Synchronous and Asynchronous Collaboration Technology Use in Teamwork

Research-in-Progress

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ABSTRACT

As project teams have become dispersed and communication technology has evolved, organizations have increasingly moved towards usage of synchronous communication technologies such as video/web/audio conferencing and instant messaging to facilitate collaboration among team members although usage of asynchronous communication technologies such as electronic mail, wikis, blogs, social networks, and fax continue to play an important role in the exchange of information within teams. Little however is known about the influence of a team member's task characteristics and extent of usage of such contemporary collaboration technologies on the member's task outcomes.

To explore this gap in literature, this paper draws upon media richness theory to understand the impacts of a project team member's task characteristics and extent of usage of contemporary collaboration technologies on the member's task outcomes. This paper also has practical implications that guide the adoption and use of collaboration technologies in organizations.

Keywords

Collaboration technology, technology use, teamwork, media richness, media synchronicity

INTRODUCTION

Statement of the Problem

The usage of information technologies and the outcomes from such usage have for long been of interest to information systems (IS) researchers. A large number of studies have attempted to identify determinants of IS usage such as task characteristics, technology characteristics, individual and group attitudes, or situational characteristics (Davis et al., 1989; Compeau and Higgins, 1995; Goodhue and Thompson, 1995; Taylor and Todd, 1995; Venkatesh et al., 2003; Brown et al., 2010). Likewise, many studies have focused on outcomes for individuals and organizations from IS usage such as knowledge sharing, satisfaction, and productivity (DeLone and McLean, 1992; Sabherwal et al., 2006). However, little empirical research to date has simultaneously examined individual task characteristics and task outcomes in the context of usage of contemporary collaboration information technologies.

Task characteristics and outcomes are critical considerations in the adoption of collaboration technologies by project teams. A recent study by Brown et al. (2010) integrated theories from collaboration as well as technology adoption research to explain the adoption and use of collaboration technologies. The results of that study showed that technology characteristics, individual and group characteristics, task types, and situational conditions influence behavioral intention and use of collaboration technologies. Brown et al. (2010) called for further investigation of the influence of task characteristics on technology use. They recommended incorporating task aspects such as uncertainty or interdependence in order to uncover the relationship between the role of tasks and the use of collaboration technologies.

Brown et al. (2010) further suggested that synchronicity of communication was a significant characteristic that needed to be carefully examined by future research on collaboration technologies. As project teams have become more geographically dispersed, organizations have increasingly adopted synchronous collaboration technologies such as web conferencing and instant messaging to facilitate collaboration among team members (Dennis et al. 2010). However, usage of asynchronous collaboration technologies such as electronic mail, fax, wikis and blogs continue to play an important role in the exchange of information within teams. Despite the widespread usage of collaboration technologies in teamwork, little is known about the influence of an individual team member's task characteristics on task outcomes in the context of differential usage of synchronous versus asynchronous collaboration technologies. The results of this study are intended to bridge the gap between real world practice and research literature on collaboration technologies as recommended by many scholars (Martins et al., 2004; Kirkman and Mathieu, 2005), and furthermore to help organizations ensure that the collaboration technologies deployed within their organizations are appropriate to their team members' tasks as well as benefit the team members.

Background

Both synchronous and asynchronous collaboration technologies are widely used by organizations to enhance their employees' communication and collaboration. Synchronous collaboration technologies (e.g. video/web/audio conferencing, instant messaging, and certain group decision support systems) allow all participants from the same or different locations, time zones, or organizations to collaborate on the same tasks in real time, while asynchronous collaboration technologies (e.g. electronic mail, fax, online forums, wikis, blogs, and social networks) are utilized when participants wish to share information but simultaneous interaction is not necessary. According to media synchronicity theory by Dennis et al. (2008), media synchronicity can also be differentiated by communication processing. Collaboration technologies with high synchronicity, enabling faster message transmission, are associated with reduced cognitive effort to interpret messages, whereas collaboration technologies with low synchronicity allows participants to take more time between message in analyzing the content of messages. It is important to understand that media synchronicity can depend upon the manner in which participants use technologies. It is also important to consider that team members often use an array of collaboration technologies to interact with their cohorts. Therefore this study focuses on all kinds of synchronous and asynchronous collaboration technologies.

Prior work has demonstrated that the fit between tasks and technologies leads to better performance (Goodhue and Thompson, 1995). This study extensively draws upon media richness theory to understand the impacts of a team member's task characteristics and synchronous versus asynchronous collaboration technology usage on the task outcomes.

Research Questions

This study seeks to answer the following two questions:

1) Which characteristics of a project team member's task influence the team member's task outcomes?

2) What is the impact of the differential usage of synchronous versus asynchronous collaboration technologies on the relationship between the team member's task characteristics and task outcomes?

THEORY BACKGROUND AND HYPOTHESES

Media richness theory seeks to answer the question as to why organizations process information. This theory originates from several assumptions. The most basic assumption is that organizations must process information to accomplish tasks, but they have limited capacity. Due to the organizational division of labor, in order to process information in organizations, each department or subgroup must perform its tasks. The tasks must be coordinated with one another. However, employees who receive or send data within organizations may have different interpretations of the same event. Therefore organizational information processing needs to account for the diversity of each individual.

There are four related aspects in media richness theory proposed by Daft and Lengel (1986). These four aspects are uncertainty, equivocality, interdependence, and differentiation. Task uncertainty is defined as the degree to which work to be performed cannot be anticipated or forecast. According to the assumptions in Galbraith's (1974) information processing theory, task uncertainty can cause changes in resource allocations, schedules, and priorities. When a team member deals with fluctuation in information available to perform his or her task, the task is subject to uncertain events, no procedures and practices are established for performing the task, then the member may face difficulties in planning resource allocations, task schedules, and task priorities. Therefore, when a team member's task becomes more uncertain, the member will have difficulty in planning or making decisions about the task. As a result, the member's task knowledge sharing, satisfaction, and productivity will likely be lower. Hence,

Hypothesis 1a: The greater the uncertainty in a team member's task, the lower will be that member's task knowledge sharing.

Hypothesis 1b: The greater the uncertainty in a team member's task, the lower will be that member's task satisfaction.

Hypothesis 1c: The greater the uncertainty in a team member's task, the lower will be that member's task productivity.

According to the information processing theory (Galbraith, 1974), when task uncertainty increases, more information needs to be processed. In such circumstances, either the amount of information to be processed must be reduced or the capacity to handle more information must be increased. An assumption of the theory is that the ability to handle non-routine, consequential events which cannot be anticipated and planned for in advance will limit information processing because of the communication load inherent in non-programmed events.

Daft and Lengel (1986) applied this assumption to media richness theory. They asserted that to alleviate and mitigate task uncertainty, employees should adopt real-time media in their communication to achieve a high level of task confidence. Task uncertainty lacks sufficient information and can be overcome by obtaining and sharing the needed information (Dennis and Kinney, 1998). Task uncertainty is usually measured by the degree of problem routinization (Lamberti and Wallace, 1990). This means that routine problems or low-uncertainty tasks can be dealt with by a rule or standardized procedure, whereas non-routine problems or high-uncertainty tasks usually require individual attention and greater information processing.

In media richness theory, specific structural mechanisms can be implemented by organizations to facilitate the amount of information needed to cope with uncertainty. Communication transactions that clarify ambiguous issues and change understanding in a timely manner are considered rich. Synchronous collaboration tools are information technologies with the capacity to capture and process rich information among users. These media allow immediate feedback, the number of cues utilized, personalization, and language variety, compared to asynchronous tools that process fewer cues and restrict feedback. While asynchronous information technologies are more effective for processing well understood messages and standard data, synchronous technologies can provide the capacity to process complex and subjective messages (Dennis et al., 2008). Hence,

Hypothesis 2a: Greater use of synchronous collaboration technology to work with other team members will moderate the relationship between task uncertainty and task knowledge sharing to a greater positive extent than the use of asynchronous collaboration technology.

Hypothesis 2b: Greater use of synchronous collaboration technology to work with other team members will moderate the relationship between task uncertainty and task satisfaction to a greater positive extent than the use of asynchronous collaboration technology.

Hypothesis 2c: Greater use of synchronous collaboration technology to work with other team members will moderate the relationship between task uncertainty and task productivity to a greater positive extent than the use of asynchronous collaboration technology.

Task equivocality refers to the degree to which work to be performed is vague or confusing. Weick (1979) stated that the basic materials on which organizations operate are informational inputs that are equivocal, thus there are many possibilities or sets of outcomes that might occur. An organization attempts to transform such equivocal information into sensible outputs. According to Daft and Lengel (1986), high equivocality in organizational tasks leads to confusion and lack of understanding of participants. Employees are not certain about what questions to ask or what clear answers to define for the task. Thus, when a team task becomes more equivocal, a team member's perceptions on task knowledge sharing, satisfaction, and productivity are expected to be decreased. Thus,

Hypothesis 3a: The greater the equivocality in a team member's task, the lower will be that member's task knowledge sharing.

Hypothesis 3b: The greater the equivocality in a team member's task, the lower will be that member's task satisfaction.

Hypothesis 3c: The greater the equivocality in a team member's task, the lower will be that member's task productivity.

Typically, efforts to solve equivocality involve two or more people (Weick, 1979). To alleviate and mitigate task equivocality among employees, they should employ real-time media in their communication to achieve a high level of task confidence (Daft and Lengel, 1986). In organizations, equivocality leads to a challenge for employees to reach the same meaning of the information. Task equivocality can be reduced by exchanging existing views among employees to define problems and resolve conflicts through the enactment of a shared interpretation that can reach agreement and direct future activities. Employees gather data that can be combined with discussions and judgments to reduce equivocality.

In media richness theory, specific structural mechanisms can be implemented by organizations to process rich information by enabling debate, clarification, and enactment to reduce equivocality. The influence of task equivocality on task outcomes will be moderated by the usage of synchronous collaboration technologies that allow immediate feedback, a large number of cues, personalization, and language variety such that the team member with high task equivocality will have better perceptions on task knowledge sharing, satisfaction, and productivity. However, the usage of asynchronous collaboration technologies, which are more effective for processing well understood messages and standard data, will not influence the relationship between task equivocality and task outcomes as much as the usage of synchronous collaboration technologies. Hence,

Hypothesis 4a: Greater use of synchronous collaboration technology to work with other team members will moderate the relationship between task equivocality and task knowledge sharing to a greater positive extent than the use of asynchronous collaboration technology.

Hypothesis 4b: Greater use of synchronous collaboration technology to work with other team members will moderate the relationship between task equivocality and task satisfaction to a greater positive extent than the use of asynchronous collaboration technology.

Hypothesis 4c: Greater use of synchronous collaboration technology to work with other team members will moderate the relationship between task equivocality and task productivity to a greater positive extent than the use of asynchronous collaboration technology.

According to Thompson (1967), the three types of interdependence: pooled, sequential, and reciprocal, contain increasingly degrees of contingency, resulting in increasing difficulty in coordination. With pooled interdependence, action in each unit can proceed without regard to action in other units so long as the overall organization remains viable. With sequential interdependence, however, each unit in the set must be readjusted if any one of them acts improperly or fails to meet expectations. With reciprocal interdependence, the actions of each unit in the set must be adjusted to the actions of one or more others in the whole set.

The theory of task interdependence in organizational structure by Thompson (1967) can be applied to team task interdependence. Task interdependence in this study refers to the degree to which work to be performed depends on each team member to accomplish it. An action by a team member may force adaptation by others. As task interdependence embedded in a team becomes more complex, team can face significant challenges for task success, compared to a team with pooled or independent interdependence. The team member's task outcomes are contingent upon the level of task interdependence in the way that the more complex task interdependence will relate to the lower level of team member's perceptions on task knowledge sharing, satisfaction, and productivity. Thus,

Hypothesis 5a: The greater the interdependence in a team member's task, the lower will be that member's task knowledge sharing.

Hypothesis 5b: The greater the interdependence in a team member's task, the lower will be that member's task satisfaction.

Hypothesis 5c: The greater the interdependence in a team member's task, the lower will be that member's task productivity.

Daft and Lengel (1986) incorporated the assumption of task interdependence by Thompson (1967) into the media richness theory. They stated that interdependence increases uncertainty and hence more information must be processed and frequent interactions are needed to accomplish tasks. Consequently, as task interdependence increases, more elaborate collaboration mechanisms are required to connect employees to achieve their tasks. Synchronous collaboration technologies can be mechanisms to coordinate the efforts of individuals working on high interdependent tasks and to yield positive outcomes, whereas asynchronous collaboration technologies that are effective in collaboration of low interdependence tasks should not significantly affect such relationship. Hence,

Hypothesis 6a: Greater use of synchronous collaboration technology to work with other team members will moderate the relationships between task interdependence and task knowledge sharing to a greater positive extent than the use of asynchronous collaboration technology.

Hypothesis 6b: Greater use of synchronous collaboration technology to work with other team members will moderate the relationships between task interdependence and task satisfaction to a greater positive extent than the use of asynchronous collaboration technology.

Hypothesis 6c: Greater use of synchronous collaboration technology to work with other team members will moderate the relationships between task interdependence and task productivity to a greater positive extent than the use of asynchronous collaboration technology.

Lastly, Daft and Lengel (1986) adopted the assumptions related to task differentiation from Galbraith (1974) who defined another framework of the mechanistic model in the organizational information processing theory. It is assumed that an organization is large and employs a number of specialist groups and resources in providing an output. After a task has been divided into subtasks, the problem is to integrate the subtasks into a global task. This is the problem of organizational design. The behaviors that occur in one subtask are effective or ineffective depending upon the behaviors of the other subtask performers. There will be a design problem if the executors of the behaviors cannot communicate with all the roles with whom they are interdependent.

Daft and Lengel (1986) incorporated task differentiation in media richness theory. They stated that normally an organizational activity is subdivided into a group of tasks that is broken down and assigned to many positions within the organization. Because each employee or department develops his or its own specialization, experience, values, priorities, time horizon, goals, and jargon (Lawrence & Lorsch, 1967; Shrivastava & Mitroff, 1984), a task is usually assigned to an employee or department based on these factors. This phenomenon can be called task differentiation. Task differentiation refers to the degree to which work to be performed is divided into smaller segments on some reasonable basis (Walton, 1980). Such differentiation influences equivocality, especially in the task that is divided into smaller subtasks and such subtasks require several team members to provide an output. Interpersonal communications thus can be complex, ambiguous, and difficult to interpret.

When a team member has a large number of tasks to perform or his or her task constitutes a small part of the overall work process, causing equivocality about the task due to complex communication with the rest of the team members, the member's knowledge sharing may not be easy. To discuss the problems and to get solutions related to the task with several other team members will become very difficult when a team member's task is highly differentiated. The team member may also feel difficult in seeking help related to the task from many other team members and finally not satisfied with the task. Whenever a task relatively depends on the performance of other members in the team, the member may feel that he or she is not be able to work efficiently on the task if other members cannot perform their jobs well. If these problems persist, each day the member may not be able to complete a large number of things related to the task. In the end, the member may perceive that the task is not productive. Hence,

Hypothesis 7a: The greater the differentiation in a team member's task, the lower will be that member's task knowledge sharing.

Hypothesis 7b: The greater the differentiation in a team member's task, the lower will be that member's task satisfaction.

Hypothesis 7c: The greater the differentiation in a team member's task, the lower will be that member's task productivity.

In media richness theory, Daft and Lengel (1986) proposed that rich media resolve tasks requiring large differentiation. Organizations use structural mechanisms that permit coordinated action across large numbers of differentiated roles on a task. The structural mechanisms developed by organizations should enable participants to confront and resolve disagreement and misunderstanding that can arise. The collaboration technologies used should allow the project team members to process their highly differentiated tasks and enable mutual adjustments. Meanwhile, they coordinate on tasks with low differentiation through standardized rules and operating procedures (Galbraith, 1974).

In the situation that a face-to-face meeting is not an option, with using a synchronous collaboration technology which provides immediate feedback, the number of cues utilized, personalization, and language variety, the team member could release equivocality from task differentiation. With the abilities to provide high levels of information exchange, the synchronous tools instantly facilitate the precise information needed to eliminate confusion and lack of understanding of participants. The ambiguous issues can be clarified and understanding can be changed in a timely manner. The member's satisfaction with the task will be increased. The team member may also be able to complete a large number of things related to the task by using a synchronous collaboration tool. The member can work more efficiently on the task and finally feel that the task is productive.

By using an asynchronous collaboration technology that is more effective for processing well understood messages and standard data than complex and subjective messages in the communication, a team member may not be able to easily eliminate confusion and lack of understanding of the task occurred from task differentiation. The ambiguous issues may not be easily clarified and understanding may not be changed in a timely manner. The member's satisfaction with the task may not be significantly improved. A team member may not be able to complete a significantly large number of things related to the task within a timely manner due to the limitation of the technology in instantly exchanging opinions among employees to perform tasks. The member may not work efficiently on the task and finally perceive that the task is not significantly productive. Thus,

Hypothesis 8a: Greater use of synchronous collaboration technology to work with other team members will moderate the relationships between task differentiation and task knowledge sharing to a greater positive extent than the use of asynchronous collaboration technology.

Hypothesis 8b: Greater use of synchronous collaboration technology to work with other team members will moderate the relationships between task differentiation and task satisfaction to a greater positive extent than the use of asynchronous collaboration technology.

Hypothesis 8c: Greater use of synchronous collaboration technology to work with other team members will moderate the relationships between task differentiation and task productivity to a greater positive extent than the use of asynchronous collaboration technology.

The research model (Figure 1) depicts the relationships between task characteristics, synchronous and asynchronous collaboration technology use, and task outcomes.

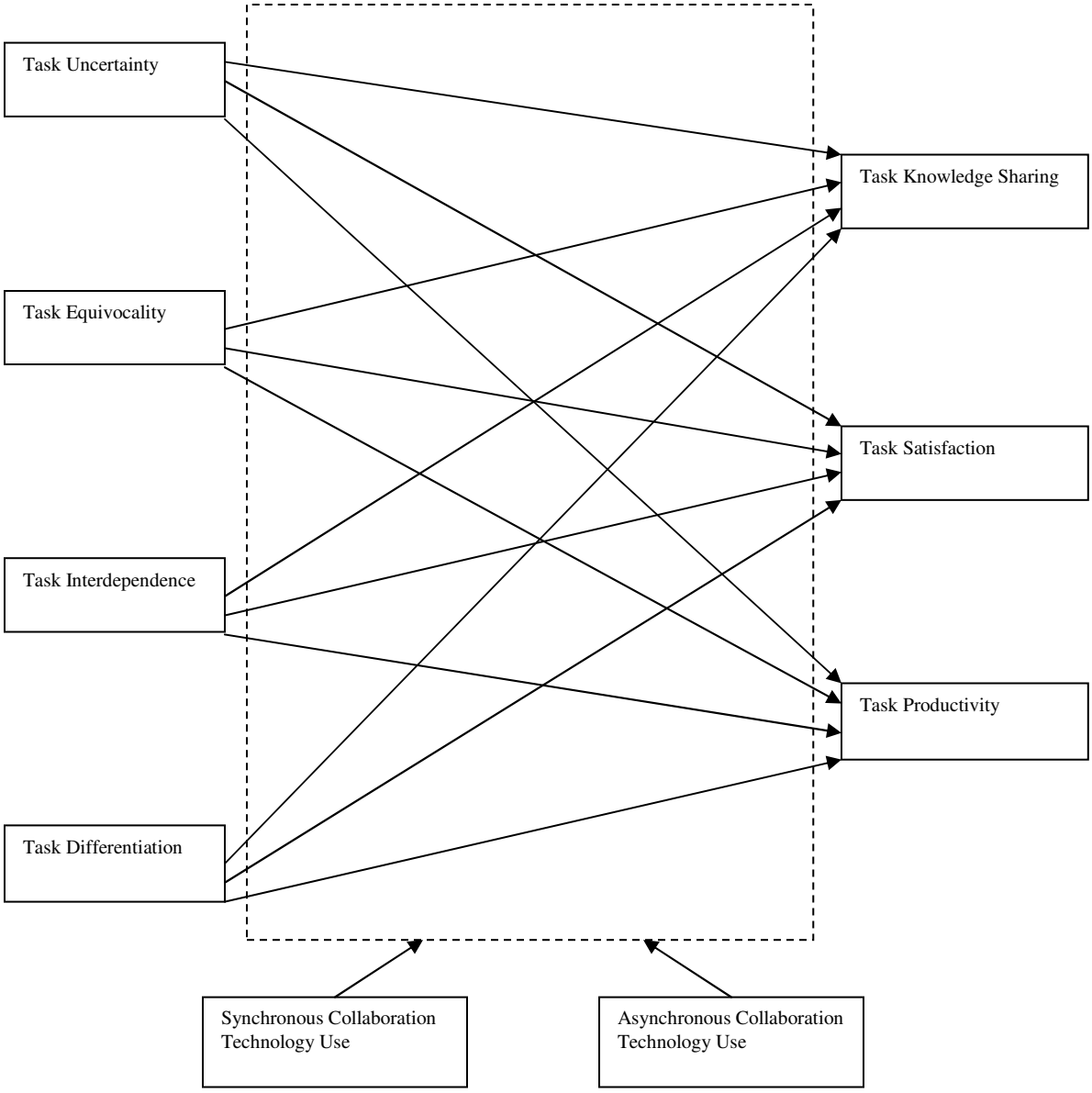

Figure 1: Research Model

METHODOLOGY

Research Design

In order to answer the research questions pertaining to task characteristics, synchronous and asynchronous collaboration technology usage, and task outcomes, a cross-sectional research design is clearly a strong candidate. This study uses a quantitative empirical approach to seek precise measurement and analysis of target concepts in order to explain what, rather than how or why, a phenomenon happens. The study therefore utilizes a survey questionnaire to collect perceptual data from employees on their team tasks, collaboration technology usage, and task outcomes to empirically examine the relationships of the constructs in the research model. This enables the research to accomplish the purpose of the study in observing a population of samples and basing the overall findings from the sample group, assuming it to be representative of the whole population. All measures of the constructs in this study are operationalized based on prior research to the greatest extent possible in order to enhance validity.

Data Collection

This study intends to understand the behavior of the individual team members on their project team task, collaboration technology use for the task, and task outcomes. Thus, the unit of analysis in this study is the individual. Even though the study focuses on a macro level to span multiple technologies and types of users in organizations, the targeted team member must employ at least one synchronous and one asynchronous collaboration technology in their communication with the team members. The scope of the collaboration technologies will be defined by providing respondents a definition of software to ensure their common understanding of the types of software that typically fall under the domain of synchronous and asynchronous collaboration technology. In addition, the selected team project must have a majority of electronic interaction to exclusively virtuality in order to avoid bias from face-to-face interaction. Data will be collected directly from project team members. Each participating team member will surveyed during an ongoing project or after the completion of a recent project.

Sample

As a large sample is needed to test the research hypotheses and have generalizable results, the sampling frame will be at least 100 individuals. The sample will be acquired from the organizations in a Midwestern U.S. city. The high-level executives of these organizations will be contacted by an introductory letter describing the study, explaining benefits and risks involved, and eliciting the participation so that they will urge their project team members to participate in the survey. These project team members will be asked to sign a consent form, understand the survey questionnaire instructions, and fill out the survey questionnaire. They should self-reportedly have intimate knowledge of their task in an ongoing or recently completed project that used at least one synchronous and one asynchronous collaboration technology as main communication tools among team members who work in different physical spaces or at different time zones. Therefore, the sample frame used in this study will be appropriate to the proposed research questions and meet the objectives of the study.

Model Measurement and Hypotheses Testing

A pilot will be conducted for a preliminary trial of all instrument aspects to ensure that there are no unanticipated difficulties at the time of data collection. Reliability, content validity, and construct validity will be assessed to validate the measure and test hypotheses in the research framework. A partial least squares (PLS) approach to structural equation modeling (SEM) using PLS-Graph is preferred to LISREL in this study since the interest in the study is to assess the predictive validity of constructs, making a focus on the paths rather than the model appropriateness (Compeau et al., 1999; Gefen et al., 2000). Harman's one-factor statistical test will be used to assess whether common-methods bias is a serious issue in the study.

CONCLUSION

By exploring the interactions of task with technology to discover how different technology capabilities match different task characteristics, this study may help organizations better support their project teams and improve task outcomes using collaboration technologies. Practitioners can utilize this study to understand the role played by task characteristics and collaboration technology usage as well as the benefits accruing to team members from such usage. This understanding may lead to improved adoption and utilization of collaboration technologies in organizations. The project team members will not only know how, but also why or when to use the tools at their disposal.

Moreover, this study will extend prior research that has focused primarily on traditional collaboration technologies (e.g. electronic mail, fax, newsgroups, discussion boards, and early group decision support systems). The study will add a new dimension to prior research comparing virtual with traditional face-to-face teams by examining the influence of synchronicity of collaboration tools (Martins et al., 2004; Kirkman and Mathieu, 2005). In addition, the current study will extend media richness theory to the usage of IS in a project team. The study also includes multiple constructs of task outcomes rather than a single construct as is common in prior literature (Goodhue and Thompson, 1995; Koo et al., 2011). Finally, this study will move away from commonly utilized laboratory settings in prior research that typically examine student teams working on short-term tasks, to a field setting with more generalizable results.

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