (Hirst 2009) and reducing predictability in group performance (Arrow and McGrath 1993). In contrast, groups with stable membership are able to facilitate open communication (Choi and Thompson 2005), maintain habitual routines (Gersick and Hackman 1990) and reinforce group interactions (Arrow and McGrath 1995) thus sustaining greater levels of group output. Taking these concerns into account, we suggest that groups with greater membership change will experience a decrease in learning benefits from repository KMS usage.

In our research setting, the most pervasive membership change occurs when new members are added to the group. A primary function of managers is to recruit new agents and licensed

assistants to expand sales capacity and increase overall commissions. The recruitment of new members may however, introduce greater inefficiency and chance for error when using organizational knowledge to enhance group learning. New members are less familiar with the knowledge stored in the repository KMS and have less insight into who knows what in the group. These members may therefore seek out knowledge which is less useful to group needs thus reducing the value of knowledge circulating in the group. Further, new members may have not yet established an adequate understanding of internal group processes to benefit fully from knowledge shared within the group. As such, multiple knowledge sharing attempts may be needed to achieve desired results. Greater time and effort is therefore needed to establish shared understandings and coordinate collective action in the group. Given these inefficiencies, we anticipate that relative to stable groups, groups with greater membership change will attain fewer learning benefits from repository KMS usage thus attenuating group performance. We therefore hypothesize:

*H4: The group performance effects of repository KMS usage are contingent upon membership change such that for groups with greater membership change, repository KMS usage will have a lower impact on performance.*

Figure 5. shows the research model.

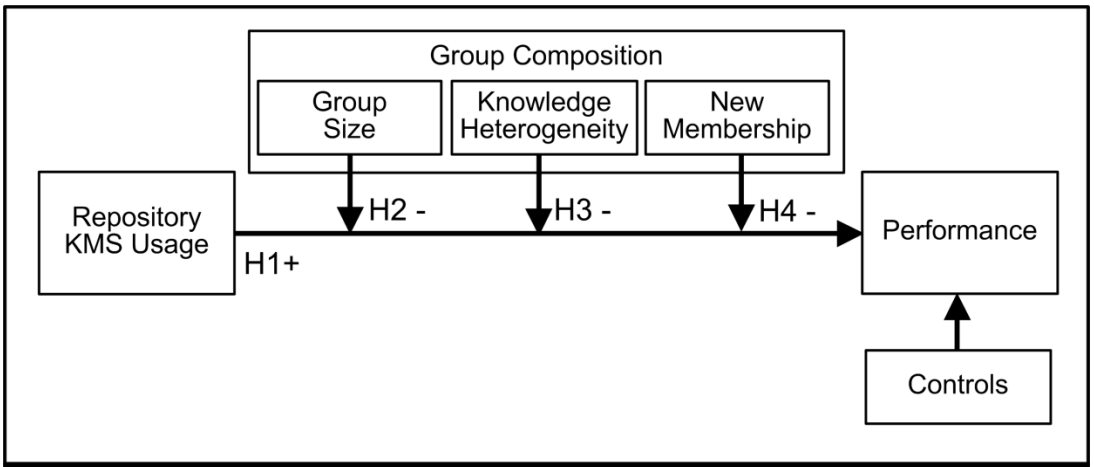

Figure 5. Research Model

## RESEARCH METHOD

### Data Collection

We collected data from two distinct sources, the usage logs from the repository KMS and the membership records from the franchise membership database – both accessed from the franchise headquarters. The usage logs contain document download metrics from March 1st until December 31st 2010. The membership records contain group-level variables such as commissions, age, size, and county, as well as individual group member variables including experience, tenure, join date, and number of designations earned. In addition, we drew from county level census data to include market-level control variables. We focused our analysis on all work groups which were active during 2009 and 2010 and who had at least two members.

## Measures

### Dependent Variable

Past knowledge management studies have typically measured the collective performance effects of KMS usage through the use of self-reported measures (i.e. Gottschalk 2007; Khalifa et al. 2008; Lakshman and Parente 2008; Lee and Choi 2003; Lin 2011). Organizational learning research has noted that these measures are limited in assessing the learning that occurs when acquired organizational knowledge intermixes with existing tacit knowledge (Argote and Miron-Spektor 2011; Hodgkinson and Sparrow 2002). Following the advice of this literature, we measured group *performance* using objective data of actual sales commissions. This variable was measured as the natural log of group commissions for 2010.

### Independent / Moderating Variables

We measured *repository KMS usage*, the independent variable, as the total number of documents downloaded by all members associated with the work group during the focal time period. Following Ko and Dennis (2011), we used a square root transformation of this measure to adhere to normality assumptions. We measured *group size,* the first moderating variable, as the total number of members associated with the work group during 2010. *Knowledge heterogeneity,* the second moderator, was calculated using the number of specialized designations that group members hold across functional categories. Following Smith et al. (2005) we used the count of designations across these categories to calculate Blau's (1977) heterogeneity index. This index ranges in value from 0 to 1 with a high score representing heterogeneous knowledge and a low score representing homogeneous knowledge. *Membership change,* the third moderator, was measured as the proportion of members who joined the work group during 2010 relative to the total number of members associated with the group at that time.

**Control Variables**

To control for performance effects due to differences in market conditions across the United States, we included average county income and median home value measures obtained from 2010 U.S census data[21]. These variables provide an indication of the size and munificence of the real estate market in which work groups are situated. Furthermore, to control for market effects stemming from market turbulence we included an estimate of the county foreclosure rate sourced from the U.S. Department of Urban Housing[22]. We use this measure as a broad indicator of the market instability experienced from the subprime mortgage crisis. To control for differences in group capabilities, we further controlled for prior year commissions and the age of the group - operationalized as the number of years since the group was established. We also controlled for the professional experience of the group which was measured as the average numbers of years since group members obtained a real estate license. Similarly, the tenure of the group was calculated based on the average number of years since members joined the franchise. Finally, we included the average number of designations held by group members to control for the overall knowledge level of the group.

## Data Analysis

We chose Hierarchical Linear Modelling (HLM) as the analysis technique (Raudenbush and Bryk 2002; Snijders 2011) due to the potential for performance heterogeneity across markets. In so doing, we constructed a two level model. Level 1 contains all group-level variables including all hypothesized effects. Level 2 contains the county-related control variables. The group-level intercept was treated as a random effect to account for heterogeneity in variance across counties.

[21] http://www.census.gov/2010census/data Accessed Jan 10th 2016
[22] https://www.huduser.gov/portal/datasets/nsp_foreclosure_data.html Accessed Jan 10th 2016

All level 1 independent variables were kept as fixed effects as there was no theoretical reason for us to expect that these coefficients are heterogeneous across markets.

We introduced the hypothesized variables in a step-wise comparison approach (Judd et al. 2009). In the first model, we established a baseline which includes the controls together with the main effects of group size, knowledge heterogeneity, and membership change. We then introduced the hypothesized variables progressively. In the second model we added repository KMS usage. To test the interaction hypotheses, we first introduced the interaction between usage and group size in the third model, followed by the interaction between usage and knowledge heterogeneity in the fourth model, and finally the interaction between usage and membership change in the final model. The final model contains all main effects and interactions.

## RESULTS

Our data consists of 3,092 work groups nested in 1,169 counties spread across 50 states. The summary statistics shown in Table 13 summarizes the descriptive statistics and correlations among the variables. To test for the presence of potential county level effects on group-level sales commissions, we calculated the intraclass correlation for the dependent variable (ICC). An ICC of .15 suggests that substantial heterogeneity exists (Hofmann 1997; Snijders 2011). The HLM analysis was conducted with Stata 14 (StataCorp 2015) using the *mixed* command. We standardized all variables which were included in the interactions prior to the analysis in order to reduce multicollinearity and increase the interpretability of the interaction effects. Variance inflation factors were below four and the average variance inflation factor for the full model including interaction effects was below three. These values therefore fall below the established thresholds (Menard 2002; Myers 2000) suggesting that multicollinearity was not a substantial threat to our results.

| Table 13. Summary Statistics and Correlations | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Mean | Std. Dev. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. Current Year Commissions | 1225710 | 1498170 | 1 | | | | | | | | | | | |
| 2. County Average Income | 73642 | 18959 | .24*** | 1 | | | | | | | | | | |
| 3. Med. Home Value | 196742 | 105021 | .18*** | .79*** | 1 | | | | | | | | | |
| 4. Foreclosure Rate | 0.04 | 0.02 | -.01 | -.37*** | -.34*** | 1 | | | | | | | | |
| 5. Prior Year Commissions | 1287583 | 1546667 | .95*** | .24*** | .17*** | .01 | 1 | | | | | | | |
| 6. Group Age | 12.83 | 7.87 | .39*** | .12*** | .07*** | -.01 | .42*** | 1 | | | | | | |
| 7. Average Experience | 12.26 | 4.30 | .19*** | .15*** | .16*** | -.01 | .21*** | .46*** | 1 | | | | | |
| 8. Average Tenure | 6.27 | 3.03 | .24*** | .16*** | .11*** | .00 | .27*** | .66*** | .73*** | 1 | | | | |
| 9. Average Designations | 0.85 | 0.58 | .22*** | .09*** | .04 | -.09*** | .21*** | .20*** | .27*** | .28*** | 1 | | | |
| 10. Group Size | 22.76 | 22.10 | .90*** | .22*** | .12*** | -.03 | .87*** | .35*** | .13*** | .17*** | .18*** | 1 | | |
| 11. Knowledge Heterogeneity | 0.65 | 0.28 | .37*** | .23*** | .14*** | -.07*** | .36*** | .26*** | .20*** | .21*** | .59*** | .42*** | 1 | |
| 12. Membership Change | 0.10 | 0.12 | -.03* | -.01 | .00 | .01 | -.08*** | -.23*** | -.32*** | -.44*** | -.09*** | .03 | .05*** | 1 |
| 13. Repository KMS Usage | 126.80 | 155.32 | .57*** | .14*** | .05*** | -.01 | .50*** | .16*** | -.02 | -.03 | .24*** | .64*** | .21*** | .43*** |

n= 3,092; * p < .1; ** p < .05; *** p < .01

After establishing the baseline control model (Model 1 in Table 14), we followed the aforementioned step-wise comparison approach. Model 2 indicates that the effect of repository KMS usage on group performance is positive and significant ($p < 0.01$) providing strong support for hypothesis 1. As such, the results support the standpoint that on average across all groups, greater repository KMS usage leads to greater group performance by facilitating group learning. Hypothesis 2 predicts that larger groups attain fewer benefits from repository KMS usage relative to smaller groups. The coefficient of the interaction term between group size and usage is negative and significant ($p < .01$) thus showing strong support for this hypothesis. Group size therefore presents challenges to learning from repository KMS usage. Hypothesis 3 predicts that, over and above group size, knowledge heterogeneity will further moderate the performance effects of repository KMS usage. The interaction between repository KMS usage and knowledge heterogeneity is negative and significant ($p < 0.01$) providing strong support for this hypotheses.

We therefore note that knowledge heterogeneity presents further obstacles to group learning over and above group size. Finally, Hypothesis 4 predicts that the group performance effects of repository KMS usage are contingent upon membership change. The results lend strong support for this hypothesis as evidenced by the negative and significant ($p < 0.01$) interaction between repository KMS usage and membership change. This result suggests that over and above group size and knowledge heterogeneity, membership change introduces a further contingency to group learning. Table 15 presents the results of the hypotheses tested in the study.

Table 14. Results of HLM Analysis

| | Controls | | Repository KMS Usage | | Repository KMS Usage x Size | | Repository KMS Usage x Knowledge Heterogeneity | | Repository KMS Usage x Membership Change | |
|---|---|---|---|---|---|---|---|---|---|---|
| Constant | 4.994*** | (0.199) | 5.139*** | (0.193) | 5.756*** | (0.193) | 5.735*** | (0.193) | 5.848*** | (0.192) |
| County Average Income | -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) |
| Foreclosure Rate | 0.981 | (0.640) | 0.912 | (0.615) | 0.902 | (0.602) | 0.865 | (0.600) | 0.968 | (0.600) |
| Prior Year Commissions | 0.623*** | (0.015) | 0.609*** | (0.014) | 0.565*** | (0.014) | 0.567*** | (0.014) | 0.560*** | (0.014) |
| Group Age | 0.000 | (0.002) | 0.000 | (0.002) | -0.000 | (0.002) | -0.000 | (0.002) | -0.001 | (0.002) |
| Average Experience | 0.003 | (0.004) | 0.006 | (0.004) | 0.007* | (0.004) | 0.008** | (0.004) | 0.008** | (0.004) |
| Average Tenure | 0.002 | (0.007) | 0.009 | (0.006) | 0.010* | (0.006) | 0.010 | (0.006) | 0.011* | (0.006) |
| Average Designations | -0.048* | (0.025) | -0.083*** | (0.024) | -0.034 | (0.024) | -0.030 | (0.024) | -0.040* | (0.024) |
| Group Size | 0.318*** | (0.016) | 0.212*** | (0.017) | 0.385*** | (0.021) | 0.385*** | (0.021) | 0.376*** | (0.021) |
| Knowledge Heterogeneity | 0.188*** | (0.016) | 0.161*** | (0.016) | 0.103*** | (0.016) | 0.066*** | (0.018) | 0.072*** | (0.018) |
| Membership Change | 0.103*** | (0.013) | 0.073*** | (0.012) | 0.063*** | (0.012) | 0.062*** | (0.012) | 0.052*** | (0.012) |
| Repository KMS Usage | | | 0.204*** | (0.015) | 0.217*** | (0.015) | 0.224*** | (0.015) | 0.239*** | (0.015) |
| Repository KMS Usage x Size | | | | | -0.122*** | (0.009) | -0.111*** | (0.010) | -0.107*** | (0.010) |
| Repository KMS Usage x Knowledge Heterogeneity | | | | | | | -0.055*** | (0.015) | -0.052*** | (0.014) |
| Repository KMS Usage x Membership Change | | | | | | | | | -0.079*** | (0.011) |
| Model degrees of freedom | 11 | | 12 | | 13 | | 14 | | 15 | |
| Log Likelihood | -2848 | | -2757 | | -2671 | | -2664 | | -2637 | |

Standard errors in parentheses; n = 3,092; Number of groups: 1,169 counties; * p < .1; ** p < .05; *** p < .01

| Table 15. Summary of Hypothesis Tests | |
|---|---|
| **Hypothesis** | **Result** |
| H1: Greater repository KMS usage by group members leads to greater group performance. | Supported |
| H2: The group performance effects of repository KMS usage are contingent upon group size such that for larger groups, repository KMS usage will have a lower impact on performance. | Supported |
| H3: The group performance effects of repository KMS usage are contingent upon knowledge heterogeneity such that for groups with greater knowledge heterogeneity, repository KMS usage will have a lower impact on performance. | Supported |
| H4: The group performance effects of repository KMS usage are contingent upon membership change such that for groups with greater membership change, repository KMS usage will have a lower impact on performance. | Supported |

These results also provide an indication of the economic value of repository KMS usage. The coefficients in Model 2 indicate that a one standard deviation increase in usage increases performance by 23.9 percent, on average. In examining the coefficients shown in model 5, the results suggest that groups with one standard deviation greater size exhibit a10.7 percent attenuation in performance, groups with one standard deviation greater knowledge heterogeneity exhibit an estimated performance attenuation of 5.2 percent, and groups with one standard deviation greater membership change are estimated to experience an average performance attenuation of 7.9 percent. As such, these results suggest that for groups with one standard deviation greater size, knowledge heterogeneity, and membership change, the group performance gains from repository KMS usage are offset by the challenges faced in using acquired knowledge to influence the collective actions of the group. Graphical representations of the tested interaction effects are shown in Figure 6.

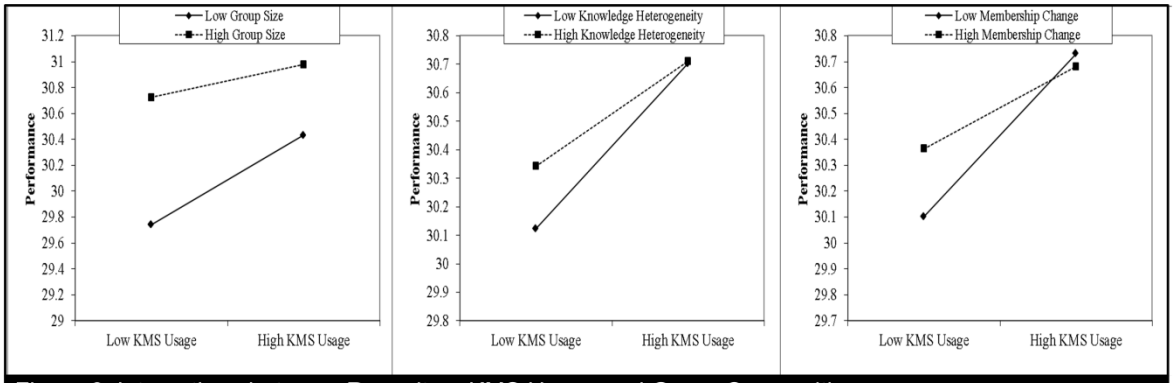

Figure 6. Interactions between Repository KMS Usage and Group Composition

To validate our findings we conducted a series of robustness checks. First, we entered alternate measures of the focal variables into an HLM analysis. For repository KMS usage we examined the untransformed total count of document downloads as well as the natural log transformation of this variable. Further, we tested alternate measures of the moderating variables. For group size, we examined the square root and log transformations of the total count of group members. Regarding knowledge heterogeneity, we used the standard deviation of the number of designations held by group members. For membership change, we calculated the proportion of the net difference of the number of group members associated with the group between 2009 and 2010 relative to the total number of group members. Finally, as an alternate measure for the dependent variable, group performance, we examined the percentage growth of group commissions between 2009 and 2010. In addition to these tests, we also retested the original model using alternate analysis techniques. To handle the potential for heteroscedasticity we used the robust option in the HLM analysis. Further, to ensure that the results are consistent across analysis techniques we tested the model with ordinary least squares analysis using clustered and unclustered standard errors. Across all of these robustness checks, the results were generally consistent with the original model.

# DISCUSSION

## Contributions and Implications

In this study, we set out to examine the contingent performance effects of repository KMS usage in groups. Based on prior literature and insights gained from our research context, we first hypothesized that repository KMS usage influences group performance by serving as a mechanism to enhance group learning. We further hypothesized that group size, knowledge heterogeneity, and membership change attenuate this relationship by erecting distinct barriers to group communication and coordination. We examined the repository KMS usage and group performance outcomes of 3,092 work groups belonging to a large franchise company. Consistent with our hypotheses, we find that repository KMS usage has a positive effect on group performance. This positive effect is diminished for groups with greater size, knowledge heterogeneity, and membership change.

This study provides three main contributions to the knowledge management literature. First, the results of the model support our standpoint that repository KMS usage serves as a learning mechanism to increase group performance, thus addressing a gap in prior literature. Knowledge management literature has recognized the role of repository KMS in enhancing individual performance (Kim et al. 2016; Ko and Dennis 2011; Poston and Speier 2008) but is relatively underdeveloped in its understanding of the role of repository KMS in enhancing group performance. This study builds from prior group learning literature (Argote 2013; Goodman et al. 2001; Gruenfeld et al. 2000; Wilson et al. 2007) to provide a lens through which the relationship between repository KMS usage and group performance may be better understood. The conceptualization of repository KMS usage as a group learning mechanism paves the way to understand the broader role of other forms of KMS in enhancing group learning. For example, a

further conceptualization of the specific role of network KMS (Alavi and Leidner 2001) in group learning may prove fruitful. Similarly, the learning mechanism lens may be useful in conceptualizing the role of complementary knowledge management technologies such as blogs (Grudin 2006) and enterprise Wikis (Majchrzak et al. 2013).

Second, our results suggest that the group performance effects of repository KMS are contingent on group composition. We argue that aspects of group composition may present distinct communication and coordination barriers thus impeding group learning. Building from prior research, we argue that larger groups experience greater conflict and incur greater costs in coordinating collective action thus reducing the benefits of repository KMS usage. Similarly, groups with greater knowledge heterogeneity are argued to possess multiple thought worlds and gain less value from organizational knowledge across functional domains thus reducing potential learning benefits of organizational knowledge. Moreover, groups which experience greater membership change are argued to incur costs in socializing new members and stabilizing member interactions thus hindering the effective distribution of organizational knowledge in the group. As such, each aspect of group composition presents unique challenges to the retrieval and sharing of organizational knowledge.

At the same time, past research suggests that the processes which underlie group learning may be facilitated through organizational interventions. For instance, knowledge sharing may increase through the careful implementation of reward systems (Kankanhalli et al. 2005a; 2005b; Kulkarni et al. 2006), the establishment of training programs (Watson and Hewett 2006), or the development of collaborative norms (Ardichvili et al. 2006; Bock et al. 2006). Given the distinct contingencies of group composition which are shown in this study, it may be possible that these interventions differ in their efficacy across compositional configurations. Our study therefore

suggests that more research is needed to understand when and how such interventions help to increase the learning that occurs when using technology to increase group performance. For example, future research may examine the three-way interactions between KMS usage, group composition, and organizational interventions.

Third, this paper evaluates the economic value of repository KMS usage in groups based on objective measures of usage and performance. A dearth of research exists in this area with only small handful of studies examining economic impacts at the individual level of analysis (Kim et al. 2016; Ko and Dennis 2011). Our examination presents new evidence of the differential value of repository KMS usage across groups in a real world setting. With the average work group in our analysis earning roughly over $1.2 million in sales commissions, the estimated coefficients suggest that a one standard deviation increase in repository KMS usage equates to approximately $292 thousand in increased commissions. These benefits are substantially reduced however when the composition of the group hinders group learning. A one standard deviation increase in group size effectively reduces this economic gain by approximately $131 thousand, while knowledge heterogeneity incurs a reduction of $63 thousand, and membership change incurs a reduction of approximately $96 thousand. Our results indicate that the realized value gained from repository KMS usage is highly dependent on group composition. For example, groups with a size more than two standard deviations above the mean are likely to gain almost no added value from repository KMS usage. Alternately, those which are simultaneously larger than one standard deviation above the mean and who concurrently exhibit a moderate amount of knowledge heterogeneity are likely to gain very little value. These results therefore suggest that the efficacy of organizational knowledge management initiatives is highly sensitive to factors in the local

context thus providing support for the contingency perspective of knowledge management (Becerra-Fernandez 2001).

Overall, our study complements past group KMS usage studies (Choi et al. 2010; Gallivan 2003; Haas and Hansen 2005; Pavlou and El Sawy 2006) thus expanding the nomological network of group KMS usage. Further identification of this nomological network is especially important because groups have been seen across multiple literatures to play a critical role in facilitating knowledge distribution. In particular, knowledge management research sees groups as systems of individuals which couple knowledge processes across levels (Alavi and Leidner 2001; Garud and Kumaraswamy 2005). Organizational learning literature further notes the importance of groups as epistemological communities which facilitate the transition between individual and organizational knowledge (Crossan et al. 1999; Nonaka 1994; Nonaka and Takeuchi 1995). Our study provides further evidence of the fragility of these processes thus supporting the view that technological features have the potential to enable learning by altering group structures but is also subject to structural constraints (Desanctis and Poole 1994; Orlikoswki 1992). Moreover, by revealing the effects of contingencies that are not apparent at the individual level of analysis (Morgeson and Hofmann 1999) this study draws further attention to the need to extend prior research which examines the efficacy of KMS usage across multiple levels of analysis (i.e. Garud and Kumaraswamy 2005).

For practitioners, this study may provide useful insights to guide the management and usage of repository KMS. By understanding that some groups benefit more from repository KMS usage than others, companies may focus their knowledge management efforts on groups which are more likely to learn from organizational knowledge distributed through IT. Companies may also consider implementing a personalization knowledge management strategy (Hansen et al. 1999)

when transferring organizational knowledge to groups which face greater barriers to learning. For example by rotating members between groups (Argote 2013) or developing communities of practice which span across work groups (Brown and Duguid 1991; Garud and Kumaraswamy 2005). Our study also suggests that companies may also take action to alleviate the barriers introduced by group composition. For instance, companies may increase group learning by staffing groups with members who are intrinsically motivated to share knowledge (Kankanhalli et al. 2005a; Wasko and Faraj 2005). Alternately, companies may create new roles assigned with the responsibility of retrieving and sharing knowledge throughout the group. Finally, companies may consider placing guidelines on how groups are established and maintained. When the composition of the group impedes group learning, it may be necessary to reorganize groups based on compositional factors to maximize overall performance gains.

## Limitations and Future Research

As with any study, our analysis is subject to limitations that future research may address. First, we argued that the use of repository KMS serves as a learning mechanism to facilitate the group learning process. The group learning process involves the retrieval of knowledge by individual members but also the sharing of knowledge between these members. Our data allowed us to examine the retrieval of knowledge but prohibited us from directly assessing the degree to which this knowledge was actually shared between group members. While we recognize this limitation, members in the work groups which we examined are highly collaborative and cooperative thus offering an adequate setting for group learning to occur. Future research may extend this study by further opening the black box of group learning and measuring its sub processes directly (Wilson et al. 2007).

Second, we measured repository KMS usage as the total count of document downloads for all members of the group. This measure provides an indication of the quantity or organizational knowledge retrieved by group members but does not provide detail into the characteristics of the acquired knowledge. Due to these limitations in our data, we were unable to construct measures of the variety and type of acquired knowledge. Our hypotheses hinge on the assumption that groups acquire high quality documents serving a variety of individual and group needs. It may be possible that these different types of organizational knowledge serve different purposes in group learning. As such, future research could implement measures to examine the role of different types of knowledge in group learning. For example, delineations between declarative and procedural knowledge (Alavi and Leidner 2001; Stein and Zwass 1995) could offer valuable insights.

Third, because we examined work groups belonging to a single company, the generalizability of our findings may be limited. The franchise real estate setting provided a suitable environment to compare the relative effects of repository KMS usage since groups draw from the same source of knowledge provided by the franchise headquarters. Further, these groups perform similar practices thus making the comparison of performance outcomes possible. While we admit that the generalizability of our findings may be limited. We speculate, however, that these findings may be generalizable to other settings wherein a repository KMS is used to disseminate organizational knowledge to a large number of work groups. For instance, these results may be generalized to other service-based franchise organizations, consultancies, and large professional service firms.

Finally, we examined repository KMS usage and group performance within a single timeframe. While our data set allowed us to conduct a cross-sectional examination of the relative

performance benefits of repository KMS usage across a large number of groups, it precluded the examination of longitudinal effects over time. This research design impedes us from ruling out the possibility that the relationship between repository KMS usage and group performance actually occurs in the reverse direction. In other words, groups with better performance may be more likely to acquire greater amounts of knowledge from the repository KMS thus reversing the causal path. While this may be possible, prior research at the individual level of analysis provides strong evidence supporting the notion that repository KMS usage does indeed influence performance through learning (Kim et al. 2016; Ko and Dennis 2011). Given that we argue that group learning is a product of individual learning, we expect the direction of this causal path to hold. Specific to our research setting, the knowledge acquired from the KMS is not required to facilitate real estate transactions directly but is designed to increase the know-how of group members. Its acquisition is therefore not driven by the level of sales. Still, given this limitation, future research may make further advancements by examining the influence of repository KMS usage on group performance through the use of a longitudinal dataset. Further, future longitudinal analyses could examine if the contingencies of group composition vary across time.

## CONCLUSION

This study set out to examine the conditions under which the use of a repository KMS leads to differential performance outcomes for work groups. We first conceptualized repository KMS usage as a group learning mechanism which positively influences group performance. We then identified aspects of group composition which are argued to influence learning – group size, knowledge heterogeneity, and membership change. We analyzed the repository KMS usage and performance outcomes of 3,092 work groups in a large real estate franchise. Our findings suggest that repository KMS usage has an overall positive effect on group performance. This positive

effect is diminished for groups with a greater number of members, for groups with greater membership change, and for groups with greater knowledge heterogeneity. Overall, these findings draw attention to the potential of KMS usage to enhance group learning and emphasizes the importance of group composition to garnering benefits from this use.

## SUMMARY OF FINDINGS AND CONTRIBUTIONS

### Purpose of the Dissertation

In theorizing the role of KMS in organizations, the majority of scholars have considered its potential in facilitating a spectrum of knowledge management processes. Building from this theoretical background, empirical research has developed an understanding of the determinants of KMS use. While this body of literature has brought valuable insights into the purpose that information systems serve, and identifies the antecedents of system use in knowledge management settings, the central role of the human actor in using KMS to create organizational value has not received as much attention. As such, several questions regarding the role of KMS usage in creating value for organizations remain open. This dissertation attempts to advance the understanding of how KMS usage generates sustained value for organizations. It builds from developments in information system use, organizational learning, and group learning literature to provide insights into how actors interact with technology to achieve desired task outcomes. As such, this dissertation 1) identifies the behavioral actions and knowledge outcomes involved in using KMS, 2) explores the function of learning in sustaining benefits from KMS use, and 3) identifies and examines important contingent factors which organizations should consider when implementing knowledge management initiatives.

Following a three paper format, the first paper is a review paper which offers a framework to organize past empirical KMS research, identifies gaps in this research, and offers guidance on how future research may better understanding how the ongoing transfer of knowledge between actors, technologies, and tasks generates organizational value. The second paper proposes a model delineating two acquisition behavior dimensions: frequency and intensity, and two knowledge contexts: personal and social, predicting their influence on individual performance.

The results of this paper indicate that acquisition frequency positively interacts with social knowledge and acquisition intensity positively interacts with personal knowledge. Finally, the third paper argues that repository KMS usage serves as a group learning mechanism to increase the performance of work groups. This paper provides an indication of the contingencies of group composition, in particular group size, knowledge heterogeneity, and membership change. The results suggest that repository KMS usage has the potential to increase group learning but only when groups are configured to retrieve and share organizational knowledge to coordinate the collective actions of the group.

## Implications for Theory

The three papers in this dissertation contribute to the literature on KMS. The first paper identifies important behavioral actions and knowledge outcomes and suggests that organizations garner value from KMS use via the interplay between two sub-processes: *learning from technology* and *learning from task*. This study contributes to literature on three fronts. First, the review framework advances the ontological and epistemological understanding of KMS by conceptualizing KMS as a socio-technical concept placing actors as central links in the flow of knowledge between technologies and tasks (Argote and Ingram 2000) thus grounding our understanding of KMS and enabling more holistic investigations of how human agency and material agency interrelate in the use and outcomes of technology (Leonardi 2011). Second, the study provides a comprehensive inventory of an article set spanning across multiple disciplines and methodological paradigms and identifies its salient contributions and limitations. Third, this study offers an agenda for future research which may help to gain a richer understanding of how KMS use leads to sustained value creation.

The results of Paper 2 provide evidence of the differential effects of acquisition frequency and acquisition intensity, this study adds to more recent literature that has begun to bridge the gap between the behavioristic and constructivism paradigms (Leidner and Jarvenpaa 1995). Previous studies have placed greater emphasis on understanding the behavioral aspects of the use of knowledge repositories, often focusing on the level of exhibited behavior. The results of Paper 2 highlight the importance of drawing closer associations between behavioral components and the individual cognition that these behaviors support. Furthermore, in demonstrating differential moderating effects of personal knowledge and social knowledge, the study also helps to bridge the gap between cognitive constructivism, and collaborative constructivism (Leidner and Jarvenpaa 1995; Du and Wagner 2007). Cognitive constructivism highlights individual information processing as a key mechanism in developing, testing, and refining mental models in the learning process. Collaborative constructivism, on the other hand, highlights social interaction as a key mechanism in building shared understandings. The empirical results of this study indicate a nuanced learning process such that that individual cognition and social interactions may represent independent pathways to individual learning when combined with specific knowledge acquisition behaviors.

The results of Paper 3 present important implications for knowledge management literature. A dearth of research has sought to explain the relationship between KMS usage and performance at the group level of analysis. This study provides a perspective of KMS use as a learning mechanism thus helping to fill this void. Furthermore, the results of Paper 3 indicate that individual aspects of group composition present distinct challenges to the retrieval and sharing of organizational knowledge suggesting that more research is needed to understand how managerial interventions help to offset these constraints. Moreover, this paper evaluates the economic value

of repository KMS usage in groups thus presenting new evidence of the differential value of repository KMS usage across groups. Finally, this paper complements past group KMS usage literature to expand the nomological network of group KMS use.

## Implications for Practice

Both Papers 2 and 3 offer implications for practice. The findings from Paper 2 suggest that actors who acquire knowledge from a KMS may increase the realized value of this knowledge by being cognizant not only of the new knowledge which they acquire but also of the personal and social knowledge which is available to them. Furthermore, the results indicate that managers of KMS may pay heed to the acquisition behavior of acquiring actors and seek ways to encourage favorable behavior. By examining the frequency and intensity dimensions of acquisition behavior, managers may seek ways to cater the system towards each usage pattern. The findings from Paper 3 suggest that since some groups of actors benefit more from repository KMS usage than others, companies may focus their knowledge management efforts on groups which are capable of learning from organizational knowledge in order to garner increased value. In contrast, for groups that face greater barriers to learning, companies may consider implementing a personalization knowledge management strategy (Hansen et al. 1999) when transferring organizational knowledge. This study also suggests that companies may seek to alleviate the barriers introduced by group composition. For instance, companies may staff groups with members who are intrinsically motivated to share knowledge (Kankanhalli et al. 2005a; Wasko and Faraj 2005), create new roles, or even consider placing guidelines on how groups are staffed to maintain an environment which is conducive to group learning.

## Avenues for Future Research

This dissertation also offers suggestions for future work on KMS use. For instance, in the review paper I propose two learning sub-processes, *learning from technology* and *learning from task* and suggest several ways in which future research may develop a better understanding of how garner sustained value from KMS use. I argue for the need to establish clear conceptual distinctions of behavioral actions and knowledge outcomes to determine the simultaneous role of multiple dimensions within each learning sub-process. Furthermore, I suggest that future research examines sequences of behavioral actions and knowledge outcomes via mediation or path analyses. Additionally, future research may examine the role of the actor as a knowledge transfer conduit between technology and task. Lastly, future research may consider the relative impact that determinants may have on multiple behavioral actions. Such examinations would help to understand which determinants present a general effect across behavioral actions and which present an isolated effect.

The two empirical papers are limited by the dataset used to test the conceptual models thus presenting several opportunities for future research. First, I examined the effects of using *repository* KMS, which is specifically purposed to transfer codified knowledge only. Future research should examine the performance impacts of other types of KMS such as *network* or *conversational* KMS which are designed to transfer codified and tacit forms of knowledge. Second, while the dataset provided precise measures of the number of documents downloaded by individuals and groups, I was unable to measure the quality of the embedded content. Future research should perform finer grained analyses of knowledge quality factors such as *currency* or *relevancy* to determine the degree to which the performance effects of knowledge acquisition depend on these factors. Another suggestion is for future research to examine the contingent

effects of KMS use across time. Since the performance effects of KMS use are shown to vary over time periods (Kim et al. 2016; Ko and Dennis 2011) it may be that some contingencies may reduce in intensity over the passage of time while other contingencies increase in their effect. Lastly, the empirical studies in this dissertation are based on the KMS usage and performance of single company. To lead towards more generalizable findings, future research should examine the contingent performance effects of KMS use across multiple organizations.

## Concluding Remarks

The purpose of this dissertation was to advance the understanding of how KMS generates sustained value for organizations. I propose an actor-centric perspective which emphasizes the significance of learning in increasing performance outcomes. Based on this perspective, I examine important contingent factors which organizations should consider when implementing knowledge management initiatives. It is my hope that the three papers in this dissertation contribute to the advancement of KMS research and encourage the continued examination of the role that KMS use plays in learning and performance.

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# APPENDIX A – SEARCH TERMS

Table A1. Search Terms

| Study | Quote | Search Term |
|---|---|---|
| Markus, M. L. 2001. "Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success," Journal of Management Information Systems (18:1), pp. 57-93. | The purpose of this paper is to begin building a theory of knowledge reusability, with particular emphasis on the role of knowledge management systems and knowledge repositories, often called organizational memory systems or organization memory information systems | • Knowledge management system(s)<br>• Knowledge repository(ies)<br>• Organizational memory system(s)<br>• Organizational memory information system(s) |
| Alavi, M., and Leidner, D. E. 2001. "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues," MIS Quarterly (25:1), pp. 107-136. | IS researchers have begun promoting a class of information systems, referred to as knowledge management systems (KMS)… Reviewing the literature discussing applications of IT to organizational knowledge management initiatives reveals three common applications: (1) the coding and sharing of best practices, (2) the creation of corporate knowledge directories, and (3) the creation of knowledge networks… IT can support all four forms of knowledge transfer, but has mostly been applied to informal, impersonal means (through such venues as Lotus Notes discussion databases) and formal, impersonal means (such as knowledge maps or corporate directories) | • KMS(s)<br>• Knowledge directory(ies)<br>• Knowledge network(s)<br>• Discussion database(s)<br>• Knowledge map(s) |
| Marwick, A. D. 2001. "Knowledge Management Technology," IBM Systems Journal (40:4), pp. 814-830. | The goal of this paper is to provide an overview of technologies that can be applied to knowledge management | • Knowledge management technology(ies) |
| Huber (2001), Transfer of Knowledge in Knowledge Management Systems: Unexplored Issues and Suggested Studies, pp. | The roles of IT continue to expand, both in society at large and in the functioning of organisations. This article addresses motivational issues in the relatively new man machine technology known as Knowledge Management Systems (KMSs) | • Knowledge management system(s)<br>• KMS(s) |
| Alavi, M., and Tiwana, A. 2002. "Knowledge Integration in Virtual Teams: The Potential Role of KMS," Journal of the American Society for Information Science and Technology (53:12), pp. 1029-1037. | A knowledge management system (KMS) is defined as an information technology (IT)-based system developed to support and enhance organizational knowledge management processes…consider the following example: a global oil company has invested millions of dollars in the development of a Web-based knowledge repository | • Knowledge management system(s)<br>• KMS(s)<br>• Knowledge repository(ies) |

# APPENDIX B – SELECTED ARTICLES

| Table B1. Selected Articles |
|---|
| Alavi, M., Kayworth, T. R., and Leidner, D. E. 2005. "An Empirical Examination of the Influence of Organizational Culture on Knowledge Management Practices," Journal of Management Information Systems (22:3), pp. 191-224. |
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| Ardichvili, A., Maurer, M., Li, W., Wentling, T., and Reed, S. 2006. "Cultural Influences on Knowledge Sharing through Online Communities of Practice," Journal of Knowledge Management (10:1), pp. 94-107. |
| Ardichvili, A., Page, V., and Wentling, T. 2003. "Motivation and Barriers to Participation in Virtual Knowledge-Sharing Communities of Practice," Journal of Knowledge Management (7:1), pp. 64-77. |
| Bansler, J. P., and Havn, E. C. 2003. "Building Community Knowledge Systems: An Empirical Study of IT-Support for Sharing Best Practices among Managers," Knowledge and Process Management (10:3), p. 156. |
| Bera, P., Burton-Jones, A., and Wand, Y. 2011. "Guidelines for Designing Visual Ontologies to Support Knowledge Identification," MIS Quarterly (35:4), pp. 883-A811. |
| Bock, G.-W., Kankanhalli, A., and Sharma, S. 2006. "Are Norms Enough? The Role of Collaborative Norms in Promoting Organizational Knowledge Seeking," European Journal of Information Systems (15:4), pp. 357-367. |
| Boh, W. F. 2008. "Reuse of Knowledge Assets from Repositories: A Mixed Methods Study," Information & Management (45:6), pp. 365-375. |
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| Gray, P. H., and Durcikova, A. 2005. "The Role of Knowledge Repositories in Technical Support Environments: Speed Versus Learning in User Performance," Journal of Management Information Systems (22:3), pp. 159-190. |
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| Table B1. Selected Articles (Continued) |
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|---|
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| Poston, R., and Speier, C. 2008. "Knowledge Management Systems Usage: Rating Scheme Validity and the Effort-Accuracy Trade-Off," Journal of Organizational and End User Computing (20:1), pp. 1-16. |
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| Ravishankar, M. N. 2008. "Rewarding End-Users for Participating in Organizational KM: A Case Study," Journal of Organizational and End User Computing (20:1), pp. 35-49. |
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| Sha, X., Ting-Ting Chang, K., Zhang, C., and Zhang, C. 2013. "Knowledge Popularity in a Heterogeneous Network: Exploiting the Contextual Effects of Document Popularity in Knowledge Management Systems," Journal of the American Society for Information Science & Technology (64:9), pp. 1842-1851. |
| Sherif, K., Hoffman, J., and Thomas, B. 2006. "Can Technology Build Organizational Social Capital? The Case of a Global IT Consulting Firm," Information & Management (43:7), pp. 795-804. |
| Shin-Yuan, H., Hui-Min, L., and Wen-Wen, C. 2011. "Knowledge-Sharing Motivations Affecting R&D Employees' Acceptance of Electronic Knowledge Repository," Behaviour & Information Technology (30:2), pp. 213-230. |
| Su, C. 2012. "Who Knows Who Knows What in the Group? The Effects of Communication Network Centralities, Use of Digital Knowledge Repositories, and Work Remoteness on Organizational Members' Accuracy in Expertise Recognition," Communication Research (39:5), pp. 614-640. |
| Subramanian, A. M., and Soh, P.-H. 2009. "Contributing Knowledge to Knowledge Repositories: Dual Role of Inducement and Opportunity Factors," Information Resources Management Journal (22:1), pp. 45-62. |
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| Teo, T. S. H., and Men, B. 2008. "Knowledge Portals in Chinese Consulting Firms: A Task-Technology Fit Perspective," European Journal of Information Systems (17:6), pp. 557-574. |
| Vaast, E. 2007. "What Goes Online Comes Offline: Knowledge Management System Use in a Soft Bureaucracy," Organization Studies (28:3), pp. 282-306. |
| Van Den Hooff, B., Van Weenen, F. D. L., Soekijad, M., and Huysman, M. 2010. "The Value of Online Networks of Practice: The Role of Embeddedness and Media Use," Journal of Information Technology (25:2), pp. 205-215. |
| Vitari, C., Moro, J., Ravarini, A., and Bourdon, I. 2007. "Improving KMS Acceptance: The Role of Organizational and Individuals' Influence," International Journal of Knowledge Management (3:2), pp. 68-72,75-90. |
| Wagner, C. 2006. "Breaking the Knowledge Acquisition Bottleneck through Conversational Knowledge Management," Information Resources Management Journal (19:1), pp. 70-83. |
| Walczak, S., and Mann, R. 2010. "Utilization and Perceived Benefit for Diverse Users of Communities of Practice in a Healthcare Organization," Journal of Organizational and End User Computing (22:4), p. 24. |
| Wang, Y., Meister, D. B., and Gray, P. H. 2013. "Social Influence and Knowledge Management Systems Use: Evidence from Panel Data," MIS Quarterly (37:1), pp. 299-313. |
| Wasko, M. M., and Faraj, S. 2005. "Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice," MIS Quarterly (29:1), pp. 35-57. |
| Watson, S., and Hewett, K. 2006. "A Multi-Theoretical Model of Knowledge Transfer in Organizations: Determinants of Knowledge Contribution and Knowledge Reuse," Journal of Management Studies (43:2), pp. 141-173. |

| Table B1. Selected Articles (Continued) |
| --- |
| Wattal, S., Racherla, P., and Mandviwalla, M. 2010. "Network Externalities and Technology Use: A Quantitative Analysis of Intraorganizational Blogs," Journal of Management Information Systems (27:1), pp. 145-173. |
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# APPENDIX C – DEFINITIONS OF BEHAVIORAL ACTIONS AND KNOWLEDGE OUTCOME VARIABLES

Table C1. Definitions of Behavioral Action Variables

| | Variable | Definition | Example Measure |
|---|---|---|---|
| **Contribution** | Adding Contribution | Contributing the content of one's domain expertise (Majchrzak et al. 2013, p.457) | Think about the contributions you have made to this wiki. How often have your contributions been: New pages? Added content to existing pages? (Majchrzak et al. 2013, p.A8) |
| | Information Provision | "individual members… provide … information to whom they perceive to be the experts so that the information could be properly stored and retrieved for later use" (Huang et al. 2013 p.542) | Participants used a 5-point Likert scale to identify how often they provided information to the DKR in each of the group-specific knowledge areas. |
| | Intention to Share | "…knowledge is shared by means of interaction and communication flows between individuals, groups, departments, and organizational boundaries" (Chen et al. 2012 p.106) | I will share my work reports and official documents with other team members more frequently in the future; I intend to share my experience or know-how from work with other team members more frequently in the future… |
| | Knowledge Contribution | Degree of electronic knowledge repository usage to contribute knowledge (Kankanhalli et al. 2005a p.123) | What is your frequency of usage of EKRs to contribute knowledge? I often use EKRs to contribute my knowledge in my work. |
| | Knowledge Sharing | Individual distribution of work relevant experiences and information within organizations through the use of knowledge management technology (Zhang et al. 2013) | I share report templates, models, and designing methodologies with members of my team, I share success and failure stories about my work in documents with members of my team, I share related knowledge obtained from other media |
| | Team Knowledge Sharing | "Knowledge sharing refers to the process of locating distributed knowledge in an organization and transferring it to another context where the knowledge is needed "(Choi et al. 2010 p.858). | Our team members share their work reports and official documents with other team members… provide their manuals and methodologies for other team members… Share their experience or know-how from work with other team members (Choi et al. 2010 p.870) |
| | Shaping Contribution | Shaping behavior involves publicly modifying others' contributions as well as one's own, and entails reorganizing content, removing redundancies or inconsistencies, and making the content more meaningful, usable, and maintainable" (Majchrzak et al. 2013 p.457) | Think about the contributions you have made to this wiki. How often have your contributions been: Rewrites of whole paragraphs? Reorganization of a set of pages? Integration of ideas on existing pages? (Majchrzak et al. 2013, p.A8) |
| **Acquisition** | Content Search | "…involves anchoring and adjustment, whereby knowledge workers anchor their judgments on specific content and insufficiently adjust away from this content as new content is evaluated" (Poston and Speier 2005 p.224) | "…clickstream data was captured …This data provided insight into which work plans were opened and what content (steps) from each work plan was included in final solutions… the order in which the subject searched and evaluated the work plans was coded…". |
| | Knowledge Consumption | "The [KMS] allows users to consume knowledge in the form of browsing or searching" (Li 2010 p.42) | Measured through interviews |
| | Knowledge Identification | "The task of asking the right questions to determine what actions need to be taken to change the current state of affairs to a goal state" (Bera et al. 2011 p. 885) | "we presented subjects with a description of a current state and asked them to use the diagrams to come up with questions they would need to answer if they (or someone else) were to change the current state to a specified goal state." (Bera et al. 2011 p. 891) |
| | Knowledge Seeking | "…the process of seeking knowledge typically involves formulating a query and then refining the search until satisfactory outputs are retrieved…" (He et al. 2009 p. 528) | 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 |
| | Knowledge Sourcing | "…organizations clearly would prefer that analysts first consult a knowledge repository when facing a customer problem for which they have no immediate answer…" (Gray and Durcikova 2005 p.160) | 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 |

| Table C1. Definitions of Behavioral Action Variables (Continued) | | | |
|---|---|---|---|
| | **Variable** | **Definition** | **Example Measure** |
| **Application** | Solution Innovation | …analysts must also explore their own solutions to problems (Durcikova et al. 2011 p.856) | Most of the time I am quite innovative in solving work problems. I believe I am usually very creative in my solutions to work problems. (Durcikova et al. 2011 p. 864) |
| | Solution Reuse | As a firm develops KMS-based repositories of solutions, analysts may be able to exploit these solutions to solve problems (Durcikova et al. 2011 p.856) | The majority of problems I deal with can be solved by applying previously developed solutions. When I solve problems I often rely on existing solutions (Durcikova et al. 2011 p. 864) |
| | Team Knowledge Application | the phase in which existing knowledge is brought to bear on the problem at hand" (Alavi and Tiwana 2002, p.1030). from (Choi et al. 2010 p.858). | Our team members apply knowledge learned from experience. … use knowledge to solve new problems… apply knowledge to solve new problems (Choi et al. p. 870) |
| | Knowledge Reuse | "Knowledge reuse is one way, among many, for an individual to obtain the knowledge necessary to do his or her work better or more efficiently" (Watson and Hewett 2006 p.146) | To measure frequency of knowledge reuse respondents were asked to indicate the frequency with which they access the four knowledge repositories |
| | Knowledge Use | "Degree to which a knowledge worker believes he or she has incorporated procedures for the capture and use of knowledge of various types into decision-making activities, routine and otherwise" (Kulkarni et al. 2006 p.315) | I refer to shared knowledge in my work. In my group, using shared knowledge is a part of the work flow |
| **Valuation** | Perceived Benefits | We adopt the generic framework of IS Success Model and customize it to the context of knowledge management systems. (Halawi et al. 2007) | The knowledge management system Increased my productivity. The knowledge management system has created innovative ideas. (Halawi et al. 2007) |
| | Individual-Level Perceived KM Effectiveness | Whether the entity receives and understands the knowledge needed to perform its tasks (Sabherwal and Becerra-Fernandez 2003 p.227) | The available knowledge improves your effectiveness in performing your tasks. You are satisfied with the management of knowledge you need (Sabherwal and Becerra-Fernandez 2003 p.237) |
| | Group-Level Perceived KM Effectiveness | Whether the entity receives and understands the knowledge needed to perform its tasks (Sabherwal and Becerra-Fernandez 2003 p.227) | You are satisfied with knowledge sharing among individuals at your directorate… The available knowledge improves the effectiveness of your directorate…You are satisfied with the management of knowledge at your directorate (Sabherwal and Becerra-Fernandez 2003 p.237) |
| | Organization-Level Perceived KM Effectiveness | Whether the entity receives and understands the knowledge needed to perform its tasks (Sabherwal and Becerra-Fernandez 2003 p.227) | You are satisfied with the knowledge available for various tasks across KSC. You are satisfied with knowledge sharing among various directorates at KSC. (Sabherwal and Becerra-Fernandez 2003 p.237) |
| | Perceived Productivity | Perceived productivity benefits of using a KMS (Walczak and Mann 2010) | Participating in a CHI KC: Helps me do my job better. Saves (has saved) me significant time on programs or projects. Saves (has saved) me significant money on programs or projects. Helps me to avoid costly mistakes (Walczak and Mann 2010 p.32) |

| Table C2. Definitions of Knowledge Outcome Variables | | | |
|---|---|---|---|
| | **Variable** | **Definition** | **Example Measure** |
| **Content** | Helpfulness of Contribution | The average helpfulness of response messages in a community of practice (Wasko and Faraj 2005) | Response messages were reviewed to assess the extent to which the content actually addressed and answered the posted questions. |
| | Information Quality | Fitness for use: intrinsic information quality, contextual information quality, and representational information quality (Arazy et al. 2011) | Raters' consensus on the quality of the article based on accuracy, completeness, objectivity, and representation. |
| | Knowledge Acquisition | The capture of rules and facts or similar formal knowledge representations directly from engineers (Wagner 2006) | Knowledge asset growth is measured through summary statistics by logging the number of articles written each month in Wikipedia |
| | Knowledge Popularity | The amount of attention that specific knowledge receives after it is published in a KMS (Sha et al. 2013) | Knowledge popularity was measured by the download count of a document |
| | Knowledge Quality | The knowledge in the knowledge management system (Jang-Hwan et al. 2006) | Information quality dimensions: relevancy, completeness, accuracy, and reliability |
| | Quality of Response | Degree to which a response adequately answers a question (Hahn and Wang 2009) | Asked the community to vote for the best answer among all of the responses that were posted |
| | Perceived Content Quality | "The extent to which an individual believes that a repository provides precise and accurate content that meets his or her knowledge needs" (Durcikova and Gray 2009 p. 84) | The knowledge in the Kbase is precise, The content of Kbase meets my needs, The knowledge in the Kbase is accurate, Overall, the quality of knowledge in the Kbase is high. |
| **Individual Learning** | Expertise Recognition | Accuracy in recognizing group member expertise (Su 2012) | The degree of similarity between a group member's perceptions of other members' knowledge and other members' self-reported knowledge across all knowledge domains (Su 2012 p.623) |
| | Learning Outcome | Viewed as the extent of knowledge internalization in terms of its effective usage (Chin-Yen et al. 2007) | *I now have a much better understanding of the right way to do my work than I did a year ago. I have been very innovative in my thinking in the last year. (Gray and Meister 2004 p.830)* |
| | Knowledge Attainment | "An individual's collaboration know-how refers specifically to knowledge about how to communicate one's own ideas and integrate it with others' ideas…" (Majchrzak et al. 2005 p.10) | Working in this distributed team is helping me learn: How to streamline the team's internal processes. How to reduce redundancy of information and knowledge in the team. How to rapidly implement new team ideas |
| **Collective Learning** | Dynamic Capabilities | "Dynamic capabilities (the ability to reconfigure functional competencies to address turbulent environments" (Pavlou and El Sawy 2006 p.198) | Please rate the effectiveness of your NPD work unit in the following activities relative to your major competitors: Reconfigurability, Market orientation, Absorptive capacity, Coordination capability, Collective mind |
| | KMS Success | Improved communication and collaboration, improved decision making, increased knowledge sharing (Kamla Ali and Olfman 2005) | Increase in project size, number of users and usage (Kamla Al and Olfmani 2005 p.16) |
| | Knowledge Dissemination | Creation and dissemination of knowledge throughout the organization (Garud et al. 2006) | Measured through case study analysis |
| | Knowledge Sharing Practices | Manner in which the KMS was used to share knowledge between groups (Duilpovici and Robey 2013) | Measured through case study analysis |
| | Knowledge Reuse | Extent to which an individual perceives that his/her contributed knowledge has been used by others for organizational improvements (Majchrzak et al. 2013 p. 461) | To what extent would you say your knowledge-sharing on this wiki has helped your organization to: Improve work processes. Increase collaboration efficiency, increase knowledge reuse (Majchrzak et al. 2013, p.A8) |

| Table C2. Definitions of Knowledge Outcome Variables (Continued) | | | |
|---|---|---|---|
| | **Variable** | **Definition** | **Example Measure** |
| **Individual Performance** | Creative Performance | Number of Ideas, Creativity of Ideas (Cheung et al. 2008) | Tested by the abbreviated tolerance test for adults (Cheung et al. 2008) |
| | Decision Accuracy | The quality and accuracy of a decision (Poston and Speier 2008) | Decision accuracy was measured as the number of line items in the subject's submitted work plan matching the 36 line items in the highest quality work plan. |
| | Decision Performance | Decision Quality, Decision Time (Poston and Speier 2005) | Decision quality was determined by the number of line items in the subject's work plan that matched the 19 line items in the highest-quality work plan. Decision time was the duration (in minutes) of time spent on the task (Poston and Speier 2005) p.228 |
| | Job Performance | Individual job performance (Ko and Dennis 2011) | An individual's actual monthly sales compared to the sales quota for their sales territory set for that month (Ko and Dennis 2011) |
| | | Performance may be measured not only in terms of tangible benefits, but also intangible benefits. (Teo 2008 p.558) | Please evaluate the extent of your performance with the assistance of the K-portal… The efficiency of the operations in my work… The adherence to plan and budgets of my work…The amount of work I produce… (Teo 2008 p.574) |
| | | The quality and efficiency of their work. (Van den Hooff 2010 p.206) | When using the system I…can solve problems more efficiently, Quality of knowledge I use in work improved, Can obtain new relevant knowledge, Speed with which tasks completed has increased. (Van den Hooff 2010 p.210) |
| | Problem Resolution Performance | Performance variables tracked by the help desk (González et al. 2005) | Resolution time and throughput, Total number of calls resolved in time period, Time in the system of critical priority problems, Number of problem calls in third level queue (González et al. 2005 p. 399) |
| | | Solving problems by analogizing from examples. (McCall 2008) | The participants solved a series of posttest cases. The posttest cases provided a measure of the participants' interpretive problem-solving abilities. (McCall 2008 p.84) |
| **Collective Performance** | Financial Performance | Financial performance indicators: return on assets, return on sales, asset turnover (Feng et al. 2004) | Archival financial data extracted from Compustat |
| | Organizational Performance | Implementation of KMS to fulfill the general knowledge process needs of the organization and increase performance (Khalifa et al. 2008). | Four IT-enabled organizational benefits: profitability, market shares, supply chain efficiency, and customer responsiveness. |
| | | Organizational performance may be defined as the degree to which companies achieved its business objectives. (Lee and Choi 2003 p.181) | Assessed by the use of global output measures such as market share, profitability, growth rate, innovativeness, successfulness. And the size of business in comparison with key competitors (Lee and Choi 2003 p.194) |
| | | Impact on organizational performance: e.g. high product quality, reputation, and quick speed for product development, and a low cost structure (Lakshman and Parente 2008) | Respondents were asked questions using a Likert scale with respect to the… performance dimensions of business unit profitability, return on investment, return on sales, and overall financial performance |
| | Organizational Productivity | Ability to achieve goals and meet planned performance measures (Jennex 2008) | External rating of operational effectiveness, internal assessment of expected and realized outcomes, adherence to key performance indicator tolerances |
| | Team Performance | "…team performance consists of quality, efficiency, and timeliness in the context of knowledge workers" (Choi et al. 2010 p.861) | The team's deliverables were of excellent quality, The team managed time effectively, The team met important deadlines on time (Choi et al. 2010 p. 861) |
| | | Sales bid outcome (Haas and Hansen 2005) | Whether sales teams were successful in securing a contract (Haas and Hansen 2005) |
| | | Helpdesk call resolution efficiency (Gallivan et al. 2003) | Resolution time based on observations and objective data |

# APPENDIX D – DETERMINANTS OF BEHAVIORAL ACTIONS

| Table D1. Determinants of Contribution | | |
|---|---|---|
| **Category** | **Independent Variable** | **Dependent Variable** |
| Actor Characteristics | Advancement in the Organization | Knowledge Sharing (Watson and Hewett 2006) |
| | Enjoyment in Helping Others | Knowledge Contribution (Kankanhalli et al. 2005a) |
| | Experience | Knowledge Sharing (Watson and Hewett 2006) |
| | Knowledge Breadth | Shaping Contribution (Majchrzak et al. 2013) |
| | Knowledge Depth | Adding Contribution (Majchrzak et al. 2013) |
| | Knowledge Sharing Attitude | Intention to Share (Chen et al. 2012) |
| | Perceived Benefits | Information Provision (Huang et al. 2013) |
| | Perceived Ease of Use | Intention to Share (Shin-Yuan et al. 2011) |
| | Perceived Usefulness | Intention to Share (Shin-Yuan et al. 2011) |
| | Performance Expectancy | Knowledge Contribution (Li 2010) |
| | Prior Knowledge Reuse | Knowledge Sharing (Watson and Hewett 2006) |
| | Sharing Intention | Knowledge Contribution (He and Wei 2009; Vitari et al. 2007) |
| | | Knowledge Sharing (Jeon et al. 2011) |
| | Self-Efficacy | Intention to Share (Chen et al. 2012) |
| | | Knowledge Contribution (Ardichvili et al. 2003; Kankanhalli et al. 2005a) |
| | Tenure | Knowledge Sharing (Wasko and Faraj 2005) |
| | Trust | Information Provision (Huang et al. 2013) |
| Technology Characteristics | Asynchronous Communication | Knowledge Sharing (Hara and Hew 2007) |
| | Perceived Content Quality | Knowledge Contribution ([-] Durcikova and Gray 2009) |
| | Support for Knowledge Management | Team Knowledge Sharing (Choi et al. 2010) |
| | Validation Restrictiveness | Knowledge Contribution ([-] Durcikova and Gray 2009) |
| | Validation Transparency | Knowledge Contribution (Durcikova and Gray 2009) |
| Task Characteristics | Task Interdependence | Information Provision ([-] Huang et al. 2013) |
| | Time Pressure | Knowledge Contribution ([-] Li 2010) |
| | | Knowledge Sharing ([-] Bansler and Havn 2003) |
| | Type of Knowledge | Intention to Share (Huerta et al. 2012) |
| Social Factors | Altruism | Intention to Share (Shin-Yuan et al. 2011) |
| | Experts' Information Retrieval | Information Provision (Huang et al. 2013) |
| | In-Group Orientation | Knowledge Sharing (Ardichvili et al. 2006) |
| | Manager Posts | Knowledge Contribution (Wattal et al. 2010) |
| | Member Feedback | Knowledge Contribution (Sutanto and Jiang 2013; Wattal et al. |
| | Pro-Social Value Orientation | Knowledge Contribution (Ardichvili et al. 2003) |
| | | Knowledge Sharing (Marks et al. 2008; Wolfe and Loraas 2008) |
| | Provision by Peers | Information Provision (Huang et al. 2013) |
| | Reciprocity | Knowledge Contribution ([-] Wasko and Faraj 2005) |
| | Reputation | Knowledge Contribution (Wasko and Faraj 2005) |
| | | Knowledge Sharing (Ardichvili et al. 2006) |
| | Social Norms | Knowledge Sharing (Bansler and Havn 2003) |
| | Social Ties | Knowledge Contribution (Li 2010; Wasko and Faraj 2005) |
| | | Knowledge Sharing (Alavi et al. 2005; Bansler and Havn 2003) |
| | Transactive Memory System | Team Knowledge Sharing (Choi et al. 2010) |
| Organizational Factors | Authority | Knowledge Sharing ([-] Ardichvili et al. 2006) |
| | Competitiveness | Knowledge Sharing ([-] Ardichvili et al. 2006) |
| | Employee's Commitment | Collective Knowledge Sharing (Jang-Hwan et al. 2006) |
| | Facilitating Conditions | Knowledge Contribution (He and Wei 2009) |
| | | Knowledge Sharing (Jeon et al. 2011) |
| | Hierarchy | Knowledge Sharing ([-] Ardichvili et al. 2006) |
| | Incentive | Intent to Contribute (Iyer and Ravindran 2009) |
| | | Knowledge Contribution (Subramanian and Soh 2009) |
| | | Knowledge Sharing (Wolfe and Loraas 2008) |

Note: [-] = Negative Relationship

| Table D1. Determinants of Contribution (Continued) | | |
|---|---|---|
| **Category** | **Independent Variable** | **Dependent Variable** |
| Organizational Factors | Knowledge Sharing Culture | Knowledge Contribution (Ardichvili et al. 2003; Li 2010) |
| | | Knowledge Sharing (Young et al. 2012) |
| | Leadership | Knowledge Sharing (Alavi et al. 2005) |
| | Management Expectations | Information Provision (Huang et al. 2013) |
| | Managerial Prompting | Knowledge Sharing (Marks et al. 2008) |
| | Moderator Support | Knowledge Sharing (Hara and Hew 2007) |
| | Non-competitive Environment | Knowledge Sharing (Hara and Hew 2007) |
| | Opportunity to Contribute Knowledge | Knowledge Contribution (Subramanian and Soh 2009) |
| | Organizational Climate | Intention to Share (Chen et al. 2012) |
| | Organizational Value Systems | Knowledge Sharing (Alavi et al. 2005) |
| | Perceived Organizational Support | Knowledge Contribution (King 2006) |
| | Supervisory Control | Knowledge Contribution (King 2006) |
| Interactions | Age x Network Externalities | Knowledge Contribution (Wattal et al. 2010) |
| | Assessment of Transactive Memory System | Shaping Contribution (Majchrzak et al. 2013) |
| | Assessment of Transactive Memory System | Adding Contribution ([-] Majchrzak et al. 2013) |
| | Codification Effort x Generalized Trust | Knowledge Contribution ([-] Kankanhalli et al. 2005a) |
| | Experts' Retrieval x Task Interdependence | Information Provision (Huang et al. 2013) |
| | Experts' Retrieval x Trust | Information Provision (Huang et al. 2013) |
| | High Ambiguity Tolerance x Usefulness x Incentives | Intent to Contribute (Iyer and Ravindran 2009) |
| | Low Ambiguity Tolerance x Incentives | Intent to Contribute (Iyer and Ravindran 2009) |
| | Organizational Reward x Exchange Ideology | Knowledge Sharing (Zhang et al. 2013) |
| | Organizational Reward x Identification | Knowledge Contribution (Kankanhalli et al. 2005a) |
| | Reciprocity x Pro-Sharing Norms | Knowledge Contribution ([-] Kankanhalli et al. 2005a) |
| | Sufficient Knowledge Incentives x Lack of Reciprocity | Knowledge Sharing ([-] Wolfe and Loraas 2008) |
| | Type of Knowledge x Collectivist Culture | Intention to Share (Huerta et al. 2012) |

Note: [-] = Negative Relationship

| Table D2. Determinants of Acquisition | | |
|---|---|---|
| **Category** | **Independent Variable** | **Dependent Variable** |
| Actor Characteristics | Learning Motivation | Knowledge Sourcing (Chin-Yen et al. 2007) |
| | Learning Orientation | Knowledge Sourcing ([-] Gray and Durcikova 2005) |
| | Level in the Organization | KMS Use (Wang et al. 2013) |
| | Perceived Benefits | Knowledge Consumption (Ardichvili et al. 2003; Li 2010) |
| | Perceived Usefulness | Knowledge Seeking (He et al. 2009) |
| | Prior KMS Use | KMS Use (Wang et al. 2013) |
| | Risk Aversion | Knowledge Sourcing ([-] Gray and Durcikova 2005) |
| | Seeker Knowledge Growth | Knowledge Seeking (Bock et al. 2006) |
| | Seeking Intention | Knowledge Seeking (He and Wei 2009) |
| | Self-Efficacy | Knowledge Seeking (Bock et al. 2006) |
| Technology Characteristics | Average Rating of Content | Knowledge Seeking (Sutanto and Jiang 2013) |
| | Guided Ontology Features | Knowledge Identification (Bera et al. 2011) |
| | Perceived Output Quality | Knowledge Seeking (Kankanhalli et al. 2005b) |
| | Rating Validity | Content Search (Poston and Speier 2005; 2008) |
| Task Characteristics | Intellectual Demands | Knowledge Sourcing (Gray and Durcikova 2005) |
| | Time Pressure | Knowledge Sourcing ([-] Gray and Durcikova 2005) |
| | | Consumption ([-] Li 2010) |
| Social Factors | Collaborative Norms | Knowledge Seeking (Ardichvili et al. 2006; Bock et al. 2006) |
| | Usage of Reference Groups | KMS Use (Wang et al. 2013) |
| Organizational Factors | Incentive | Knowledge Seeking (Kankanhalli et al. 2005b) |
| | Facilitating Conditions | Knowledge Seeking (Bock et al. 2006; He and Wei 2009) |
| | Resource Availability | Knowledge Seeking (Kankanhalli et al. 2005b) |
| Interactions | Future Obligation x Collaborative Norms | Knowledge Seeking (Bock et al. 2006) |
| | Incentive Availability x Task Interdependence | Knowledge Seeking (Kankanhalli et al. 2005b) |
| | Influence of Other Users x Level in the Organization | Knowledge Reuse ([-] Wang et al. 2013) |
| | Low Rating Validity x Low Content Credibility | Content Search (Poston and Speier 2005) |
| | Perceived Usefulness x Collaborative Norms | Knowledge Seeking ([-]Bock et al. 2006) |
| | Resource Availability x Task Tacitness | Knowledge Seeking ([-] Kankanhalli et al. 2005b) |

Note: [-] = Negative Relationship

| Table D3. Determinants of Application | | |
|---|---|---|
| **Category** | **Independent Variable** | **Dependent Variable** |
| Actor Characteristics | Experience | Knowledge Reuse ( [-] Desouza et al. 2006a) |
| | Perceived Climate for Autonomy | Solution Innovation (Durcikova et al. 2011) |
| | Perceived Climate for Innovation | Solution Reuse (Durcikova et al. 2011) |
| | Perceived Risk of Consumption | Knowledge Use ([-] Desouza et al. 2006b) |
| | Perceived Usefulness | Intent to Reuse (Iyer and Ravindran 2009) |
| | Training in Knowledge Reuse | Knowledge Reuse (Watson and Hewett 2006) |
| | User Satisfaction | Knowledge Use (Kulkarni et al. 2006) |
| Technology Characteristics | Ease of Knowledge Access | Knowledge Reuse (Watson and Hewett 2006) |
| | Perceived Complexity of Content | Knowledge Use ([-] Desouza et al. 2006b) |
| | Perceived Relative Advantage of Knowledge | Knowledge Use (Desouza et al. 2006b) |
| | Support for Knowledge Management | Team Knowledge Application (Choi et al. 2010) |
| | Value of Knowledge | Knowledge Reuse (Watson and Hewett 2006) |
| Acquisition | Knowledge Sharing | Team Knowledge Application (Choi et al. 2010) |
| Social Factors | Transactive Memory System | Team Knowledge Application (Choi et al. 2010) |
| Organizational Factors | Incentive | Intent to Reuse (Iyer and Ravindran 2009) |
| | | Knowledge Use (Kulkarni et al. 2006) |
| | Leadership | Knowledge Use (Kulkarni et al. 2006) |
| Interactions | KMS Access x Climate for Autonomy | Solution Innovation ([-] Durcikova et al. 2011) |
| | KMS Access x Climate for Innovation | Solution Innovation (Durcikova et al. 2011) |
| | Low Ambiguity Tolerance x Incentives | Intent to Reuse (Iyer and Ravindran 2009) |

Note: [-] = Negative Relationship

| Table D4. Determinants of Valuation | | |
|---|---|---|
| **Category** | **Independent Variable** | **Dependent Variable** |
| Actor Characteristics | Knowledge Sharing Attitude | Individual Productivity (Walczak and Mann 2010) |
| | User Satisfaction | Knowledge Management System Success (Halawi et al. 2007) |
| Technology Characteristics | Knowledge Combination Features | Organization-level perceived KM Effectiveness (Sabherwal and Becerra-Fernandez 2003) |
| | Knowledge Externalization Features | Individual-level perceived KM Effectiveness (Sabherwal and Becerra-Fernandez 2003) |
| | Knowledge Internalization Features | Individual-level perceived KM Effectiveness (Sabherwal and Becerra-Fernandez 2003) |
| | Knowledge Socialization Features | Group-level perceived KM Effectiveness (Sabherwal and Becerra-Fernandez 2003) |
| Application | Technology Use | Individual Productivity (Walczak and Mann 2010) |
| | | Knowledge Management System Success (Halawi et al. 2007) |
| | | Perceived Benefits from Knowledge Reuse (Boh 2008) |
| Social Factors | Shared Perspective | Perceived Benefits from Knowledge Reuse (Boh 2008) |
| Interactions | Asset Complexity x Seeking Assistance from Author | Perceived Benefits from Knowledge Reuse (Boh 2008) |

Note: [-] = Negative Relationship

# APPENDIX E – DETERMINANTS OF KNOWLEDGE OUTCOMES

Table E1. Determinants of Content

| Category | Independent Variable | Dependent Variable |
|---|---|---|
| Actor Characteristics | Commitment | Helpfulness of Contribution ([-] Wasko and Faraj 2005) |
| | Content Orientation | Information Quality (Arazy et al. 2011) |
| | Enjoyment in Helping Others | Helpfulness of Contribution (Wasko and Faraj 2005) |
| | Power of Communication | Knowledge Popularity (Sha et al. 2013) |
| | Strategic Self-Presentation | Knowledge Quality ([-] Leonardi and Treem 2012) |
| Technology Characteristics | Open Knowledge Sharing Architecture | Knowledge Acquisition (Wagner 2006) |
| | Support of Collaboration Processes | Quality of Response (Hahn and Wang 2009) |
| | Validation Duration | Perceived Knowledge Quality ([-] Durcikova and Gray 2009) |
| | Validation Restrictiveness | Perceived Knowledge Quality (Durcikova and Gray 2009) |
| | Validation Transparency | Perceived Knowledge Quality (Durcikova and Gray 2009) |
| Task Characteristics | Task Conflict | Information Quality ([-] Arazy et al. 2011) |
| Social Factors | Reputation | Helpfulness of Contribution (Wasko and Faraj 2005) |
| | Social Ties | Knowledge Popularity (Sha et al. 2013) |
| | | Helpfulness of Contribution (Wasko and Faraj 2005) |
| Organizational Factors | Employees' Commitment | Knowledge Quality (Jang-Hwan et al. 2006) |
| | Incentive | Knowledge Quality ([-] Garud and Kumaraswamy 2005; [-] Ravishankar 2008) |
| Interactions | Task Conflict x Cognitive Diversity | Information Quality (Arazy et al. 2011) |

Note: [-] = Negative Relationship

Table E2. Determinants of Individual Learning

| Category | Independent Variable | Dependent Variable |
|---|---|---|
| Technology Characteristics | Degree of IT Support for Contextualization | Perceived Collaboration Know-How Development (Majchrzak et al. 2005 ) |
| | Support for Embedded Accrual of Content | Knowledge Attainment (Griffith and Sawyer 2006) |
| | Support for Proactive Accrual of Content | Knowledge Attainment (Griffith and Sawyer 2006) |
| Acquisition | KMS Use | Influence on Individual KM Practices (Alavi et al. 2005) |
| | | Knowledge Attainment (Griffith and Sawyer 2006) |
| | | Learning Outcomes (Chin-Yen et al. 2007) |
| | | Perceived Collaboration Know-How Development (Majchrzak et al. 2005) |
| Interactions | Knowledge Reuse x Task Non-Routineness | Perceived Collaboration Know-How Development (Majchrzak et al. 2005) |
| | Social Ties X Technology Use | Accuracy in Recognizing Group Member Expertise (Su 2012) |

| Table E3. Determinants of Collective Learning | | |
|---|---|---|
| **Category** | **Independent Variable** | **Dependent Variable** |
| Technology Characteristics | Electronic Community of Practice Features | Organizational Learning (Kane and Alavi 2007) |
| | Knowledge Repository Features | Organizational Learning (Kane and Alavi 2007) |
| | Learning by Doing Features | Accumulated Knowledge (Ryu et al. 2005) |
| | Learning by Investment Features | Accumulated Knowledge (Ryu et al. 2005) |
| | Learning from Others Features | Accumulated Knowledge (Ryu et al. 2005) |
| | Virtual Team Room Features | Organizational Learning (Kane and Alavi 2007) |
| Task Characteristics | Integration of Technology Use with Work Practices | Organizational Capabilities (Vaast 2007) |
| Contribution | Adding Contribution | Perceived Reuse of Knowledge for Organizational Improvement (Majchrzak et al. 2013) |
| | Shaping Contribution | Perceived Reuse of Knowledge for Organizational Improvement (Majchrzak et al. 2013) |
| Acquisition | KMS Use | Accumulated Knowledge (Ryu et al. 2005) |
| | | Alignment of KMS with Organizational Strategy [-] (Dulipovici and Robey 2013) |
| | | Influence on Organizational KM Practices (Alavi et al. 2005) |
| | | KMS Success (Kamla Ali and Olfman 2005; Massey 2002; Ravishankar et al. 2011) |
| | | Knowledge Exchange (Pfaff and Hasan 2011) |
| | | Knowledge Management Success [-] Dudezert and Leidner 2011 |
| | | Knowledge Sharing (Pemberton et al. 2002) |
| | | Organizational Capabilities (Garud et al. 2006; Levina and Vaast 2005; Pavlou and El Sawy 2006; Sherif et al. 2006; Vaast 2007; Zboralski 2009) |
| | | Organizational Learning (Kane and Alavi 2007) |
| Organizational Factors | Alignment | KMS Success (Ravishankar et al. 2011) |
| | Collaborative Leadership | Influence on Organizational KM Practices (Alavi et al. 2005) |
| | Knowledge Management Strategy | KMS Success (Kamla Ali and Olfman 2005; Massey 2002) |
| | | Organizational Capabilities (Garud et al. 2006) |
| | Leadership | Organizational Capabilities (Zboralski 2009) |
| | Management Support | Organizational Capabilities (Zboralski 2009) |
| Interactions | Use of Technology x Environmental Turbulence | Organizational Learning (Pavlou and El Sawy 2006) |

Note: [-] = Negative Relationship

| Table E4. Determinants of Individual Performance | | |
|---|---|---|
| **Category** | **Independent Variable** | **Dependent Variable** |
| Technology Characteristics | Knowledge Visualization Features | Task Performance (Hou and Tsai 2008) |
| Task Characteristics | Integration of Technology Use with Work Practices | Individual Performance (Van Den Hooff et al. 2010) |
| Application | KMS Use | Creative Performance ([-]Cheung et al. 2008) |
| | | Individual Performance (Teo and Men 2008; Van Den Hooff et al. 2010) |
| | | Decision Accuracy (Poston and Speier 2008) |
| | | Decision Quality (Poston and Speier 2005) |
| | | Decision Time (Poston and Speier 2005) |
| | | Problem Solving Performance (McCall et al. 2008) |
| | | Sales Quota Performance (Ko and Dennis 2011) |
| | | Task Performance (González et al. 2005; Hou and Tsai 2008) |
| Interactions | Compatibility x Knowledge Tacitness | Individual Performance ([-] Teo and Men 2008) |
| | Knowledge Reuse x Experience | Sales Quota Performance (Ko and Dennis 2011) |
| | Knowledge Reuse x Individual Creativity | Task Execution ([-] Cheung et al. 2008) |
| | Output Quality x Knowledge Tacitness | Individual Performance ([-] Teo and Men 2008) |

| Table E5. Determinants of Collective Performance | | |
|---|---|---|
| **Category** | **Independent Variable** | **Dependent Variable** |
| Technology Characteristics | System Quality | KM Success (Lin 2011) |
| Task Characteristics | Work Restructuring | Team Performance (Liang et al. 2009; Malhotra et al. 2001) |
| Knowledge Characteristics | Document Quality | Team Performance (Haas and Hansen 2007) |
| | Document Rework | Team Performance ([-] Haas and Hansen 2007) |
| Application | KMS Use | KM Success (Lin 2011) |
| | | Organizational Capabilities (Khalifa et al. 2008) |
| | | Organizational Performance (Feng et al. 2004; Gottschalk 2007; Jennex 2008; Lakshman and Parente 2008; Lee and Choi 2003) |
| | | Team Performance (Choi et al. 2010; [-] Gallivan et al. 2003; [-] Haas and Hansen 2005; Haas and Hansen 2007; Liang et al. 2009; Malhotra et al. 2001) |
| Organizational Factors | Decision Leadership | Organizational Performance (Gottschalk 2007) |
| | Democratic Culture | Organizational Performance (Gottschalk 2007) |
| | Incentive | Team Performance ([-] Gallivan et al. 2003) |
| | Knowledge Management Strategy | Team Performance (Malhotra et al. 2001) |
| | Management Support | KM Success (Lin 2011) |
| | Role Development | Team Performance (Liang et al. 2009) |
| Interactions | Use of Technology x Number of Competitors | Team Performance ([-] Haas and Hansen 2005) |
| | Use of Technology x Task Experience | Team Performance ([-] Haas and Hansen 2005) |
| | Technological Knowledge Sharing x Technological Dynamism | Organizational Performance (Lakshman and Parente 2008) |

Note: [-] = Negative Relationship

# APPENDIX F – KNOWLEDGE ACQUISITION ARTICLES

| Table F1. 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* | 3 |
| *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 |
| *Behaviour & 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 F2. Knowledge Acquisition 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.<br>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<br>Encyclopedic information<br>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.<br>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*, especially 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. (2005b) | Effort-based | EKR usage for knowledge seeking | Survey | Level of usage of EKR<br>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 via 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 three 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*. |

| Table F2. Knowledge Acquisition Constructs in Prior Research (Continued) | | | | | |
|---|---|---|---|---|---|
| **Study** | **Behavior** | **Construct Name** | **Method** | **Measures** | **Findings** |
| Chen et al. (2015) | Time-based | Intention to continue seeking knowledge via EKR | Survey | I intend to use the EKR system in the next two months<br>I intend to use the EKR system for my work during the next two months<br>I intend to use the EKR system frequently during the next two months | *Perceived usefulness* is positively related to intention to seek knowledge. The strength of this relationship differs across nations with varying *climato-economic characteristics*. |
| Poston and Speier (2005) | Effort-based | Content search and evaluation | Experiment / Log file Analysis | Clickstream data was captured for each subject's experimental session. This 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*, s*ubordinate usage*, and *prior usage* are positively related to current KMS use. |
| 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?<br>How often in the last week did you use the [Intranet database] to access a data base 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)<br>I frequently check in the knowledge repository when I need to improve my knowledge on a topic or issue<br>When I am working on a challenging problem, I often look in the knowledge repository to find solutions to similar problems | *Perceived usefulness* of a knowledge repository positively influences knowledge sourcing. |
| Durcikova and Fadel (2016) | Time-based | KR knowledge sourcing | Survey | I rarely use the KR as a way of acquiring knowledge [reversed]<br>I frequently check the KR when I need to improve my knowledge on a topic or issue<br>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. |

| Table F2. Knowledge Acquisition Constructs in Prior Research (Continued) | | | | | |
|---|---|---|---|---|---|
| **Study** | **Behavior** | **Construct Name** | **Method** | **Measures** | **Findings** |
| Durcikova and Grey (2009) | Time-based | KR knowledge sourcing | Survey | I rarely use the KBase as a way of acquiring knowledge. (reversed)<br>I frequently check in the KBase when I need to improve my knowledge on a topic or issue.<br>When I am working on a problem, I often look in the KBase to find solutions to similar problems.<br>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 of acquiring knowledge (reverse coded).<br>I frequently check in KMS when I need to improve my knowledge on a topic or issue.<br>When I am working on a challenging problem,<br>I often look in KMS to find solutions to similar problems. | There is no direct effect of KMS access on *solution reuse*. There is also no direct effect of KMS access 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 of acquiring knowledge. (reverse coded)<br>I frequently check in the KM system when I need to improve my knowledge on a topic or issue.<br>When I am working on a challenging problem,<br>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 was 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<br>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*. |

| Table F2. Knowledge Acquisition Constructs in Prior Research (Continued) | | | | | |
|---|---|---|---|---|---|
| **Study** | **Behavior** | **Construct Name** | **Method** | **Measures** | **Findings** |
| 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?<br>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<br>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.<br>I regularly use EKRs to search knowledge in my work.<br>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<br>Regularly use the system to seek knowledge<br>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 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 influences 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*. |

| Table F2. Knowledge Acquisition Constructs in Prior Research (Continued) | | | | | |
|---|---|---|---|---|---|
| **Study** | **Behavior** | **Construct Name** | **Method** | **Measures** | **Findings** |
| 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-based and Effort-based | PKMS Usage: Number of PKMS functions<br>Used PKMS usage frequency (distinct constructs) | Survey | How many functions supplied by Google Desktop have you used in the past month?<br>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 number of functions used. |
| Teo and Men (2008) | Time-based and Effort-based | Utilization frequency and intensity (compound construct) | Survey | On the average, how frequently do you use the K-portal in your company<br>On the average, how much time do you spend per week using the K-portal in your company?<br>Please indicate the extent to which you use the K-portal in your company to perform the following tasks for obtaining 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<br>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.<br>If I could, I would like to continue my use of EKR.<br>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*. |

| Table F2. Knowledge Acquisition Constructs in Prior Research (Continued) | | | | | |
|---|---|---|---|---|---|
| **Study** | **Behavior** | **Construct Name** | **Method** | **Measures** | **Findings** |
| He et al. (2009a) | Unspecified | Knowledge seeking continuance intention | Survey | I intend to continue using KMS to seek knowledge in the future<br>My intentions are to continue using KMS to seek knowledge in the next month<br>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<br>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.<br>I intend to continue using the EKR in the future.<br>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) | 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 F3. Reviewed Articles |
|---|
| Bock, G.-W., Kankanhalli, A., and Sharma, S. 2006. "Are Norms Enough? The Role of Collaborative Norms in Promoting Organizational Knowledge Seeking," European Journal of Information Systems (15:4), pp. 357-367. |
| Bock, G.-W., Mahmood, M., Sharma, S., and Youn Jung, K. 2010. "The Impact of Information Overload and Contribution Overload on Continued Usage of Electronic Knowledge Repositories," Journal of Organizational Computing & Electronic Commerce (20:3), pp. 257-278. |
| Chen, L., Hsieh, J. J. P.-A., Van de Vliert, E., and Huang, X. 2015. "Cross-National Differences in Individual Knowledge-Seeking Patterns: A Climato-Economic Contextualization," European Journal of Information Systems (24:3), pp. 314-336. |
| Cheung, P.-K., Chau, P. Y. K., and Au, A. K. K. 2008. "Does Knowledge Reuse Make a Creative Person More Creative?" Decision Support Systems (45:2), pp. 219-227. |
| Child, J. T., and Shumate, M. 2007. "The Impact of Communal Knowledge Repositories and People-Based Knowledge Management on Perceptions of Team Effectiveness," Management Communication Quarterly (21:1), pp. 29-54. |
| Choi, M., and Durcikova, A. 2014. "Are Printed Documents Becoming Irrelevant? The Role of Perceived Usefulness of Knowledge Repositories in Selecting from Knowledge Sources," Communications of the Association for Information Systems (34), pp. 751-774. |
| Doong, H. S., and Wang, H. C. 2009. "Predictors of Diverse Usage Behaviour Towards Personal Knowledge Management Systems," Online Information Review (33:2), pp. 316-328. |
| Durcikova, A., and Fadel, K. J. 2016. "Knowledge Sourcing from Repositories: The Role of System Characteristics and Psychological Climate," Information & Management (53:1), pp. 64-78. |
| Durcikova, A., Fadel, K. J., Butler, B. S., and Galletta, D. F. 2011. "Knowledge Exploration and Exploitation: The Impacts of Psychological Climate and Knowledge Management System Access," Information Systems Research (22:4), pp. 855-866. |
| Durcikova, A., and Gray, P. 2009. "How Knowledge Validation Processes Affect Knowledge Contribution," Journal of Management Information Systems (25:4), pp. 81-107. |
| Filieri, R., and Willison, R. 2016. "Antecedents of Knowledge Sourcing and Reuse from a Knowledge Repository in the Virtual Product Prototyping: The Role of Knowledge and System Quality Dimensions," Knowledge & Process Management (23:2), pp. 147-160. |
| Galunic, C., Sengupta, K., and Petriglieri, J. L. 2014. "Deus Ex Machina? Career Progress and the Contingent Benefits of Knowledge Management Systems," European Management Journal (32:1), pp. 13-23. |
| Gray, P. H., and Durcikova, A. 2005. "The Role of Knowledge Repositories in Technical Support Environments: Speed Versus Learning in User Performance," Journal of Management Information Systems (22:3), pp. 159-190. |
| Haas, M. R., and Hansen, M. T. 2005. "When Using Knowledge Can Hurt Performance: The Value of Organizational Capabilities in a Management Consulting Company," Strategic Management Journal (26:1), pp. 1-24. |
| He, W., Fang, Y., and Wei, K. K. 2009a. "The Role of Trust in Promoting Organizational Knowledge Seeking Using Knowledge Management Systems: An Empirical Investigation," Journal of the American Society for Information Science & Technology (60:3), pp. 526-537. |
| He, W., Qiao, Q., and Wei, K.-K. 2009b. "Social Relationship and Its Role in Knowledge Management Systems Usage," Information & Management (46:3), pp. 175-180. |
| He, W., and Wei, K.-K. 2009. "What Drives Continued Knowledge Sharing? An Investigation of Knowledge-Contribution and -Seeking Beliefs," Decision Support Systems (46:4), pp. 826-838. |
| Hester, A. J. 2011. "A Comparative Analysis of the Usage and Infusion of Wiki and Non-Wiki-Based Knowledge Management Systems," Information Technology and Management (12:4), pp. 335-355. |
| Kankanhalli, A., Lee, O. K., and Lim, K. H. 2011. "Knowledge Reuse through Electronic Repositories: A Study in the Context of Customer Service Support," Information & Management (48:2-3), pp. 106-113. |
| Kankanhalli, A., Tan, B. C. Y., and Kwok-Kee, W. 2005. "Understanding Seeking from Electronic Knowledge Repositories: An Empirical Study," Journal of the American Society for Information Science & Technology (56:11), pp. 1156-1166. |
| Khedhaouria, A., and Ribiere, V. 2013. "The Influence of Team Knowledge Sourcing on Team Creativity Evidences from Information System Development," Learning Organization (20:4/5), pp. 308-321. |
| Kim, S. H., Mukhopadhyay, T., and Kraut, R. E. 2016. "When Does Repository KMS Use Lift Performance? The Role of Alternative Knowledge Sources and Task Environments," MIS Quarterly (40:1), pp. 133-A137. |
| Ko, D.-G., and Dennis, A. R. 2011. "Profiting from Knowledge Management: The Impact of Time and Experience," Information Systems Research (22:1), pp. 134-152. |
| Lai, H.-M., Chen, C.-P., and Chang, Y.-F. 2014. "Determinants of Knowledge Seeking in Professional Virtual Communities," Behaviour & Information Technology (33:5), pp. 522-535. |
| Lai, J.-Y. 2009. "How Reward, Computer Self-Efficacy, and Perceived Power Security Affect Knowledge Management Systems Success: An Empirical Investigation in High-Tech Companies," Journal of the American Society for Information Science & Technology (60:2), pp. 332-347. |

| Table F3. Reviewed Articles (Continued) |
|---|
| Lin, T.-C., and Huang, C.-C. 2009. "Understanding the Determinants of EKR Usage from Social, Technological and Personal Perspectives," Journal of Information Science (35:2), pp. 165-179. |
| McCall, H., Arnold, V., and Sutton, S. G. 2008. "Use of Knowledge Management Systems and the Impact on the Acquisition of Explicit Knowledge," Journal of Information Systems (22:2), pp. 77-101. |
| Phang, C. W., Kankanhalli, A., and Sabherwal, R. 2009. "Usability and Sociability in Online Communities: A Comparative Study of Knowledge Seeking and Contribution," Journal of the Association for Information Systems (10:10), p. 721. |
| Poston, R., and Speier, C. 2008. "Knowledge Management Systems Usage: Rating Scheme Validity and the Effort-Accuracy Trade-Off," Journal of Organizational and End User Computing (20:1), pp. 1-16. |
| Poston, R. S., and Speier, C. 2005. "Effective Use of Knowledge Management Systems: A Process Model of Content Ratings and Credibility Indicators," MIS Quarterly (29:2), pp. 221-244. |
| Su, C. 2012. "Who Knows Who Knows What in the Group? The Effects of Communication Network Centralities, Use of Digital Knowledge Repositories, and Work Remoteness on Organizational Members' Accuracy in Expertise Recognition," Communication Research (39:5), pp. 614-640. |
| Su, C., and Contractor, N. 2011. "A Multidimensional Network Approach to Studying Team Members' Information Seeking from Human and Digital Knowledge Sources in Consulting Firms," Journal of the American Society for Information Science & Technology (62:7), pp. 1257-1275. |
| Sutanto, J., and Jiang, Q. 2013. "Knowledge Seekers' and Contributors' Reactions to Recommendation Mechanisms in Knowledge Management Systems," Information & Management (50:5), pp. 258-263. |
| Teigland, R., and Wasko, M. 2009. "Knowledge Transfer in MNCs: Examining How Intrinsic Motivations and Knowledge Sourcing Impact Individual Centrality and Performance," Journal of International Management (15:1), pp. 15-31. |
| Teo, T. S. H., and Men, B. 2008. "Knowledge Portals in Chinese Consulting Firms: A Task-Technology Fit Perspective," European Journal of Information Systems (17:6), pp. 557-574. |
| Wang, Y., Meister, D. B., and Gray, P. H. 2011. "In or Out: An Integrated Model of Individual Knowledge Source Choice," Journal of Organizational & End User Computing (23:2), pp. 37-56. |
| Wang, Y., Meister, D. B., and Gray, P. H. 2013. "Social Influence and Knowledge Management Systems Use: Evidence from Panel Data," MIS Quarterly (37:1), pp. 299-313. |
| Watson, S., and Hewett, K. 2006. "A Multi-Theoretical Model of Knowledge Transfer in Organizations: Determinants of Knowledge Contribution and Knowledge Reuse," Journal of Management Studies (43:2), pp. 141-173. |
| Zboralski, K. 2009. "Antecedents of Knowledge Sharing in Communities of Practice," Journal of Knowledge Management (13:3), pp. 90-101. |

# APPENDIX G - ALTERNATE SPECIFICATIONS OF THE FULL MODEL

Table G1. Alternate Specifications of the Full Model

| | Weekly Acquisition | | Monthly Acquisition | | Daily Acquisition and Team Size | | Daily Acquisition and (Prof. Experience + Tenure) | |
|---|---|---|---|---|---|---|---|---|
| Constant | 9.321*** | (0.063) | 9.316*** | (0.063) | 9.317*** | (0.063) | 9.362*** | (0.063) |
| Population | 0.000 | (0.000) | 0.000 | (0.000) | 0.000 | (0.000) | 0.000 | (0.000) |
| Average Income | -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) |
| Foreclosure Rate | -0.952* | (0.541) | -0.945* | (0.541) | -0.934* | (0.540) | -0.945* | (0.539) |
| Office Size | 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) |
| Office Attrition | -0.005*** | (0.002) | -0.005*** | (0.002) | -0.005*** | (0.002) | -0.005*** | (0.002) |
| Office Expansion | 0.009*** | (0.002) | 0.009*** | (0.002) | 0.009*** | (0.002) | 0.009*** | (0.002) |
| Prior Commissions | 0.141*** | (0.002) | 0.141*** | (0.002) | 0.141*** | (0.002) | 0.142*** | (0.002) |
| Gender | -0.053*** | (0.015) | -0.054*** | (0.015) | -0.053*** | (0.015) | -0.054*** | (0.015) |
| Tenure | 0.008*** | (0.002) | 0.008*** | (0.002) | 0.008*** | (0.002) | | |
| Team Size | 0.004*** | (0.001) | 0.004*** | (0.001) | 0.004*** | (0.001) | 0.004*** | (0.001) |
| Professional Experience | 0.041*** | (0.010) | 0.042*** | (0.010) | 0.041*** | (0.010) | | |
| Team Membership | 0.312*** | (0.027) | 0.313*** | (0.027) | 0.320*** | (0.027) | 0.315*** | (0.027) |
| Overall Acquisition | -0.002*** | (0.001) | -0.001* | (0.001) | -0.002** | (0.001) | -0.001** | (0.001) |
| Weekly Acquisition Frequency | 0.076*** | (0.011) | | | | | | |
| Weekly Acquisition Intensity | 0.033*** | (0.011) | | | | | | |
| Weekly Frequency x Prof. Experience | 0.007 | (0.007) | | | | | | |
| Weekly Intensity x Prof. Experience | 0.017** | (0.008) | | | | | | |
| Weekly Frequency x Team Membership | 0.062*** | (0.016) | | | | | | |
| Weekly Intensity x Team Membership | 0.004 | (0.021) | | | | | | |
| Monthly Acquisition Frequency | | | 0.080*** | (0.010) | | | | |
| Monthly Acquisition Intensity | | | 0.019 | (0.012) | | | | |
| Monthly Frequency x Prof. Experience | | | 0.001 | (0.007) | | | | |
| Monthly Intensity x Prof. Experience | | | 0.024*** | (0.008) | | | | |
| Monthly Frequency x Team Membership | | | 0.058*** | (0.017) | | | | |
| Monthly Intensity x Team Membership | | | -0.007 | (0.020) | | | | |
| Daily Acquisition Frequency | | | | | 0.079*** | (0.011) | 0.066*** | (0.012) |
| Daily Acquisition Intensity | | | | | 0.033*** | (0.010) | 0.029*** | (0.010) |
| Daily Frequency x Prof. Experience | | | | | 0.010 | (0.007) | | |
| Daily Intensity x Prof. Experience | | | | | 0.021*** | (0.008) | | |
| Daily Frequency x Team Size | | | | | 0.012** | (0.005) | | |
| Daily Intensity x Team Size | | | | | 0.007 | (0.008) | | |
| (Prof. Experience + Tenure) | | | | | | | 0.080*** | (0.008) |
| Daily Frequency x (Prof. Experience + Tenure) | | | | | | | 0.013* | (0.007) |
| Daily Intensity x (Prof. Experience + Tenure) | | | | | | | 0.017** | (0.008) |
| Daily Frequency x Team Membership | | | | | | | 0.054*** | (0.016) |
| Daily Intensity x Team Membership | | | | | | | 0.015 | (0.020) |
| Model degrees of freedom | 21 | | 21 | | 21 | | 20 | |
| Log Likelihood | -25168 | | -25153 | | -25182 | | -25181 | |

Standard errors in parentheses; n = 18,219; Number of groups: 1,022 counties, 2,743 offices; *** p<0.01, ** p<0.05, * p<0.1