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IMPROVING PERFORMANCE IN DISTRIBUTED COGNITION ENVIRONMENTS BY INCREASING THE LIKELIHOOD OF CONTRIBUTIONS TO AND ADOPTIONS FROM KNOWLEDGE MANAGEMENT SYSTEMS

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Abstract

Distributed cognition within an organization is more prevalent today than ever before. Organizations have greater global reach, often operating in multiple countries, which has allowed them to increase the amount and diversity of employee knowledge. It is more frequent that knowledge required for task completion is spread out across a number of individuals and brought together through local and virtual teams or experts within the organization. This research draws on the distributed cognition, knowledge management, and information systems literatures to examine how technology can help an organization leverage its distributed cognition to yield more innovative and efficient problem solving by increasing the likelihood of contributing knowledge to and adopting knowledge from knowledge management systems.

Keywords: Distributed cognition, knowledge sharing, knowledge management, knowledge management systems, innovation

Introduction

Organizations cannot escape the fact that they are operating in an environment in which knowledge is distributed. Today organizations have greater global reach, often operating in multiple countries, which has allowed them to increase the amount and diversity of employee knowledge. In addition, organizations have realized there are benefits associated with combining diverse domains of expertise whether they are local or global. Given this understanding a greater emphasis has been placed on collaboration within the organization, such that knowledge for a task is not self-contained within one individual. Today it is more frequent that knowledge required for task completion is spread out across a number of individuals and brought together through local and virtual teams or experts within the organization.

Distributed cognition within an organization is more prevalent today than ever before. This means the knowledge required to complete a task is dispersed among more than one individual (Hutchins 1995). In many cases the knowledge is distributed such that each individual has a diverse perspective to offer to the situation (Boland, Tenkasi, Te'eni 1994; Hutchins 1995; Weick and Roberts 1993). While the actual work may be carried out independently, the individual recognizes his interdependence with others and takes it into consideration during the course of his work (Boland, et al. 1994; Hutchins 1995; Weick and Roberts 1993). In addition to diversity and interdependence among individuals, there is the advantage of redundant or overlapping knowledge among individuals. This serves to respond to interruption or error through adaptation rather than full-scale breakdown (Hutchins 1995; Weick and Roberts 1993). In some cases, the interruption or error may be preempted.

Thus with distributed cognition knowledge is dispersed and diverse, but it is also interdependent and redundant. These unique features yield two major benefits, innovation and efficiency. In practice, organizations attempt to leverage the distinct domains of expertise that exist internally in order to gain competitive advantage. Research has shown that by drawing on diverse

perspectives organizations can deliver more innovative solutions (Amabile 1996; Dougherty 1992; Guilford 1950; Kazanjian, Drazin, Glynn 2000). Recognizing the existence of interdependent and redundant knowledge within an organization (i.e. past solutions, lessons learned, or best practices) often means avoiding past mistakes or reinvention of the wheel. Research shows increases in productivity when knowledge is transferred from one entity to another (Baum and Ingram, 1998 as cited in Argote 1999; Epple, Argote, Murphy 1996 as cited in Argote 1999).

While there are inherent costs (i.e. time and effort) associated with knowledge exchange in a distributed cognition environment, the information technology (IT) that exists today lowers these costs (Goodman and Darr 1998). In turn, individuals are more likely to exchange knowledge virtually during the normal course of their tasks. However for this alternative to be viable in a virtual environment, there are several factors that need to be in place (Goodman and Darr 1998). First technology such as a KMS is needed to enable knowledge capture for exchange. Second, the individual must recognize that her past problem solving experiences may be able to help other (known and unknown) workers and she must be willing to contribute knowledge for use by them. Third, the individual must recognize that other (known and unknown) workers within the organization may have solutions to her current problem and she must be willing to adopt the existing knowledge provided by them. This research draws on the distributed cognition, knowledge management (KM), and information systems (IS) literatures to adapt a research framework presented by Goodman and Darr (1998) that examines how computer aided systems, which I refer to as knowledge management systems (KMS), enhance organizational learning in a geographically dispersed setting. Specifically this research examines how technology can help an organization leverage its distributed cognition to yield more innovative and efficient problem solving by increasing the likelihood of contributing knowledge to and adopting knowledge from KMS.

The research study addresses the following four research questions.

1. Is innovative and efficient problem solving behavior is more likely when individuals decide to adopt knowledge from KMS?
1. Do the two different decisions of contributing and adopting knowledge influence one another over time?
3. How do the KMS attributes affect decisions to contribute and adopt knowledge when cognition is distributed?
4. How do communication complexities and the degree of support in the work environment moderate the relationship between the KMS attributes and the decisions to contribute and adopt knowledge?

Conceptual Model

The literatures on creativity and research and development suggest that successful innovation requires convergent and divergent activities (Amabile 1996; Dougherty 1992), Guilford 1950; Kazanjian, et al. 2000). While divergent activities are stimulated by knowledge from unfamiliar domains and more closely associated with the need to adopt rather than contribute knowledge, the opposite is true for convergent activities. Thus KMS that allow individuals to access new, unfamiliar knowledge domains will be positively related to the individuals' innovativeness in problem solving to the extent that the individuals are likely to adopt the knowledge from KMS. Research shows productivity gains when knowledge is transferred from one entity to another (Baum and Ingram 1998 as cited in Argote 1999; Epple, et al. 1996 as cited in Argote 1999). Thus KMS that allow individuals to adopt another person's knowledge will be positively related to the individuals' problem solving efficiency to the extent that the individuals are likely to adopt the knowledge from KMS

Hypothesis 1: *Individuals who are more likely to adopt knowledge from KMS will be more innovative and efficient problems solvers.*

While treating the decisions to contribute and adopt knowledge separately enables researchers to highlight different factors at play, it does not consider how the two decisions may influence one another over time. Goodman and Darr (1998) treat the two decisions as one organizational learning process. Although Goodman and Darr (1998) do not explicitly theorize whether the decisions reinforce one another over time, they do offer evidence of the possibility. Goodman and Darr (1998) found that when one searches, but does not find content, the perceived value of the system is negatively affected. In other words, one may be less likely to search again as well as less likely to contribute in the future.

Hypothesis 2: *Individuals' likelihood of contributing knowledge to and adopting knowledge from KMS will be positively related and mutually reinforcing over time.*

Drawing from Boland et al. (1994) there are six IT principles, which are designed to support distributed cognition – ownership, easy travel, indeterminacy, multiplicity, emergence, mixed forms. While these comprehensive design principles are accompanied by technology feature detail to support their implementation, I draw from the distributed cognition, KM and IS literatures (Boland

et al. 1994; Goodman and Darr 1998; Linde 2002; Majchrzak, Neece, Cooper 2001; Markus 2001; Moreland 1999) to develop a more comprehensive although not exhaustive list of KMS attributes that support distributed cognition. Moreover, I hypothesize that KMS attributes that support distributed cognition through the six design principles reduce the costs of contributing and adopting knowledge via the KMS and thus increase the likelihood of contributions to and adoptions from KMS.

Hypothesis 3: *The more KMS attributes used to support distributed cognition the more likely individuals will decide to contribute knowledge to and adopt knowledge from the KMS*

I draw from Te'eni's (2001) notion of communication complexity to provide an overarching theory for several of the moderators in the KM research that influence the decisions to contribute and adopt knowledge. Goodman and Darr (1998) found complex, tacit problem-solutions inhibited decisions to contribute and adopt knowledge due to the difficulties associated with articulating problem attributes or solution alternatives. It is these types of problem-solution characteristics that increase cognitive complexity (Te'eni 2001). Factors from the KM literature such as the use of alternative communication systems (Goodman and Darr 1998) and the recipients' absorptive capacity (Szulanski 1996) contribute to the level of dynamic complexity. Dynamic complexity is a function of time constraints, degree of misunderstanding between the knowledge source and the various knowledge recipients and the level of communication feedback allowed (Te'eni 2001). Factors taken from the KM literature including perceptions of the trustworthiness of the recipients, the credibility of the sources, and the social confidence of the recipients (Andrews and Delahaye 2000) contribute to affective complexity. According to Te'eni (2001) anxiety and lack of trust of those involved in the knowledge exchange reduce the likelihood of the knowledge exchange. Cognitive, dynamic, and affective complexities all serve to increase communication complexity. Moreover, communication complexity in the tasks performed by the individuals will serve as a moderator.

Hypothesis 4a: *Communication complexity in the tasks performed by the individual will weaken the relationship between the KMS attributes that support distributed cognition and the likelihood of contributing knowledge to and adopting knowledge from KMS.*

Two factors that do not fit within Te'eni's (2001) concept of communication complexity are organizational culture and motivation. While Goodman and Darr (1998) do not distinguish between these moderating factors during the decisions to contribute and adopt knowledge, I argue that these factors may have subtle differences that should be considered. For example, the organizational culture and motivation necessary for contributing one's personal knowledge may be different than the organizational culture and motivation necessary for adopting another person's knowledge. Thus both moderating factors will be used in two distinct conceptualizations of the work environment - a supportive knowledge capture work environment and a supportive knowledge reuse work environment.

Hypothesis 4b: *A supportive knowledge capture work environment will strengthen the relationship between the KMS attributes that support distributed cognition and the likelihood of contributing knowledge to KMS.*

Hypothesis 4c: *A supportive knowledge reuse work environment will strengthen the relationship between the KMS attributes that support distributed cognition and the likelihood of adopting knowledge from KMS.*

Research Design

The research will take place at a private, nonprofit organization that provides scientific research, development, and advisory services. The organization is focused on the development of the best space-related hardware at the lowest prudent cost. Most of the organization's work is hands-on engineering associated with the design, test, evaluation, and initial operation of space systems with contractors doing detailed engineering, manufacturing, delivery, and launch.

In a 3 wave survey of 6 divisions of the Engineering and Technology Group, all scientists and engineers (S&Es) in the 6 divisions will be asked to complete a website survey that will take approximately 45 minutes. Data to be collected includes the following:

- Knowledge contributions and adoptions to and from KMS
- KMS attributes used
- Communication complexity of the tasks performed
- Supportive knowledge capture work environment
- Supportive knowledge reuse work environment

After each wave of the website survey, the manager of those S&Es that have completed the survey will be asked to rate S&E innovativeness and efficiency during problem solving.

In addition data will be collected from the content stewards appointed to each division. They will be interviewed to gather data about their responsibilities and background information on the KM initiative in their respective divisions. This will include a demonstration of the KMS and other technologies available for use in the division (including all the features and functions).

Contributions

Upon completion of the research study, the contributions to theory include,

- Provide empirical support that KMS attributes that support distributed cognition can reduce the costs (i.e. time and effort) associated with the knowledge exchange, thereby increase the likelihood of decisions to contribute knowledge to and adopt knowledge from KMS to yield more innovative and efficient problem solvers.

- Several moderating factors found in the KM literature are the source of communication complexity. Communication complexity weakens the relationship between the KMS attributes that support distributed cognition and the likelihood of contributing knowledge to and adopting knowledge from KMS by increasing the associated costs.

- A supportive knowledge capture work environment and a supportive knowledge reuse work environment are conceptually distinct and strengthen the relationship between the KMS attributes that support distributed cognition and the likelihood of contributing knowledge to and adopting knowledge from KMS.

- While only the likelihood of adopting knowledge from KMS leads to more innovative and efficient problem solving, the likelihood of contributing knowledge to and adopting knowledge from KMS are mutually reinforcing over time. Thus it may be prudent for future research to study knowledge sharing and knowledge transfer simultaneously in order to add additional insights into the KM literature.

Upon completion of the research study, the contributions to practice include,

- Provide a categorized list of KMS attributes that support distributed cognition within the organization and increase the likelihood of decisions to contribute and adopt knowledge to and from KMS.

- Provide a categorized list of communication complexities in the tasks performed by S&Es so that the organization will be aware of and able to address them.

- Although only the likelihood of adopting knowledge from KMS leads to more innovative and efficient problem solvers, the decisions to contribute and adopt knowledge are mutually reinforcing over time, therefore the organization may have less issues with free riding if they focus on both decisions simultaneously when formulating their KM strategy.

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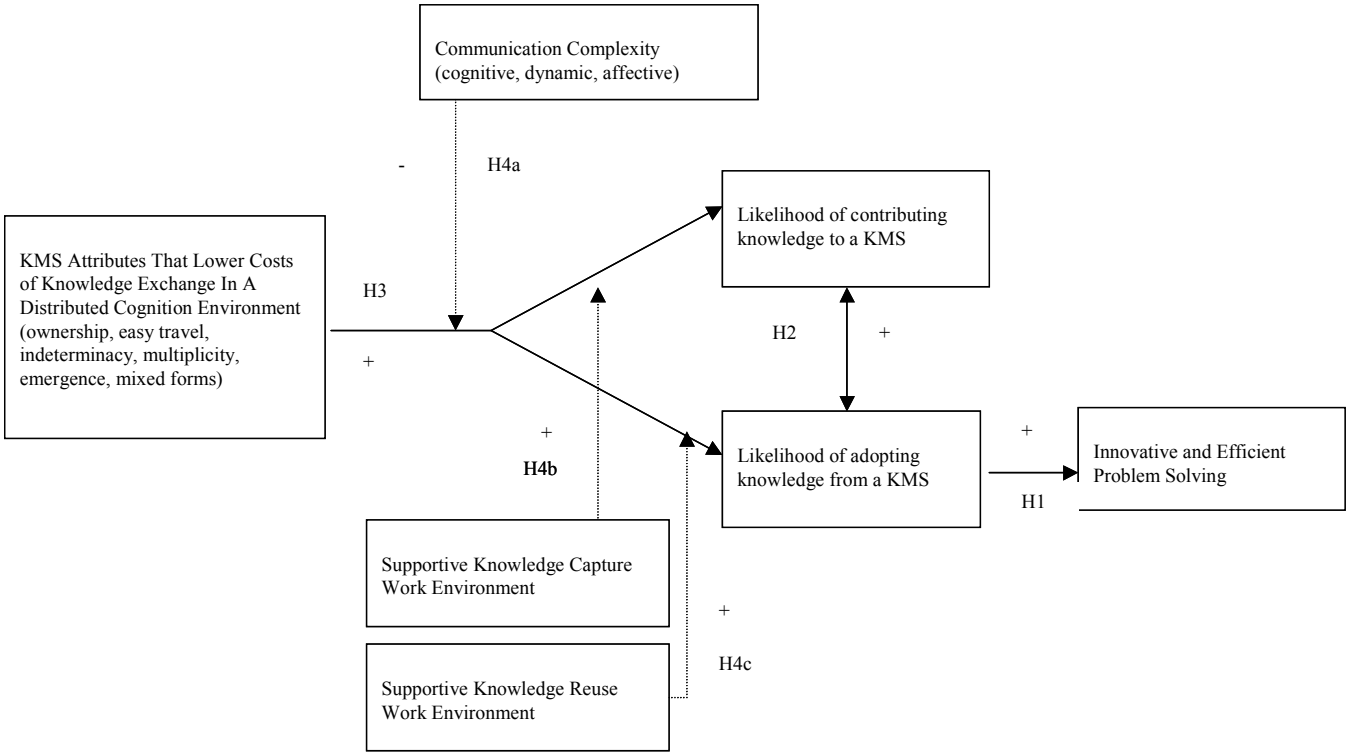

Figure 1. Conceptual Model