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The Effects of Collaborative Technology Appropriation on Group Outcomes

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Abstract

Groups are increasingly utilizing collaborative technologies to facilitate distributed work processes. While these groups are assembled based upon the task knowledge possessed by their members, collaborative technology adoption decisions are often made at an organizational level, where the members' knowledge of the technology is necessarily discounted. However, in this paper we argue that a group's knowledge of collaborative technology will impact the manner in which the technology is appropriated. Further, the manner in which a group uses collaborative technology will impact its ability to unlock the task knowledge embedded in individual group members; a critical factor in determining group outcomes in distributed environments. In short, a group's know-how regarding the collaborative technology can unlock its know-what regarding the task. We argue that focusing on task knowledge while ignoring technological knowledge will prevent organizations from fully leveraging group knowledge in virtual settings.

The Effects of Collaborative Technology Appropriation on Group Outcomes

Introduction

Organizations are increasingly relying on groups, which are often aided by the use of information technology, to complete tasks requiring coordinated action and knowledge sharing (Jehn and Mannix 2001; Sarker and Lee 2002). Accordingly, there is an increasing need for research which seeks to better understand the role of collaborative technologies in impacting group outcomes. Previous theories which have sought to explain this role, such as task-technology fit (Zigurs and Buckland 1998), have typically adopted the perspective of technological determinism, whereby a group's performance is determined, at least in part, by its ability to select the proper technology to apply to the task at hand. In situations where the burden of work is borne more by the technology than by the user, the characteristics of the technology are indeed of prime importance to the success of the project. However, in situations where the burden of work is borne more by the user than by the technology, technical characteristics become less important while the user's knowledge becomes more important. The purpose of the technology shifts from simply helping to execute the task at hand to enabling users to leverage their knowledge of the technology and the task. This is *particularly* true of collaborative technologies. Group outcomes depend not only on the characteristics of the collaborative technology being used, but also upon the knowledge held by group members and the group's ability to use the collaborative technology in such a way as to leverage that knowledge. Therefore, the research question this paper seeks to address is:

> *How do groups use collaborative technologies to leverage group knowledge in achieving outcomes – both task and relational?*

We address this question by augmenting the technological determinism perspective prevalent in the task-technology fit literature with a theoretical framework that accounts for the unique distribution of knowledge within each group. Doing so allows us to better understand how knowledge of both the task and technology impacts the way that collaborative technologies are used.

Literature Review and Theoretical Development

There are a number of theories focused on understanding group processes and outcomes. We are interested in the interplay between knowledge sharing processes and technology/task characteristics in a dynamic group context. As such, the primary literatures evaluated were: Adaptive Structuration Theory (AST) and Task-technology Fit (TTF) (addressing the latter), and the Information Processing Perspective and Representational Gaps (addressing the former).

AST and TTF

Utilizing Orlikowski's (1992) notion of the "duality" of structure, DeSanctis and Poole (1994) posit an interplay between technology and social structures, whereby a given technology impacts the emerging social structures governing its very use, and those same structures impact the attitudes and beliefs of users regarding that technology. Of particular salience to the context of collaborative technology use is their proposition that "the nature of AIT [Advanced Information Technology] appropriations will vary depending on the group's internal system." (DeSanctis and Poole 1994, pg. 131) That is, once a group technology is in place, subsequent group outcomes are dependent on characteristics of the group. These characteristics encompass not only the knowledge possessed by the group members, but also the communication and coordination mechanisms necessary to reap the benefits of that knowledge.

The knowledge possessed by individuals is an important factor shared by another area of research aimed at explaining how technology use can impact outcomes: task-technology fit. Dennis, Wixom, and Vandenberg (2001) previously integrated DeSanctis and Poole's (1994) work with theories of task-technology fit in order to better understand the link between GSS use and performance. Theories of task-technology fit (Goodhue and Thompson 1995; Zigurs and Buckland 1998) posit that the appropriate matching of technology characteristics to task characteristics will lead to improved performance. Goodhue (1995) argued that individual perceptions of task-technology fit (TTF) are impacted by both task characteristics and technology characteristics. However, this conceptualization of task-technology fit does not account for an individual's knowledge of the *task* and of the *technology*. Group members' task knowledge is likely to differ based on either individual characteristics or task characteristics. Furthermore, because individual knowledge of a technology can include *know-what*, *know-how*, and *know-why* (Jasperson et al. 1999; Kim 1993; Nonaka 1994), it is unlikely that most group members have deep knowledge of every technology being considered for use or of the task at hand. If a technology contains a certain feature, of which the member is unaware, then that feature will play no role in determining either his/her perceptions of task-technology fit, or the manner in which he/she appropriates the technology. As such, an individual's appropriation of technology is not so much influenced by the characteristics of the task and technology, but rather by his or her knowledge of those characteristics. Therefore, we argue that there is an interaction between members' knowledge of the task and their knowledge of the collaborative technology, and that this interaction impacts the manner in which the group uses the technology, which in turn impacts group outcomes.

Information Processing Perspective and Representational Gaps

The information processing perspective differs from technological determinism in its approach to group outcomes. Utilizing this perspective, Cronin and Weingart (2007) developed the concept of *representational gaps* as an explanation for why groups sometimes encounter difficulties in capitalizing on the knowledge held by their members. Representational gaps are "inconsistencies between individuals' definitions of the team's problem" (Cronin and Weingart 2007, pg. 761) which can cause a group's information processing to break down and lead to "coordination problems and conflict." (Cronin and Weingart 2007, pg. 764) Because of these representational gaps, different group members may have different perceptions of task-technology fit (and thus, beliefs about the technologies) not only because of variance in knowledge about those technologies, but also because they might view the task differently, and thus envision different solutions to the problem. As such, representational gaps can negatively affect the process by which a group utilizes a collaborative technology to complete a task, which in turn can negatively impact task outcomes and relational outcomes.

Because group members who utilize a collaborative technology in the execution of a task may have different understandings of what needs to be done, the coordination of tasks to be carried out can be impeded by the presence of representational gaps. Further, if representational gaps are present within the group, then communication may be hindered by information distortion (Cronin and Weingart 2007). Even in situations where there is considerable overlap in the knowledge held by group members, representational gaps can negatively impact the relational outcomes of the group. Therefore, we expect that by uncovering those factors which counteract the detrimental effects of representational gaps (and their resulting information distortion), we will gain a better understanding of how collaborative technology can be effectively used by groups to leverage the diverse knowledge held by their members.

Research Model and Hypotheses

The information processing perspective posits that the primary driver of group outcomes will be the knowledge possessed by the group. By layering this argument on top of the contingent structure found in much of the task-technology fit literature, we argue that the *interaction* between a group's task knowledge and its knowledge of the collaborative technology is the primary driver of outcomes for technology-supported groups. Further, we utilize Carte and Chidambaram's (2004) conception of a collaborative technology as a "bundle of capabilities" which can be classified as either additive or reductive. Additive capabilities are those features of the collaborative technology which add elements to normal communication patterns (e.g., an electronic record of all communication), whereas reductive capabilities are features which remove elements of those patterns (e.g., visual anonymity) (Carte and Chidambaram 2004). We apply these notions to our previous arguments, and view a group's knowledge of a collaborative technology as knowledge of additive and reductive CT capabilities.

Our concept of group outcomes consists of both task and relational outcomes, as those are the factors which Cronin and Weingart (2007) argue can be negatively impacted by representational gaps. Additionally, DeSanctis and Poole (1994) posit that a group's beliefs about a technology (a structure governing the use of a technology) will be impacted by its use of the technology, and will likewise affect future use of the technology – a notion echoed by the task-technology fit literature (Goodhue and Thompson 1995). Therefore, satisfaction with the collaborative technology is also included as a group outcome in the research model (shown in Figure 1 below).

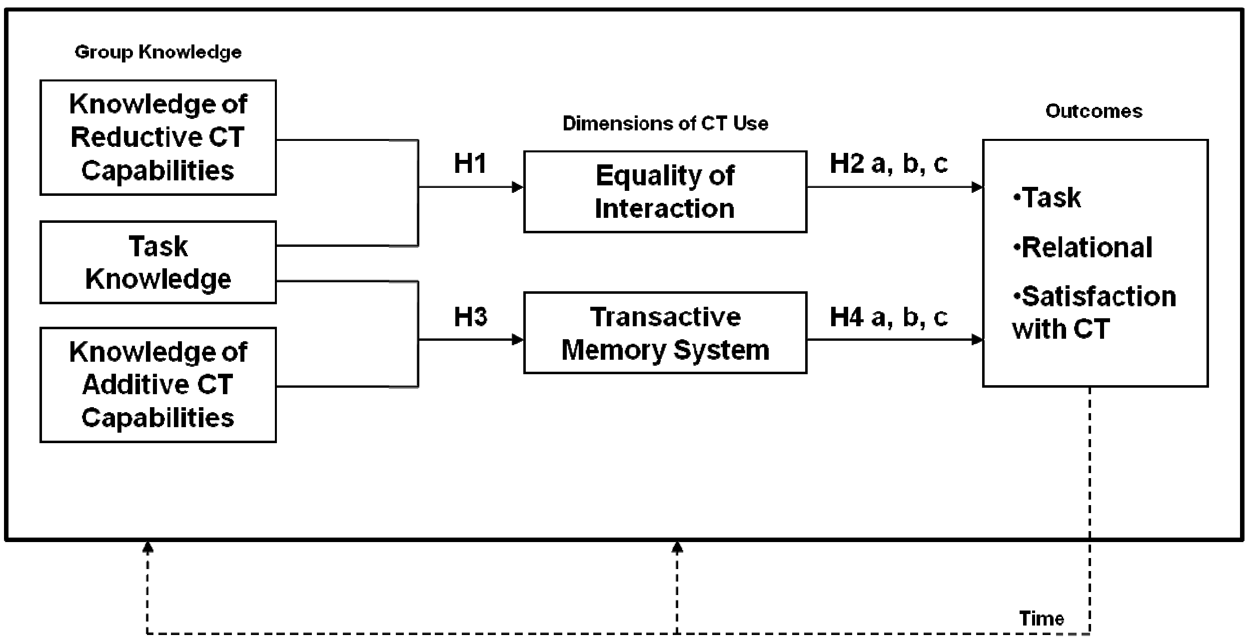

Figure 1: Research Model with Hypotheses

Equality of Interaction

Brodbeck, Kerschreiter, Mojzisch, and Schulz-Hardt (2007) utilized the information processing perspective to argue that groups can make better decisions than individuals only when members hold unique information (i.e., when there is diverse knowledge). If all group members possessed the same information, then the group would hold no advantage over an individual. However, in order for the group to take advantage of uniquely held knowledge within the group, the discussion must not be biased towards any particular member or viewpoint. These biases negatively impact both group decisions and group learning (Brodbeck et al. 2007). A group's ability to leverage the knowledge of its members is thus dependent upon its equality of interaction (i.e., the degree to which each member can express their thoughts and opinions openly during group interactions). Because it is a reflection of the group's internal system, the equality of interaction is reflective of the manner in which the group appropriates the collaborative technology.

Carte and Chidambaram (2004) contend that the reductive capabilities of a collaborative technology can have positive effects on a group's interactions and member participation. Reductive capabilities such as visual anonymity can improve interactions by reducing the "salience of surface-level diversity" and forcing group members to "articulate their ideas in writing" (Carte and Chidambaram 2004: pg. 455). Similarly, a reductive capability such as asynchronous interaction has the effect of slowing down interactions, a phenomenon which "enables members to think about issues before responding" (Carte and Chidambaram 2004: pg. 455). As such, we argue that knowledge of these reductive capabilities should reduce some of the anxiety or apprehension that group members might normally feel when interacting in a face-to-face environment, thus increasing a group's equality of interaction. Therefore, we propose:

H1: The interaction between a group's task knowledge and its knowledge of the CT's reductive capabilities will be positively related to the group's equality of interaction.

Knowledge of reductive CT capabilities enables group members to circumvent several dynamics which can reduce the effectiveness of group discussions. These include a bias towards discussing shared information (Dennis 1996; Hollingshead 1996), domination of discussion by a single member, and the formation of majority/minority factions within the group (Dennis 1996). Each of these situations allows representational gaps to remain hidden, as only a few members are communicating their representations. Further, each of these scenarios either reduces or entirely eliminates the advantage of group decisions over individual decisions. These arguments are congruent with literature on hidden profile tasks (e.g., Dennis 1996) and group polarization (e.g., Dennis et al. 1997-98; El-Shinnawy and Vinze 1998), which argues that a group's failure to account for minority-held viewpoints can result in poor performance.

A group's ability to translate its knowledge into positive task performance is facilitated by appropriating the collaborative technology in such a way as to promote equality of interaction (i.e., the degree to which each member's thoughts and opinions are accounted for during group interactions). As the equality of a group's interaction increases, so does the likelihood of uncovering any representational gaps between members. Only after these gaps have been discovered can group members begin to address them. Because representational gaps can result in coordination problems between members, it is expected that efforts to address those gaps will ultimately improve the group's coordination of effort, and thus task performance. Therefore, we propose:

H2a: The equality of interaction within a group will positively impact the group's task outcomes.

Greater equality of interaction is reflective of group processes that account for the thoughts and opinions of each team member, as opposed to those dominated by only a few members. Such processes are likely to be positively associated with trust and relational well-being (Folger and Konovsky 1989), as well as satisfaction (Korsgaard and Roberson 1995). On the other hand, processes that exclude or ignore certain members might result in a shift from beneficial task-based conflict to relational conflict, which can prove detrimental to the group (Eisenhardt et al. 1997; Jehn and Mannix 2001; Jehn 1997). Therefore, we propose:

H2b: The equality of interaction within a group will positively impact the group's relational outcomes.

As noted earlier, technology impacts the emerging social structures governing its very use, and those same structures impact the attitudes and beliefs of users regarding that technology (DeSanctis and Poole 1994). By applying this notion to a group's use of collaborative technology, we submit that the manner in which a group uses a collaborative technology will impact the group's attitudes and beliefs regarding that technology. Given that a group's equality of interaction is reflective of the manner in which the group has appropriated the collaborative technology, we expect that it will impact the group's satisfaction with the collaborative technology. To sum up, we expect that those groups who use collaborative technology in such a manner as to promote equality of interaction amongst group members will consequently be satisfied with the technology. Therefore, we propose:

H2c: The equality of interaction within a group will positively impact the group's satisfaction with the CT.

Transactive Memory System

A group's transactive memory system is a combination of the individual knowledge possessed by group members and a more generalized knowledge of the location of expertise within the group (i.e., who knows what) (Wegner 1987). Lewis (2003) argued that a group's transactive memory system is comprised of three basic dimensions: specialization, credibility, and coordination. Because each of these dimensions reflects some aspect of the group's internal system, a group's transactive memory system is indicative of the manner in which the group appropriates the collaborative technology.

Specialization refers to the level of uniquely held knowledge within the group. A group's transactive memory system is thus reflective of the knowledge distribution amongst its members. The coordination dimension of the transactive memory system highlights a key point: even if each group member possesses totally specialized knowledge and expertise, it does not benefit task performance if the members cannot effectively coordinate their efforts to account for this expertise. One of the problems which representational gaps can cause is poor task coordination. The coordination dimension of a group's transactive memory system accounts for the group's ability to negate this problem.

Carte and Chidambaram (2004) contend that the additive capabilities of a collaborative technology can have positive effects on a group's coordination and task performance efforts. Additive capabilities such as an electronic trail can aid coordination by providing a record of all group communications which can be referenced later, i.e., an "audit trail [that] helps in the clarification of issues" (Carte and Chidambaram 2004: pg. 455). Similarly, additive capabilities such as coordination support allow group members to "keep track of people, projects, and priorities" (Carte and Chidambaram 2004: pg. 455). As such, we argue that knowledge of these additive capabilities should improve the coordination of effort amongst group members when working on a task, thus promoting the development of the group's transactive memory system. Therefore, we propose:

> *H3: The interaction between a group's task knowledge and its knowledge of the CT's additive capabilities will be positively related to the development of the group's transactive memory system.*

Furthermore, because transactive memory systems bring together both specialization and coordination, a group with a well-developed transactive memory system will be able to coordinate tasks in such a manner as to take advantage of group member knowledge related to either the task or the collaborative technology in question. The ability of the group to identify those members to whom they should defer has been shown to positively influence the group's task performance (Baumann and Bonner 2004; Faraj and Sproull 2000; Libby et al. 1987; Littlepage et al. 1997). These arguments are further supported by studies which have found transactive memory system development to be positively associated with group performance (e.g., Austin 2003; Lewis 2004). Therefore, we propose:

H4a: A group's transactive memory system will positively impact the group's task outcomes.

Another dimension of transactive memory systems is credibility. Credibility in this context refers to the degree to which members feel that they can rely upon the knowledge of other members (Lewis 2003). A group's transactive memory system is thus also reflective of the level of trust between group members. This trust is a factor which can serve to negate potentially negative effects on relational development which might otherwise arise due to either representational gaps or a lack of overlapping knowledge within the group. This argument is bolstered by the fact that researchers have established a link between transactive memory systems and positive internal group evaluations (Austin 2003). The specialization dimension of a group's transactive memory system implies that there will be different representations within the group. However, rather than trying to combine these representations to eliminate any differences in knowledge (and thus forfeiting the benefits of diverse knowledge), transactive memory systems allow groups to take advantage of the diverse knowledge of their members by enabling them to coordinate their efforts accordingly. Therefore, we propose:

H4b: A group's transactive memory system will positively impact the group's relational outcomes.

We previously noted that the manner in which a group uses a collaborative technology will impact the group's attitudes and beliefs regarding the collaborative technology (DeSanctis and Poole 1994). Because we have argued that a group's transactive memory system is reflective of the manner in which the group has appropriated the collaborative technology, we expect that it will impact the group's satisfaction with the collaborative technology. Given the aforementioned benefits associated with transactive memory systems, as well as the hypothesized outcomes, we expect that those groups that use a collaborative technology in such a manner as to promote the development of their transactive memory system will consequently be satisfied with the collaborative technology. Therefore,

H4c: A group's transactive memory system will positively impact the group's satisfaction with the CT.

The Role of Time

Though not explicitly hypothesized, time plays an important role in our research model. Because a group's satisfaction with the collaborative technology can be impacted by its use of the technology as well as impact future use of the technology, we expect that it can change over time. Furthermore, certain elements of transactive memory systems can only be developed over time, through the performance of various tasks. Hence, time is represented in our research model as a feedback loop.

Summary

We have argued that in virtual settings a group's knowledge of collaborative technology, specifically the additive and reductive capabilities, will serve as the key to unlock the group's task knowledge, which will lead to positive outcomes. In other words, while task knowledge is important for successful outcomes, this knowledge cannot be fully leveraged in a virtual setting without knowledge of the capabilities of the technology. Focusing on task knowledge while ignoring technological knowledge will prevent organizations from fully leveraging group knowledge in virtual settings.

We recently completed the data collection for a study which tests the research model using a longitudinal repeated-measures research design. A summary of the measures used in this study is shown in Appendix A. We are currently completing the data analysis and will be ready to discuss the results at DIGIT 2008. If our results support our contention, organizations relying on virtual teams will need to pay particular attention to the collaborative technology expertise of their members.

Appendix A: Construct Measures

Construct	Measure	Source
Task Knowledge	Task Knowledge	*Developed*
Knowledge of CT Capabilities	Additive CT Knowledge	*Developed*
	Reductive CT Knowledge	*Developed*
Dimensions of CT Use	TMS	(Lewis 2003)
	Equality of Interaction	*Developed*
Task Outcomes	Performance	Independent Rating of Deliverables
	Satisfaction with Performance	(Chidambaram 1996)
Relational Outcomes	Conflict	(Jehn and Mannix 2001)
	Cohesion	(Seashore 1954)
Satisfaction with CT	Satisfaction with CT	*Developed*

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