Association for Information Systems

AIS Electronic Library (AISeL)

DIGIT 2006 Proceedings

Diffusion Interest Group In Information Technology

2006

Technology Adoption by Groups: A Test of Twin Predictions based on Social Structure and Technological Characteristics

Saonee Sarker

Washington State University, ssarker@wsu.edu

Technology Adoption by Groups: A Test of Twin Predictions based on Social Structure and Technological Characteristics
DIGIT 2006

Saonee Sarker
Department of Information Systems
Washington State University
Todd Hall 440D
Pullman, WA 99164
Ph: (509) 335-1183 Email: ssarker@wsu.edu

Abstract

While the study of technology adoption by individuals and organizations has received considerable attention from researchers in the information systems discipline, little is known about how groups (an important social entity within organizations) adopt technologies. Drawing on past research in groups and technology adoption, this study proposes an "additive model" of technology adoption by groups, surrounding the "twin predictions" of the key social and technological factors. Specifically, the study examines the effect of the group's social structure (e.g., influence of the majority and the high-status member), and the features of the technology (e.g., the technology's complexity, transferability, and group supportability), on the group's adoption of the technology. Further, the model also outlines the effect of the group's adoption of the technology on the group's performance. A laboratory experiment, where groups were given the choice of selecting one of two different technologies for performing a flowcharting task was conducted to test the model. Even though the empirical examination highlights the dominant effect of the technology characteristics, the study illustrates that this dominance is not an indication of the support of the "technological imperative" perspective, but is actually a testimony to the fact that "technology characteristics" is in fact a sociotechnical construct.

1. Introduction

Technology adoption has been a key area of investigation within the information systems (IS) discipline since the formulation of the technology acceptance model by Davis, Bagozzi, and Warshaw (1989). As our dependencies on technology continues to grow, it may be safe to predict that issues-related to the adoption of technologies will also continue to be the focus of researchers and practitioners. While the existing research on technology adoption have informed us significantly on this critical topic, a review of this literature reveals that there has been a tendency to focus on the adoption of technologies by *individuals* or by *organizations* (see Venkatesh, Morris, Davis, and Davis 2003; Fichman 2000), leaving a void in our understanding of adoption by *groups*. We believe that a separate focus on technology adoption by groups is critical due to the following two reasons: 1) “the complexity of problems in organizations and society demands collaborative efforts,” thereby, leading to an “increased reliance on groups,” most notably, “in organizations” (Scott 1999; p. 432); and 2) while “individuals bring their ‘selves’ to groups,” these social aggregates (or groups) have their own identities (Poole 1999, p. 39), therefore, making it inappropriate to understand their behavior by aggregating individual-level behavior/preferences (Guzzo, Yost, Campbell, and Shea 1993). Thus, the existing research on technology adoption (which focuses on individuals or organizations), cannot directly provide us with an understanding of the factors affecting (or leading to) technology adoption by groups. Unfortunately, without the exception of a recent attempt (albeit, theoretical) about technology adoption by groups (Sarker, Valacich, and Sarker 2005), there are no known studies examining the critical factors affecting this important group-level phenomenon. The current study attempts to fill that void.

Our review of the general technology adoption literature also reveals that there is a bias toward providing normative explanations on adoption (mostly through the use of social factors surrounding the adoption context). Prior research on groups (e.g., Scott 1999) has suggested that the features of the technology surrounding a group have a significant effect on the group’s behavior (Scott 1999). Thus, in our study, we focus primarily on the role played by the various characteristics of the technology on the adoption phenomenon. In addition, we also focus on the key social factors influencing a group’s adoption decision, and the effect of the adoption of that technology on the group's performance (a relationship that has not been investigated in prior research on groups or on technology adoption in general, except for the study by Lucas and Spitler (1999)). Our specific research question is as follows:

RQ: What are the key technology characteristics and social factors affecting a group's technology adoption decision?

Next, we discuss the theoretical model and present the hypotheses.

2. Theoretical Model

Given the lack of an appropriate theoretical framework surrounding technology adoption by groups, in developing our model, we draw on existing research on groups (e.g., McGrath 1984; Fisher and Ellis 1990; Gouran 1999; Poole 1999; Scott 1999), technology characteristics, and the recent theoretical model surrounding this phenomenon (Sarker et al. 2005). We develop an *additive model*, where the group's adoption of the technology is at the center of the model, and is predicted to be affected by the "independent effects" (Mehra, Kilduff, and Brass 2001, p. 127) of the key *social* factors and the *characteristics of the technology(s)* being considered by the group. While a large number of social factors could be studied, in identifying our variables, we relied on the guidance of prior group research (e.g., Poole, Keyton, and Frey 1999), who argue that when analyzing the group as a collective unit (such as in this study), researchers should *avoid* focusing on the effect of "the members' characteristics" (e.g., beliefs and personalities), and instead, pay attention to the interactional and influence processes within the group. One of the primary influence mechanisms within a group is the group's social structure (e.g., Fisher and Ellis 1990; Poole 1999). Social structure refers to the presence of high status members within the group, and the emergence of the subgroups within groups (e.g., the majority). Thus, in our model, in addition to the technology characteristics, we also examine the social influence of both the high status member and the majority on the group's adoption of the technology.

Below, we discuss the specific hypotheses pertaining to the role of each of the variables.

2.1. The Effect of the Social Factors

2.1.1. Majority Influence. Past research on groups has consistently argued that the majority have a significant influence within a group (Meyers and Brashers 1999). This influence causes the other group members to conform (or often even be pressured to conform) to the preferences of the majority (Meyers and Brashers 1999). Similarly, McPhee, Poole, and Seibold (1982) also suggest that the influence of the largest coalition within the group (i.e., the majority) explains the group's choice of an option (from a set of options). McPhee et al. (1982) emphatically state that if the majority within the group expresses "clear favor for an option, it tends to be adopted." Based on this, we argue the following:

> *H1: Majority's preference towards a technology will have a positive effect on the group's adoption of that technology.*

2.1.2. High-Status Member Influence. Fisher and Ellis (1990, p. 223-224) argue that in every group, some members have a higher status due to their possession of different types of power, and hence, have the "ability to influence other group members." Drawing on French and Raven's (1959) conceptualization of power, Fisher and Ellis (1990) argue that within small groups, typically two types of power have a significant influence: 1) *structural* power (where a group member owing to his/her structural position has certain power), and 2) *personal* power (i.e., person has power due to his/her possession of certain qualities such as expertise). We believe that in ad-hoc egalitarian groups, structural power may have limited influence (Cassell et al. 2006); thus, in our model, we focus on the influence of individuals possessing *personal power*. Bass (1990, p. 178) argues that "groups are likely to be persuaded by the perceived expert, to accept both publicly and privately the expert's opinion." We believe that such an influence is also likely to ensue during a group's technology adoption process, where the opinion of the group member, who possesses expertise in the area of the technologies being considered, or in the task to be accomplished by the group using the technology, affects the group's adoption of the technology. This leads to the following:

> *H2: The opinion of high-status individuals within the group (such as those possessing personal power regarding a particular technology) will positively affect the group's adoption of that technology.*

2.2. The Effect of the Technology Factors

Over the last several years, researchers have continuously attempted to unearth conceptual properties of technology that tend to influence adoption decisions made by individuals and organizations, and have provided us with a rich set of characteristics that were found to be critical (e.g., Kurnia and Johnston 2000; Rogers 1995; Leonard-Barton 1988; Aiman-Smith and Green 2002, Chau and Tam 1997). We draw on this body of literature in examining the specific technology characteristics affecting a *group's* adoption of technology. Further, we also draw on prior research in groups and group support systems to identify certain additional dimensions of the technology that we believe will be critical when a group (as opposed to individuals or organizations) is making an adoption decision.

The current literature on technology characteristics alerts us to three different dimensions of the technology that play a role during technology adoption decisions, irrespective of the level of the adopting unit (i.e., either individuals, groups, or organizations). They are: *Complexity*, *Transferability, and Utility*. We discuss each one of the characteristics and their specific role below:

Complexity of the technology has been viewed as one of the most important characteristics of the technology (e.g., Leonard-Barton 1988; Rogers 1995; Taylor and Todd 1995; Aiman-Smith and Green 2002). Drawing on Sarker et al. (2005), we define complexity of a technology as the *degree of difficulty (as perceived collectively by the group members) in using the technology and adapting to it.* Leonard-Barton (1988) suggested that complexity arises from the number and extent of the work-process elements that need to be altered as part of the technology adoption process, while Aiman-Smith and Green (2002, p. 423) view complexity as arising from the "number, novelty, and technological sophistication of new features and concepts in a new technology." Theoretical perspectives such as the TAM and DTPB have represented complexity using the construct of "ease of use" (Venkatesh and Davis 2000; Taylor and Todd 1995) arguing that technologies that are not easy to use have a low adoption rate. Irrespective of the form of complexity, researchers agree that it will negatively affect the adoption of the technology.

On the other hand, *transferability* can increase a technology's potential for adoption (Leonard-Barton 1988). Drawing on prior research, we define transferability as *the degree of readiness (as perceived by the group) with which a technology may be routinely used by the group-members*. Readiness of a technology may be enhanced by the degree of communicability of (or codified knowledge about) the technology, in the form of documentation and exemplars for use (e.g., Leonard Barton 1988). Similarly, the presence of supportive infrastructure including in-house/external consultants and compatible hardware/software available to the group can also contribute to the transferability of a technology (Armstrong and Sambamurthy 1999). A high transferability of a technology will tend to make the adoption process less cumbersome, and thus, increase its likelihood of adoption (Leonard-Barton 1988).

Drawing on prior research, *utility* of a technology is defined as the *relative advantage of adopting it (as perceived by the group*) (e.g., Rogers 1995; Taylor and Todd 1995). Similar to the complexity, utility of a technology may be judged in a number of different ways. Some argue for assessing the *functional benefit* (relative to costs) of a technology to assess its utility. Proponents of this approach have studied functional benefits by examining strategic and efficiency-oriented implications (e.g., Chau and Tam 1997) and the "perceived usefulness" of the technology (Venkatesh and Davis 2000). In addition to functional benefits/costs, symbolic benefits of a technology may also contribute towards its utility. For example, according to Davenport (1993), adoption of advanced technological tools may be seriously hindered, if the adopting unit perceives that the technology sends a (negative) message regarding the unit's seriousness and competence, and consequently tends to undermine the importance of the unit's functions. Based on this, it may be argued that technologies that tend to have high utility (i.e., high functional and symbolic benefit and low functional cost) will tend to be adopted by the group.

In addition to the characteristics elaborated above, our review of past literature on groups and technologies, reveal yet another dimension of the technology which we believe will play a role, especially when the adopting unit is the group. Drawing on Sarker et al. (2005), we refer to this characteristic as *group supportability*, and define it as the *extent to which a technology is perceived by the group to support its internal processes, including its task performance*. Group supportability may be assessed based on the capability of the technology to enable 1) parallelism, 2) transparency, and 3) sociality within the group context. While most tasks undertaken by groups have some degree of inter-dependence, often, small segments of the task are assigned to (and completed) independently by one or more group members, and then results from these independent task accomplishments are pooled together or integrated (e.g., McGrath 1984). This form of task accomplishment suggests that technologies adopted by groups often need to have the features to enable the group members to perform tasks in parallel within a shared framework (Nunamaker, Dennis, Valacich, Vogel, and George 1991). At times when it may not be prudent (or feasible) to segregate the group task into sub-tasks, the capability to support viewing and modification of other group-members' outputs, (if necessary in real time), can become an important feature of the technology. This characteristic may be termed as the *transparency* of the technology, and refers to the perceived ability of a technology to make individual group members' work easily visible and modifiable by other group members (e.g., Mark et al. 2003). In addition to the parallelism and transparency, the ability of a technology to enable a group to "socialize and develop relationships" and thereby establish a "strong knowledge network" (e.g., Dennis and Reinicke 2004) may also contribute positively towards the group supportability. This characteristic is referred to as the *sociality* of the technology.

Overall, we argue that:

H3: Dimensions of the technology will significantly affect the group's adoption of that technology (i.e., complexity will have a negative effect, while transparency, utility, and group supportability will have a positive effect).

2.3. Effect of Technology Adoption on Group Outcome

Prior group research argues that no study involving groups can be considered complete without an examination of the group performance. Thus, in this study we also examine the effect of the group's adoption of a technology on its performance. In examining this effect, we draw on two competing streams of research, which we discuss below.

Proponents of the resource utilization theory (Zigurs, DeSanctis, and Billingsley 1991) argue that technology is a resource, and more of it can have significant positive effects on the group. Specifically, it has been argued that the use (or adoption) of a technology (in performing a task) adds a level of structure to the task, provides a standardized representation of the problem, and thus, results in higher quality solutions or better decision-making performance (e.g., Sambamurthy and Chin 1994; Nunamaker et al. 1991). Further, researchers in the area of technology adoption have also argued that adoption of a technology can result in improved outcomes (Lucas and Spitler 1999). Thus, we argue:

H4a: Adoption of a technology by a group will have a positive effect on the group performance.

While the resource utilization theory suggests a direct effect of technology adoption on group performance, more recent research in the area of advanced information technologies (AITs) suggests that the effect of the technology on the outcome quality depends on how the technologies are appropriated or "called into use" (Salisbury, Chin, Gopal, and Newsted 2002, p. 92; DeSanctis and Poole 1994). Specifically, researchers argue that "faithful appropriation" of the technology (which refers to the extent to which the use of the technology is consistent with the "spirit and structural feature design" of the technology) has significant positive effects on the group's performance (DeSanctis and Poole 1994, p. 130). Drawing on this research, it may be argued that the group's adoption of a technology will have a positive effect on the group performance if (and only if) the adoption of the technology is consistent with the features of the technology (i.e., the technology has been faithfully appropriate by the group). In other words, a mediating effect of faithful appropriation is predicted.

H4b: The effect of a group's adoption of technology on the group performance will be mediated by the extent to which the technology is faithfully appropriated by the group.

4. Research Methodology

An experimental methodology was used to test the "additive model of technology adoption" discussed above. Our choice of methodology was dictated by the need for an adequate sample size, which is often difficult to acquire in an organizational setting, especially when a group-level of analysis is used (Sambamurthy and Chin 1994).

4.1 Sample

The specific sample consisted of students enrolled in the basic required undergraduate MIS course for all business students at a major US university. Overall, 321 students participated in the experimental sessions and were randomly assigned to three-person groups, leading to a useable sample size of 85 groups (groups with only two members or those who left large portions of the questionnaires unanswered were removed). McGrath (1984, p. 47) terms such ad-hoc laboratory groups as quasi groups. While acknowledging that these types of groups are the "least natural" among the other types of groups (natural and concocted groups), he points out that prior research has derived important insights regarding group interaction using such groups, thereby establishing their usefulness.

4.2. Task and Technology Use

The experimental task involved the creation of a flowchart for an information system application, making it relevant for IS researchers. The flowcharting technique is often used by systems analysts, and has "proven to be invaluable" not only in saving time and money, but also in helping organizations gain in "competitive advantage through eliminating rework, recycle, barriers, bottlenecks and complexity and by simplifying work processes and clarifying organizational responsibility" (Janzen 1991). The selected task can be categorized as a Type 3 (intellective) task under McGrath's (1984) Task Circumplex Model. An intellective task is a task, which usually has a "demonstrable right answer, and the group task is to invent/select/compute that correct answer" (McGrath 1984, p. 63). The intellective task type was chosen for this study, since it enabled the assessment of the quality of the groups' solutions (a key dependent variable in our model). The task was developed from different flowcharting and activity diagram examples found in both the practitioner and academic literature (e.g., Galloway 1994). As the narrative of the task was developed, it was reviewed by several peers, and graduate students, thereby confirming its face validity (Straub 1989). Finally, it was tested in a pilot study, prior to its use.

In order to create a voluntary environment, groups were given the option of collectively selecting and using ("adopting") one of the two following technologies for creating the flowcharts: the drawing tool of Microsoft (MS) Word, or MS Visio. We would like to note that an environment where subjects have been provided the "discretion" of using one of two systems has been considered to be a voluntary setting in prior technology adoption research (e.g., Venkatesh and Davis 2000, p. 193).

Further, groups were also assigned to one of the two following communication environments: 1) computer-mediated (using MS NetMeeting), and 2) face-to-face.

4.3. Measures

A key issue in any group research is the selection of an appropriate level of measurement of its primary constructs. A common practice amongst group researchers has been to collect individual-level data on a particular construct and then aggregate it across groups to reflect a group-level measure (Zigurs 1993). In recent times, this practice has been severely criticized with researchers arguing that such a method fails to capture the complex group processes that ensue during a group activity, and thus, remain a reflection of the average individual-level behavior within a group (as opposed to reflecting the group as a whole) (Guzzo et al. 1993). An alternate method, termed as the "discussion procedure" has been proposed for measuring group constructs (where feasible). As per this procedure, each group is presented with an instrument scale and asked to discuss and provide a single response to each of the items (Guzzo et al. 1993). In this study, we adopted the discussion procedure in measuring the group's adoption of the technology, faithfulness of appropriation, and the perceptions about the technology characteristics. Other constructs where group-level measurement was not meaningful (e.g., perceptions about the influence of the expert and majority opinion), were measured at the individual level and aggregated (per group).

Given that this study is among the first to empirically test a model of technology adoption by groups, there are no known scales for measuring the characteristics of the technology as perceived by a group. Thus, we drew on existing scales for measuring the general characteristics of the technology (e.g., Rogers 1995; Moore and Benbasat 1991). For group supportability, which is a new construct, we consulted prior literature (e.g., Sarker et al. 2005) and tested it using six new items (see Table 1 for the specific items).

Adoption of a technology has been measured in prior literature in a variety of ways, such as: 1) intention to use a technology (e.g., Brown and Venkatesh 2005), 2) self-reported usage logs (e.g., Venkatesh and Davis 2000), or even 3) intensity or extensiveness of use (Sambamurthy and Chin 1994). Given that there are no known existing scales measuring the adoption of a technology by groups in an experimental setting, three new items (drawn from Sarker et al. 2005) capturing the "strength of adoption" was completed by each group.

Faithfulness of appropriation was measured using the five items of Salisbury et al.'s (2002) scale, which were adopted to a group setting.

For measuring the effect of the high-status member, we followed the suggestions of prior researchers such as Moehle and Thibaut (1983) and Pearce II and Robinson Jr. (1987). Specifically: 1) we asked each individual member if there was an expert on flowcharting concepts or technologies in their group, and if so, to identify that individual, and then, 2) asked each member to respond to items drawn from the Social Power Inventory Scale, which measured the extent to which this identified individual(s) had influence over the group's orientation towards the technology. Next, for each of the three-person groups where two or more members identified the same individual as the expert, we computed the average of their responses on the specific items, and used it as a measure of the expert influence. For groups, where no one was clearly identified as an expert, we computed the expert influence as zero.

Given that there is "no clearly-justified method of measuring valence" of a majority (McPhee et al. 1982), we captured majority influence by a binary variable (1 or 0) based on whether majority in a group had been in favor of the technology chosen by the group or not.

Finally, in assessing the group's performance, we used two independent coders who rated each flowchart generated by the groups on their a) completeness, b) correctness, and c) the overall quality on a scale of 1 to 7. As suggested by prior research, the raters first performed the coding jointly (for about 14 groups), in an attempt to develop a common understanding of the coding procedure, and then, independently for the rest of the groups. The inter-rater reliability was found to be over .90, which exceeds the established benchmark of .80 (Houston et al. 2001). The average of the two raters' ratings on each of the three dimensions was used as a measure of the group's performance.

4.4. Procedure

Prior to the experimental study, a 90-minute training on basic concepts of flowcharting, and hands-on experience in using the drawing tool of MS Word and MS Visio in creating flowcharts was provided to each participant. A short quiz and after training questionnaire confirmed that their level of comfort with both the concepts and the tools was adequate. Further, computer-mediated group participants were also trained on MS NetMeeting.

During the experimental sessions each participant was first asked to read the task narrative and start working on it individually, using either the drawing tool of MS Word or MS Visio. After ten minutes, they were asked to stop and complete a short questionnaire that required them to specify the tool they used for performing the flowcharting task. The individual task performance using a technology *enabled us to capture the a priori majority support for the technology* later adopted by their group. Participants were then asked to work on the same task with their group members, using either of the two technologies, and submit a group solution at the end of the session. Group members needed to communicate and negotiate with each other in order to decide which technology they would use for the exercise. Once the task was completed, individual members provided their perceptions about expert influence. Finally, *each group jointly* completed the *group questionnaire* measuring the group's perceptions about the technology characteristics, and the strength of adoption of the technology.

4.5. Analysis

PLS Graph (version 3.00) was used for analyzing the data. Our reason for selecting PLS is as follows: 1) PLS works well with small to medium sample sizes (Chin et al. 2003; Hulland 1999), and 2) PLS has been shown to be a superior technique when it comes to analyzing mediating relationships and when the model has second-order factors (e.g., Chin et al. 2003), making it more relevant for our study.

To ensure the convergent validity of the items, we satisfied the following criteria: 1) all items loaded significantly on their respective constructs (Gefen and Straub 2005). Further, most items had a loading above .70, and none of the items had a loading below .50, (Hulland 1999); 2) the composite reliabilities of each construct was above .70 (Hulland 1999); and finally, 3) the Average Variance Extracted (AVEs) of the constructs were over the threshold value of .50.

In assessing the discriminant validity, we ensured that the square root of the AVE of a construct exceeded all correlations between that factor and any other construct within the study (Gefen and Straub 2005). Please see Table 2 where the square root of the AVEs has been reported on the main diagonal, with the off-diagonal cells reflecting the correlations between that construct and other constructs.

Next, we examined the significance and strength of our hypothesized relationships. We treated the “technology characteristic” construct as a second-order factor composed of the first order factors of complexity, transferability, utility, and group supportability. The items measuring complexity were recoded to make them consistent with the other technology dimensions that were hypothesized to have a positive effect. We adopted a “molecular approach” in representing the role of the second-order factor in our model (Chin and Gopal 1995, p. 49-50). As per guidelines provided by prior researchers (e.g., Chin et al. 2003; Lohmoller 1989), we created a hierarchical component model using repeated manifest variables. Specifically, we repeated the manifest variables for the four dimensions of technology twice: once for each of the dimensions, and once for the second order factor. All of the path coefficients from “technology characteristics” to its four dimensions were significant (Chin et al. 2003), suggesting that the second-order factor was indeed indicated by the underlying first order factors.

As hypothesized, majority opinion (H1) had an effect on the group’s adoption of the technology, but at $p< .10$. Contrary to predictions, the opinion of the high-status member (H2) did not have a significant effect on the group’s adoption of the technology (see Figure 1). Consistent with the model, the characteristics of the technology (as perceived by the group), had a significant effect on the group's adoption of the technology (H3). The group's adoption of the technology did not have a direct effect on the group's performance (H4a). However, results indicated that it had an indirect effect on performance through the extent of faithful appropriation of the technology (H4b), therefore, confirming the complete mediation of faithful appropriation (See Figure 1).

5. Discussion

5.1 Revisiting the Results

Overall, the empirical test of our model suggests that the social factors have limited influence on a group's adoption of a technology. While deliberating on the adoption of a technology from a set of multiple options, groups tend to steer towards the technology that they perceive (as a collective unit) to be offering the most attractive set of features (i.e., low complexity, and high transferability, utility, and group supportability), as opposed to conforming with the opinion of the experts, or even the preference of the majority to some extent. Based on this result, an obvious question that may be asked is: in an age where researchers and practitioners alike are arguing for the benefits of taking a sociotechnical approach to understanding human behavior, does our model indicate a dominance of the "technological imperative" (Markus and Robey 1989), especially with respect to a group's adoption of technology? Markus and Robey (1989) in their seminal paper on the dimensions of causal structures argued that the "essence of the technological imperative" is the word "impact," where technology is viewed "as an exogenous force which determines or strongly constrains the behaviors" of individuals, groups, and organizations. Clearly, results of this study indicate that the technology characteristics had a significant "impact" on the group's adoption of the technology, and thus, could be interpreted as a confirmation of the "technological imperative" perspective. While, this may be one way to interpret our results, we believe that a review of recent literature on technology characteristics helps make sense of this anomaly. Fichman (2000) argues that understanding the characteristics of the technology can be challenging, and depends on the way one views the characteristics, which could be either *primary* (the value of a certain characteristic of the technology is assumed to be objective and hold true for everyone) or *secondary* (the value of a certain characteristic of the technology is assumed to hold true for some, but not for others). While prior researchers have viewed these characteristics as "mutually exclusive," Fichman (2000, p. 112) calls for a softening of this distinction, and recognizing that any technology can have "facets of both." This "soft-primary" conceptualization suggests that technologies are socially constructed artifacts, and their properties cannot be strictly objective (or universal) and isolated from the social context within which they are assessed. Thus, it may be argued that in the context of our model, the value of a particular property of the technology that was considered for adoption by a group was not absolute or universal, but was based on the negotiated collective view of the group members. In other words, while at the surface they may have been simply "technology characteristics," the perceptions of these characteristics were developed as a result of the social interaction and influence processes that ensued within the group. Thus, we believe that our model does not lend support to the "technological imperative" perspective, but in fact, suggests that the "technology characteristics" that affect a group's adoption decision, is by itself a sociotechnical construct.

While the opinion of the majority in our model was seen to have some effect on the group's adoption of the technology, the preference of the expert did not play any role. One of the reasons for this lack of a significant effect of the expert could be due to the fact that our study used student groups enrolled in the same information systems course. Thus, there was an a priori uniformity in their skills and expertise. Further, given that participants were exposed to the flowcharting concepts (required for the task) for the first time (in most cases) during the training session, very few were able to emerge as experts.

Our model also examined the applicability of two competing theoretical perspectives surrounding the effect of technology adoption on the group performance, and found support for the predictions of the more recent stream of research (i.e., the indirect effect through "faithful appropriation").

Finally, as we discussed earlier, our study involved groups interacting in two different communication environments. While the results reported here were based on the test of the model using the combined dataset, we conducted some *post-hoc analysis* by testing the model separately for computer-mediated and face-to-face groups. In the CMC groups, we found technology characteristics to have a strong effect (even stronger than in the overall model, as assessed by the beta weight and t-statistic), while the social factors (including majority influence) had no discernable effect on the group's technology adoption. In contrast, in the face-to-face groups, technology characteristics did not have a significant effect, but the social factors played a more prominent role (majority had an effect at $p < .05$; expert influence was significant at $p < .10$). In spite of a small size (especially after splitting the dataset), these results are promising since they point towards the differential influence of the social and technological factors in the two different environments, and thus needs to be further explored in future research.

5.2 Limitations

While we believe that our study makes a number of interesting contributions, like all other research studies, it too has some limitations, one being that it does not control for group history. The study uses ad-hoc laboratory groups. Since it involves student subjects, there may have been situations where the group members have had a prior history of working together, and which could have resulted in a stronger influence of the majority and (or) the expert in some groups. However, it is hoped that the random assignment of subjects to groups would have taken care of this possible confounding effect.

Another limitation arises from the fact that the study was cross-sectional in nature, which may have provided little opportunity to the groups to develop their social dynamics, thereby leading to a low (or non-significant) effect of the social factors on the group's technology adoption process. We believe that future research involving more longitudinal studies could help in better examining the role played by social influence-related factors on a group's technology adoption process.

Finally, in this study, we examined the effect of a limited set of social factors (i.e., high-status member and majority influence) on a group's technology adoption decision. Prior group researchers suggest that whenever groups are involved in making a consensus-decision (e.g., adoption of a technology for their task performance), a number of other social interaction-related factors such as group cohesion and conflict play a critical role (e.g., Gouran 2003; Jehn and Mannix 2001; Jehn 1995; Fisher and Ellis 1990; McGrath 1984). To develop a comprehensive understanding of the role played by social factors on a group's technology adoption process, future studies will need to closely examine the effect of the above-mentioned variables on a group's technology adoption decision.

5.3 Conclusion

While technology adoption by individuals and organizations has received considerable attention from researchers in the area of information systems and other related fields, little is known about how groups (an increasingly important social entity within organizations) adopt a technology. The current study is one of the *first* known *empirical examinations* of some of the key factors affecting *technology adoption by groups*. Specifically, the study tests an additive model of technology adoption by groups, surrounding the “twin predictions” of the technology characteristics and social factors, and makes the following specific contributions: 1) It identifies some of the social structure-related factors affecting technology adoption by groups; 2) it identifies the key technology characteristics that affect a group’s technology adoption, including the characteristic of “group supportability,” which we believe is applicable only to a *group* technology adoption context; 3) it validates a new instrument for measuring the various dimensions of technology characteristics (applicable to a “technology adoption by groups” context); 4) it examines the effect of adoption of technology on outcomes (e.g., group performance), that has typically been overlooked in prior adoption research; 5) it empirically illustrates the mediating role played by “faithfulness of appropriation” of technology; and finally, 6) it illustrates (drawing on recent research), that characteristics of the technology are not objective or universal properties, but are perceptions developed as a result of the social/interactional processes that a group experiences, and thus is a sociotechnical construct.

Clearly, there is much to be learnt about technology adoption by groups, and we hope this study provides answers to a few key questions regarding this issue, and encourages future researchers to investigate this important group behavior.

6. References

Aiman-Smith, L, and Green, S. G., “Implementing New Manufacturing Technology: The Related Effects of Technology Characteristics and User Learning Activities,” *Academy of Management Journal*, 45(2), 2002, pp. 421–430.

Armstrong, C.P., and Sambamurthy, V., “Information Technology Assimilation in Firms: The Influence of Senior Leadership and IT Infrastructures,” *Information Systems Research*, Dec 1999, 10(4), pp. 304.

Bass, B.M. *Bass and Stogdill’s Handbook of Leadership: Theory, research, and managerial applications*, 3rd edition, New York, NY: The Free Press, 1990.

Cassell, J., Huffaker, D., Tversky, D., and Ferriman, K., "The Language of Online Leadership: Gender and Youth Engagement on the Internet," *Developmental Psychology* , 42(3), 2006, pp. 436-439.

Chau, P.Y, and Tam, K.Y., "Factors Affecting the Adoption of Open Systems: An Exploratory Study," *MIS Quarterly*, 21(1), 1997, pp. 1–24.

Chin, W.W., Marcolin, B.L., Newsted, P.R., "A Partial Least Squares Latent Variable Modeling Approach For Measuring Interaction Effects: Results From A Monte Carlo Simulation Study And Electronic Mail Emotion/Adoption Study," *Information Systems Research*, 14(2), 2003, pp. 189-217.

Chin, W.W., and Gopal, A. "Adoption Intention in GSS: Importance of Beliefs," *DATA BASE*, 26(2&3), 1995, pp. 42-63.

Davenport, T. *Process Innovation: Reengineering Work Through Information Technology*, Boston, MA: Harvard Business School, 1993.

Dennis, A.R., and Reinicke, B.A., "Beta Versus VHS and the Acceptance of Electronic Brainstorming Technology," *MIS Quarterly*, 28(1), 2004, pp. 1-20.

DeSanctis, G., and Poole, M.S. "Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory," Organization Science, 5(2), 1994, pp. 121-147.

Fichman, R.G., "The Diffusion and Assimilation of Information Technology," in *Framing the Domains of IT Management*, Cincinnati, Ohio: Pinnaflex Educational Resources Inc., 2000.

Fisher, B.A., and Ellis, D.G. *Small Group Decision Making: Communication and the Group Process*, 3rd ed., New York: McGraw Hill Publishing Company, 1990.

Galloway, D. *Mapping Work Processes*, ASQC Quality Press, Milwaukee, WI, 1994

Gefen, D., and Straub, D. "A Practical Guide to Factorial Validity Using PLS-Graph: Tutorial and Annotated Example," *Communications of the AIS (CAIS)*, 16, 2005, pp. 91-109.

Gouran, D. S. "Communication in groups: The emergence and evolution of a field of study," in Frey, L.R., Gouran, D. S., and M. S. Poole (Eds.), *The handbook of group communication theory and research*, Thousand Oaks, CA: Sage, 1999, pp. 1–87.

Guzzo, R. A., Yost, P. R., Campbell, R. J., and Shea, G.P., "Potency in groups: Articulating a construct," *British Journal of Social Psychology*, 32, 1993, pp. 87–106.

Houston, M.B., Walker, B.A., Hutt, M.D., Reingen, P.H., "Cross-unit competition for a market charter: The enduring influence of structure," *Journal of Marketing* (65:2), 2001, pp. 19-34.

Hulland, J. "Use of Partial Least Squares (PLS) In Strategic Management Research: A Review of Four Recent Studies," *Strategic Management Journal*, 20, 1999, pp. 195-204.

Janzen, M.W. "Total Quality through Process Flowcharting," *Transactions of the American Association of Cost Engineers*, 1991, pp. F.8.1-F.8.4

Jehn, K.A., and Mannix, E.A. "The Dynamic Nature of Conflict: A Longitudinal Study of Intragroup Conflict and Group Performance," *Academy of Management Journal*, 44(2), 2001, pp. 238-251.

Jehn, K.A. "A Multimethod Examination of the Benefits and Detriments of Intragroup Conflict," *Administrative Science Quarterly*, 40(2), 1995, pp. 256-282.

Kurnia, S. and Johnston, R.G., “The need for a processual view of inter-organizational systems adoption,” *Journal of Strategic Information Systems*, 9(4), 2000, pp. 295–319.

Leonard-Barton, D., “Implementation Characteristics of Organizational Innovations,” *Communication Research*, 15(5), 1988, pp. 603–631.

Lohmoller. J.B. *Latent variable Path Modeling with Partial Least Squares*, Physica-Verlag, Heidelberg, 1989.

Lucas, H.C., and Spitler, V.K., “Technology Use and Performance: A Field Study of Broker Workstations,” *Decision Sciences*, 30(3), 1999, pp. 291–311.

Mark, G., Abrams, S., and Nassif, N. “Group-to-Group Distance Collaboration: Examining the “Space Between,” *Proceedings of the 8th European Conference of Computer Supported Cooperative Work*, Helsinki, September 2003.

Markus, M.L.,and Robey, D., “Information Technology and Organizational Change: Casual Structure in Theory and Research,” *Management Science*, 34(5), 1983, p. 583.

McGrath, J.E. *Groups: Interaction and Performance*, Englewood Cliffs, NJ: Prentice Hall, Inc., 1984.

McPhee, R.D., M.S. Poole, and Seibold, D.R., "The valence model unveiled: Critique and alternative formulation." in M. Burgoon (Eds.), *Communication Yearbook* 5, New Brunswick, NJ: Transaction Books, 1982, pp. 259–278.

Mehra, A., Kilduff, M., and Brass, D.J., “The Social Networks of High and Low Self-Monitors: Implications for Workplace Performance,” *Administrative Science Quarterly*, 46(1), 2001, pp. 121-146.

Meyers, R.A., and Brashers, D.E., “Influence Processes in Group interaction,” in Frey, L. R., Gouran, D.S., and M.S. Poole (eds.) *The Handbook of Group Communication Theory and Research*, Thousand Oaks, CA: Sage Publication, 1999, pp. 288–312.

Moore, G.C., and Benbasat, I., “Development of an instrument to measure the Perceptions of Adopting an Information Technology Innovation,” *Information Systems Research*, 2(3), 1991, pp. 192–222.

Moehle, D., and Thibaut, J. , “Traditional versus expropriation in open groups: A comparison of two types of social power,” *Journal of Personality and Social Psychology*, 44(5), 1983, pp. 977–999.

Nunamaker, Jr. J.F., Dennis, A. R., Valacich, J.S. Vogel, D. R., & George, J.F. "Electronic Meeting Systems to Support Group Work," *Communication of ACM*, 34(7), 1991, pp. 40–61.

Pearce II, J.A., and Robinson Jr., R.B., “A Measure of CEO Social Power in Strategic Decision-Making,” *Strategic Management Journal*, 8(3), 1987, pp. 297-304.

Poole, M.S., “Group Communication Theory” in L.R. Frey, D.S. Gouran, and M.S. Poole (eds.), *The Handbook of Group Communication Theory and Research*, Thousand Oaks, CA: Sage Publication, 1999, pp. 37– 70.

Poole, M.S., Keyton, J., and Frey, L.R. “Group Communication Methodology: Issues and Considerations,” in L.R. Frey, D.S. Gouran, and M.S. Poole (eds.), *The Handbook of Group Communication Theory and Research*, Thousand Oaks, CA: Sage Publication, 1999, pp. 92– 112.

Rogers, E.M. *Diffusion of Innovations*. New York: Free Press, 1995.

Salisbury, D., Chin, W.W., Gopal, A., and Newsted, P.R. “Research Report: Better Theory Through Measurement- Developing a Scale to Capture Consensus on Appropriation,” *Information Systems Research*, 13(1), 2002, pp. 91-103.

Sambamurthy, V., and Chin, W.W. “The Effect of Group Attitudes Toward Alternative GDSS Designs on the Decision-making Performance of Computer-Supported Groups,” *Decision Sciences*, 25(2), 1994, pp. 215-241.

Sarker, S., Valacich, J.S., and Sarker, S. “Technology Adoption by Groups: A Valence Perspective,” *Journal of the AIS*, 6(2), 2005, pp. 37-71.

Scott, C.R. “Communication technology and Group Communication,” in L.R. Frey, D.S. Gouran, and M.S. Poole (eds.), *The Handbook of Group Communication Theory and Research*, Thousand Oaks, CA: Sage Publication, 1999, pp. 432-472.

Straub, D.W. “Validating Instruments in MIS Research,” *MIS Quarterly*, 13(2), 1989, pp. 147-169.

Taylor, S. and Todd, P.A. “Understanding Information Technology Usage: A test of Competing Models,” *Information Systems Research*, 6(2), 1995, pp. 144–176.

Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D., “User Acceptance of Information Technology: Toward a Unified View,” *MIS Quarterly*, 27(3), 2003, pp. 425–278.

Venkatesh, V., and Davis, F.D., “A theoretical extension of the technology acceptance model: Four longitudinal field studies,” *Management Science*, 46(2), 2000, pp. 186–204.

Zigurs, I. “Methodological and Measurement Issues in Group Support Systems Research,” in Jessup L.M. and Valacich J.S. (eds.), *Group Support Systems: New Perspectives*, New York, NY: Macmillan Publishing Company, 1993, pp. 112–122.

Zigurs, I, DeSanctis, G., and Billingsley, J. “Adoption patterns and attitudinal development in computer-supported meetings: an exploratory study,” *Journal of Management Information Systems*, 7(4), 1991, pp. 51-70.

Table 1: Items, Descriptive Statistics, and Item Loadings

Items (on a scale of 1 (Not at all) to 7 (To a Great Extent))	**Mean**	**Std. Dev.**	**Loading**	**Mean Loading**
Compl1. To what extent was the tool difficult for your group to use?	5.45	1.65	.9061	.9035
Compl2. To what extent are the features of the tool overly sophisticated?	5.47	1.53	.8947	.8881
Transf1. To what extent did your group have access to documentation necessary to use the tool?	5.13	1.82	.8474	.8417
Transf2. To what extent did your group have access to training necessary to use the tool?	5.00	1.70	.8840	.8905
Transf3. To what extent did your group have access to technical support necessary to use the tool?	4.48	1.99	.7225	.6808
Util1. To what extent was the tool useful for your group?	5.74	1.35	.8175	.8336
Util2. To what extent did the tool make it easier for your group to complete the task?	5.82	1.36	.9272	.9316
Util3. To what extent did the tool make the completion of your group's task more efficient?	5.88	1.44	.9198	.9248
Util4. To what extent did the use of the tool increase the status of your group amongst your peers (e.g., other students in the same or other courses, faculty)?	4.53	1.94	.5470	.5389
GrpS1. To what extent did the tool enable your group members to work on different sub-tasks in parallel?	4.05	1.93	.7695	.7592
GrpS2. To what extent did the tool allow your group to delegate sub-tasks to all group members?	3.67	1.82	.7280	.7174
GrpS3. To what extent did the tool allow your group to put together results from the efforts of all group members?	4.76	1.72	.7169	.7237
GrpS4. To what extent did the tool enable group members to view other members' work whenever mutually desirable?	5.51	1.42	.6252	.6092
GrpS5. To what extent did the tool enable group members to modify other members' work whenever mutually desirable?	4.74	1.96	.7673	.7622
GrpS6. To what extent did the tool enable group members to share their work with other members' whenever mutually desirable?	5.41	1.55	.6455	.6374
GrpAdop1. To what extent was your group convinced about using the above tool?	6.31	1.00	.8312	.8099
GrpAdop2. To what extent is your group committed to the use of the above tool?	6.25	.98	.7797	.7798
GrpAdop3. To what extent does your group plan to regularly use the above tool?	4.53	2.03	.6187	.5866
FA1. The developers of the tool would disagree with how our group used the system.	2.49	1.76	.7065	.6546
FA2. Our group probably used the tool improperly.	2.24	1.39	.8628	.8675
FA3. The original developers of the tool would view our group's use of the tool as inappropriate.	2.07	1.42	.8587	.8520
FA4. Our group failed to use the tool as it should have been.	2.02	1.45	.9059	.8978
FA5. We did not use the tool in the most appropriate fashion.	2.19	1.64	.6695	.6616
ExpInf1. To what extent did the above individual influence your group's flowcharting tool adoption decision?	.541	1.69	.9929	.9911
ExpInf2. o what extent did the "expert's" preference affect your group's flowcharting tool adoption decision?	.5039	1.59	.9974	.9924
GrpPerf1. Correctness	5.31	1.34	.8936	.8760
GrpPerf2. Completeness	5.56	.97	.8561	.8409
GrpPerf3. Overall Quality	5.44	1.18	.9831	.9675

Table 2: Composite Reliability, AVE, and Inter-construct Correlations

	Construct	Composite Reliability	1	2	3	4	5	6	7	8	9
1	Complexity	.895	**.901**								
2	Transferability	.860	.285	**.821**							
3	Utility	.886	.285	.425	**.817**						
4	Group Supportability	.859	.173	.363	.417	**.711**					
5	Group's Strength of Adoption of Technology	.790	.337	.199	.274	.272	**.749**				
6	Faithful Appropriation of Technology	.902	-.395	-.219	-.393	-.246	-.317	**.806**			
7	Expert Influence	.995	.113	.011	.048	-.123	-.008	.116	**.995**		
8	Majority Influence	1.00	-.085	.020	.164	.243	.314	.073	.071	**1.00**	
9	Group Solution Quality	.937	.079	.140	.090	.088	.069	-.301	.046	-.091	**.913**

Figure 1: Model of the Study with Results