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DOES SIZE MATTER? AN INVESTIGATION OF COLLABORATIVE INFORMATION TECHNOLOGY ADOPTION BY U.S. FIRMS

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ABSTRACT

We explore the adoption pattern of seven IT innovations to support task-oriented collaboration between group members working asynchronously or synchronously and the impact of two size-related variables, organization size and the size of the internal IT function, on the adoption of these seven IT innovations. IT adoption is viewed as a transition from the state of non-adoption to adoption (adoption status) and then to the extent of accessibility of the IT to organizational end-users (adoption level). Analysis of data collected from one hundred and eighteen U.S. organizations suggests that adoption patterns of the seven IT clusters vary considerably and that size (organization and IT function) is associated with the aggregate adoption status of the ITs investigated. Larger organizations with larger IT functions had adopted more of the ITs than their smaller counterparts. However, when exploring effects of size-related variables on adoption status of individual IT clusters, our findings suggest that size is associated with adoption of only those IT clusters that may require large resource infusions for acquisition, are fairly complex to use, and require substantial technical support. Size was not found to be associated with the adoption level of the majority of individual IT clusters. However, interestingly, at the aggregate level, our results suggest that once adopted, the IT clusters had

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higher adoption level in smaller organizations than their larger counterparts. Implications of these findings are discussed along with some directions for practice and research.

INTRODUCTION

The notion of information technology (IT) support for task-oriented collaboration is attracting a lot of attention in modern organizations. There is no dearth of industry reports advocating such support. With the growth of the Internet, many IT applications that can support collaboration, irrespective of time and geographical barriers, have been developed and their popularity continues. However, we know very little about the collective adoption patterns of these technologies and the organizational context that promotes their adoption.

This paper reports on a study that investigates the adoption patterns of seven IT clusters to specifically support task-oriented collaboration amongst workgroups in organizational settings. We also focus on two size-related antecedents of IT adoption, namely, organization size and internal IT function size, and explore their association with the adoption of these seven IT clusters. Although several antecedents of IT adoption have been identified in the literature, our motivation to include the two size-related antecedents stems from the fact that the relationship between "size" and IT adoption has probably been most widely debated due to the inconclusive nature of the results. We attempt to provide some richer insights to resolve some of the past empirical inconsistencies.

The seven IT clusters investigated in this study include: E-mail systems, audio teleconferencing, videoconferencing, dataconferencing, web-based tools, proprietary groupware technology, and electronic meetings systems (EMS). Some of these technologies to support group work have been around for nearly two decades. Others are somewhat recent developments. There have been a few studies investigating the adoption of some individual technologies like e-mail (Kettinger and Grover, 1997), and web groupware (Dennis et al., 1998), proprietary groupware (Slyke, Lou, & Day, 2002), and EMS (Straub and Beauclair, 1988; Lewis, Garcia, & Keleman, 2000). However, no prior

CONTRIBUTION

This paper makes two key contributions to existing research. First, it provides insights into current patterns of adoption of IT to support collaboration. To our knowledge, this paper is the first report on macro-level adoption of a multitude of collaborative technologies in U.S. organizations. Second, it provides some resolution to conflicting findings about the significance of size-related variables in adoption of IT innovations in organizations. Specifically, we provide empirical answers to the following research questions:

- What is the pattern of adoption of various IT clusters to support task-oriented collaborative work in U.S. organizations?
- How do organization size and the size of the internal IT function influence the adoption of IT to support task-oriented collaboration in U.S. organizations?

The research findings should be of considerable interest to practitioners and researchers. For practitioners, it provides a template to benchmark their own adoption patterns as they relate to IT support for task-oriented collaborative work. For developers of IT, it provides some insights into which technologies are being more widely adopted. Attributes of these technologies could provide inputs to improve future generations of collaborative tools. For researchers, it sheds new light on the relationship between organization size and technology adoption patterns. It also provides direction for future research on IT support for collaboration.

research has attempted a large-scale investigation to explore adoption patterns across multiple technologies to inform IT practice as well as research and development efforts.

The rest of the paper is organized as follows. The next section focuses on IT support in task-oriented collaboration. This is followed by a review of the literature that focuses on the impact of size-related variables on the adoption of innovations and IT. We then describe the study methodology and analyses. In the last section, we discuss our findings, address the limitations of our study, and review the implications for practice and future research.

IT SUPPORT FOR TASK-ORIENTED COLLABORATION

The majority of today's organizations depend upon group work. Group members often have to deal with multiple viewpoints and incomplete information in trying to accomplish tasks. As a result, information exchange between participants becomes critical in task-oriented collaboration. This can be problematic, especially in distributed environments due to three "distance factors": speed (or time) for information transmission, complexity of information, and the quality of communication channels. Fortunately, the proliferation of emerging information and networking technologies can provide a dependable solution for effective and efficient collaboration (Line, 1997).

Reinforcing the role of IT in distributed group process and collaboration, researchers have urged that investigations be undertaken to study distributed groups using a combination of communication technologies (Tung & Turban, 1998). This also parallels an earlier perspective that alternative communication channels for group collaboration are important and required (Turoff et al., 1993).

Several information technologies can enhance task-oriented collaboration amongst work groups by improving communication and coordination between team members. In fact, there are "dozens of books and hundreds of research articles published in the areas of group support systems, computer support cooperative work, distributed learning, and the like that are focused on people who interact while distributed with the support of technologies" (Jessup 2000, pg 245).

Perhaps the most well known technology that is used to support collaboration in modern organizations is e-mail. In addition to this, teleconferencing (audio), videoconferencing, and dataconferencing can greatly enhance group collaboration by bringing the geographically dispersed participants together. Use of such technologies to collaborate on tasks has been well documented (Betti, 2001; Edwards, 2001; Webster, 1998; www.aderhold.com/dataconferencing.htm). Other technologies that have the capability to support task-oriented collaboration include: Proprietary groupware, web-based tools, and EMS. Lotus Notes, probably the most popular of the proprietary groupware systems has sold approximately 50 million units of their software worldwide (Jessup, 2000). Many firms are using such software for supporting collaboration where expert opinions may be required. Price Waterhouse, for example, can reach hundreds of experts and specialists via Notes (Kirkpatrick, 1993). Web-based tools are another emerging technology that have the capability to support collaboration relatively inexpensively using Internet access, and without requiring any additional hardware (Dennis, 1996). Many organizations are developing web-based intranets to enable organizations to share information and collaborate easily irrespective of location (Adhikari, 1999). Successful use of web-based tools has been demonstrated for judgmental product forecasting (Ozer, 1999). As another example, Cisco uses web-based tools for hundreds of sessions a day focusing on initial sales and customer support activities (Ward, 1999). Weyerhaeuser is using such tools to facilitate exchange of expertise amongst their employees world-wide to enhance teamwork (Anderson & Kincaid-Yoshikawa, 1999). Finally, many articles have been published in the literature demonstrating EMS use for task-oriented collaboration in lab environments and organizational settings (Pervan, 1998, Jessup & Valacich, 1993).

While there is little doubt about the capabilities of all the above technologies to support task-oriented collaboration, the choice of a particular technology to support collaboration may depend upon the amount of information required, the time requirement for information (how fast is it required), effectiveness of communication required, and efficiency of communication required (Cheng, et al., 2000). The notion of technology choice to support collaboration is also supported by media richness theory. The underlying rationale is that choice of a communication medium depends upon the degree of richness required in information exchange during collaboration. Since communication media vary in their capacity to process rich information (Daft and Lengel, 1986), there is no single preferred IT that could be selected to support all types of tasks during collaboration. Thus, a combination of several IT clusters might be appropriate in many circumstances, especially when the task-oriented collaboration requires important or complicated exchange of information. Given these arguments, rather than focusing on a single technology, researching a multitude of media choices may provide greater insights into IT support for task-oriented collaboration.

INFLUENCE OF SIZE-RELATED FACTORS ON IT ADOPTION

Organization size has been proposed as an antecedent of adoption in many innovation and IT studies. For the most part, it has been convincingly argued that larger, resource-rich organizations are more able to afford the costs of IT innovations and have higher ability to handle risk (Dewar and Dutton, 1986). However, the results of research investigations have been somewhat inconclusive. While some innovation studies suggest a positive relationship between organization size and adoption behavior (Moch and Morse, 1977; Kimberly and Evanisko, 1981), a negative relationship between size and adoption behavior has also been observed (Mohr, 1969; Globerman, 1975).

The IT literature also provides inconclusive arguments with respect to the impact of organization size on IT adoption and diffusion. For example, Ein-Dor and Segev (1978) asserted that chances of IT success are less in small organizations than in large organizations. Gremillion (1984) and Raymond (1985), on the other hand, found no relationship between organization size and IT success. Research on early adopters of group support systems (GSS) indicated that larger organizations are more likely to adopt GSS than smaller organizations (Straub and Beauclair, 1988). However, Grover and Goslar (1993) found no significant relationship between organization size and the initiation, adoption, and implementation of telecommunication technologies in U.S. organizations. A study of intranet adopters in Hong Kong also reported no significant differences in adoption and implementation of intranets between large and small organizations (Lai, 2001). Similarly, no significant differences in organization size were found between adopters and non-adopters of Executive Information Systems (EIS) tools providing collaborative support, and organization size was also not found to have any impact on the level of adoption of these tools amongst adopting organizations (Rai and Bajwa, 1997). In summary, past studies have yielded mixed results on the relationship between organization size and adoption behavior.

Although fewer studies have explored the impact of IT function size on IT adoption, there is some empirical evidence suggesting that IT function size may have a positive influence on the adoption of IT innovations (Grover and Goslar, 1993; Rai, 1995). It has been convincingly argued that larger IT functions will have the resources that can facilitate the acquisition of technical competencies required to adopt IT innovations. However, while IT function size may help to differentiate adopters and non-adopters of some collaborative technologies, it has been found that it may not explain the propagation of EIS applications providing collaboration support in adopting organizations (Rai and Bajwa, 1997).

Given the inconclusive findings from past studies on the impact of organization size on IT adoption, the possibility of IT function size being an important antecedent of IT innovation adoption, and the scarcity of

empirical research exploring the adoption of IT to support task-oriented collaboration, a large-scale study was undertaken in 2001 to further explore these issues. The next section outlines the empirical study.

STUDY METHODOLOGY

Survey Instrument and Measures

To ensure valid and reliable measures, we developed our instrument using a three-stage process. The first step involved an extensive review of the literature. The primary objective of this review was to identify an initial set of ITs that have the capability to support task-oriented collaboration and to identify studies where relevant variables had been introduced and operationalized. Where previously validated measures were not available, we used the literature reviewed to generate a list of items that described our study variables. In the second step of the instrument development process, we initiated discussions amongst four faculty members, three of whom have been involved in research on group collaboration for over two decades. These discussions focused on reviewing and categorizing all the ITs identified in the first stage into logical clusters (along with appropriate examples of IT products) and on the clarity of the item-measures for our study variables. Based upon these discussions, we formulated seven logical clusters of ITs that have the capability to support task-oriented collaboration and developed our item-measures to operationalize our study variables. In the third stage, we conducted a pilot test to further ensure the face validity and reliability of our measures. For this test, the executive director of The Society for Information Management (SIM) and a past CIO of a Fortune 500 company were contacted and asked to review our survey instrument to insure that the item-measures were appropriate and clear. Both agreed to participate and the survey instrument was delivered to them electronically. After a few days, a teleconference session was set up to receive their feedback on the survey. During the teleconference, we asked both the participants to comment on the collaborative IT categories and the clarity of operationalized variable measures. Based upon their feedback, we made one major modification to our survey instrument as it relates to the scope of the variables included in this paper. While both the participants agreed with our IT cluster categorization and examples of IT products in each category, they suggested that we refine our examples of IT products for each of the seven IT clusters to include the names of specific IT tools that were well known in the industry. We modified our IT product examples in each cluster to include their suggestions. The seven IT clusters and specific products for each of the seven technologies that resulted from this pilot test are shown in table 1. This categorization was deployed to guide responses. In the following paragraphs, we'll describe the operational measures as they relate to the scope of the present paper.

Table 1. Seven Logical Clusters of ITs for Supporting Task-oriented Collaboration, with Application Examples

Collaboration Technologies	Examples
E-mail	Pegasus mail, Microsoft Outlook, Hotmail, etc.
Teleconferencing (two-way audio)	NetMeeting, CU-SeeMe, etc.
Videoconferencing (two-way audio & video)	NetMeeting, CU-SeeMe, etc.
Dataconferencing (whiteboards, application sharing, data presentations)	NetMeeting, Evoke, WebEx, etc.
Web-based Collaborative Tools (intranets, listservs, newsgroups, chat, message boards)	EGroups, Yahoo Groups, Open Topics, etc.
Proprietary Groupware Tools (with or without web browser interface)	Lotus Notes, IBM Workgroup, TeamWARE Office, Novell Groupwise, The Groove, etc.
Electronic Meeting Systems	GroupSystems, MeetingWorks, TeamFocus, VisionQuest, Facilitate.com, etc

A single item that required respondents to indicate whether the specific IT cluster was accessible and available to end-users in their organization measured adoption of each IT cluster. A five-point scale anchored at the

extremes and mid-way (1=no one in the organization, 3=some persons in the organization, 5=everyone in the organization) was used for each of the seven IT clusters. Such an approach to capture the "spread" (diffusion) of ITs supporting managerial collaboration and decision-making in organizations is quite common in the literature (Rockart and DeLong, 1988; Paller and Laska, 1990; Belcher and Watson, 1993). Although a single item-measure is used to gauge IT adoption, two measures of IT adoption are implied by the scale. The first is a binary measure identifying adoption *status* (i.e. a non-adopter versus adopter). An organization is considered to a non-adopter of IT if the IT is not accessible to any end-user in the organization and an organization is considered to be an adopter of IT if the IT is accessible to at least a few end-users in the organization. The second measure refers to adoption *level* (i.e. once adopted, to what extent is the IT available to end-users in the organization). Thus, organizations adopting an IT cluster could have low or high adoption *level* depending upon whether an IT cluster is accessible and available to only some end-users or to many end-users in the organization.

Organization size and IT function size were measured using total number of employees and number of IT employees in the organization respectively. Such measures of size-related variables are also common in the literature (Rai, 1995; Zmud, 1982). Six categories were used to measure the number of employees in the organization. These included: less than 100 employees, 100 to 499 employees, 500 to 999 employees, 1,000 to 4,999 employees, 5,000 to 10,000 employees, and over 10,000 employees. Another six categories were used to measure the total number of IT employees in the organization. These included: less than 10 IT employees, 10 to 49 total IT employees, 50 to 99 IT employees, 100 to 499 IT employees, 500 to 1,000 IT employees, and more than 1,000 IT employees. Such approaches are common in IT and innovation studies because respondents find it difficult to gather overly detailed factual data. We chose to deploy this categorical measure hoping to boost responses so that we would not face significant sample attrition due to missing values when analyzing our data.

Next, we describe the data collection process. Since the measures included in this paper are either single-item measures or categorical measures, no statistical validity and reliability parameters are reported. However, our overall instrument development process does provide substantial support for the face validity and reliability of our operational measures discussed above.

Data Collection

The data was collected electronically from members of SIM. The membership of the society primarily includes Chief Information Officers, (CIOs), Chief Technology Officers (CTOs), and emerging IT leaders. SIM is considered to be a premier society for dissemination of current IT practices. The current membership of the society is about 2500 executives belonging to approximately 1500 organizations worldwide. Almost 95% of these organizations are U.S. based.

An e-mail message with an appropriate URL address was disseminated to the members, explaining the purpose of the survey and requesting their cooperation in participation. While the IT clusters identified may be adopted broadly for communication, coordination, planning, and control activities in organizations, we were specifically interested in their adoption for task-oriented collaborative work. Towards this end, clear instructions were provided that the focus of the survey was specifically on the adoption of IT clusters "to support group collaboration in accomplishing a task, synchronously or asynchronously at any place, as contrasted with generic use for communication and coordination". It was also requested that the survey be forwarded to the executive/key manager who was most knowledgeable about IT support for task-oriented collaboration in their respective organization. A follow-up e-mail message was delivered after seven days. A total of one hundred and twenty-five organizational responses were received from the electronic mailing. Based upon the total number of member organizations of SIM, this represented a response rate of approximately 8.3 percent. One hundred and eighteen usable responses represented business organizations in the U.S. Organizations and IT functions of

all sizes responded to the survey. About 37 percent of our responses were from Fortune 1000 companies.

All except one respondent indicated their position or title. Almost 65% of the responses were received from presidents, chief information officers (CIOs), chief technology officers (CTOs), vice presidents (strategic development, IT, information management, etc), or directors (IT, enterprise services, enterprise architecture, global applications, etc). These titles place the majority of our respondents at senior level positions in their organizations and certainly in the most informed position to respond to the organization level constructs in our study. Another 18% of our responses came from managerial level positions from mainstream IT or related functions. Some of these titles, amongst others, included managers of knowledge services, knowledge management solutions, integration and development, global telecommunication services, global knowledge management services, and information management. Given the importance of collaboration in knowledge management and the level of visibility of an IT manager in an organization's activities, these respondents place themselves in a credible position to respond to adoption of ITs to support collaboration. Finally, although SIM membership primarily includes CIOs, CTOs, and emerging IT leaders in organizations, 15% of our respondents held non-IT managerial positions. This may indicate that our survey might have been forwarded (as requested) to the manager that was more knowledgeable about adoption of ITs to support collaboration. The above profile of our respondents indicates substantial support for the appropriateness of our study sample.

However, a low response rate obviously raises concerns of response bias. There could have been several reasons for a low response rate in our study. First, although web-based surveys are much more convenient and faster than traditional mail surveys, the biggest drawback is that they are "prone to technological failure" (Goldsby, Savitskie, and Stank, 2001, pp. 5). While we did not receive any feedback from our respondents on the reliability of our site, it is possible that some respondents may have encountered technical problems either in trying to access our site or in submitting their responses. Second, access to our site was provided using a hypertext link in an e-mail message sent out to SIM members. Although this was a very convenient approach for us to reach our sample audience, e-mails can "get lost in the ether" (Boyer, Olson, and Jackson, 2001, pp. 5) and may never reach the targeted respondent, especially if the survey has to be forwarded to another respondent in the organization, as might have been the case with our survey. Moreover, an e-mail can be easily deleted and several repeated follow-up messages may be required to boost responses in electronic surveys (Boyer, Olson, and Jackson, 2001; Goldsby, Savitskie, and Stank, 2001). Due to increased traffic of e-mail messages to SIM members, we were not able to get permission to send more than one follow-up message to our sample. Finally, for some respondents, their browser may have generated a different layout than the one we had designed. Although we had listed instructions that provided the best views of the layout, it is possible that some respondents (especially senior executives) may not have made any attempts to rectify the layout and simply decided not to respond.

While we were informed that the response to our survey was typical of other surveys conducted amongst the member organizations of SIM, we decided to check for any non-response bias in our sample by comparing responses between early and late respondent groups. Surveys received from the first thirty respondents (early group) and the last thirty respondents (late group) were included in the test. All in between responses were discarded. A chi-square test indicated no differences in the proportion of responses from the three size-related categories (organization size and IT function size) between the early and late respondent groups. Similarly there were no significant differences in aggregate adoption of IT clusters between the two groups.

Data Analysis

Given that we received 118 usable responses, our original six groupings of size-related variables resulted in rather low group

memberships, thereby posing limitations on statistical techniques that could be deployed. Therefore, the six groupings of size-related variables were further collapsed into three logical groupings (small, medium, and large) of organization size and the IT function size. To be consistent with the small business administration (SBA) definition, an organization was considered to be "small" if number of employees were less than 500, "medium" if number of employees were between and inclusive of 500 and 4,999, and "large" if the number of employees exceeded 4,999. The three logical groupings of "small", "medium", and "large" IT functions were based upon the fact that number of IT employees in the organization were less than 50, between and inclusive of 50 and 499, and over 499 respectively. While the approach to collapse six categories into three was purely to increase the number of responses in each category, there is always a concern that possible aggregation effects may limit the strength of analysis. However, when size is measured by the actual number of employees, there can be great variations in the data. As a result, a recent study suggests that a continuous measure of size may show a much less significant relationship with IT adoption than ordered categories of size (Yao et al, 2002-2003).

Next, we report on analyses to address our research objectives. First, we conducted a preliminary analysis to explore relationships between organization size and IT function size. We performed a chi-square procedure to test for associations between the two categorical variables. The Pearson chi-square (44.57) significance ($p<0.000$) suggested that organization size and IT function size categories are associated.

To analyze IT adoption *patterns*, we identified all the adopters and non-adopters of the seven IT clusters. The original single-item measure of adoption (scale of 1 to 5) was re-coded (scale of 0 to 4) for the remaining analyses. An organization was classified as a non-adopter if the score was 0. All other organizations were classified as adopters and were allocated a score of 1. Table 2 shows the adoption *patterns*. We found that e-mail has been adopted by almost all of the organizations, followed by teleconferencing, videoconferencing, dataconferencing, proprietary groupware, web-based tools, and finally EMS. Looking at the extremes, the responses indicate that 99% of the firms had adopted e-mail while only about 39% indicated they had adopted EMS to support task-oriented collaboration.

Table 2: Adoption pattern for seven logical clusters of ITs among sample US firms

Collaboration IT Cluster	N	Adopters	Non-Adopters
E-mail	112	111 [99.1%]	001 [0.9%]
Teleconferencing	112	104 [92.9%]	008 [7.1%]
Proprietary Groupware	110	073 [66.4%]	037 [33.6%]
Dataconferencing	107	080 [74.8%]	027 [25.2%]
Videoconferencing	112	086 [76.8%]	026 [23.2%]
Web-based Tools	108	061 [56.5%]	047 [43.5%]
Electronic Meeting Systems	107	042 [39.3%]	065 [60.7%]

To explore associations between "size" related variables and IT adoption we deployed two primary approaches that have been recommended. If the primary interest of the research is to identify antecedents of adoption of a specific IT, a single measure of adoption behavior can be used. On the other hand, when the research objective is to identify explanatory factors across a class of ITs, then aggregate measures of adoption are preferred and should be used (Fichman, 2001). To provide rich insights into the effects of size-related variables on the adoption of collaborative ITs, we will discuss the adoption *status* and adoption *level* from the individual IT cluster standpoint and from the aggregate (all clusters combined) IT standpoint.

Size and Adoption Status

To explore "size" related associations with adoption *status*, a dichotomous measure (as explained above) for adoption *status* (0= no access to IT or 1= access to IT) was deployed. Since both size-related variables (small,

medium, and large) and IT adoption *status* (non-adopter, adopter) are categorical variables, a chi-square analysis to test for any association between size-related variables and IT adoption *status* was deemed appropriate. Tables 3a and 3b show the results. Since both e-mail and teleconferencing ITs have such high adoption rates across all size-related variables, the analysis indicates that 50% of the cells have expected count less than 5. The resulting count is too small to provide meaningful results using the chi-square test. For four of the remaining five ITs, the null hypothesis for the Pearson chi-square analysis (i.e., the adoption *status* is independent of size-related categories) can be rejected. This suggests that organization size and IT function size are associated with IT adoption *status* for four of the ITs surveyed. No support was found for any association between size (organization and IT function) and adoption *status* of web-based tools.

Given the association between size-related variables and adoption of collaborative ITs, we computed the Goodman and Kruskal tau to test for directional association between organization size and IT function size (independent variables) and adoption *status* of individual ITs (dependent variable). Based on a chi-square approximation, significant directional associations were detected between organization size and adoption *status* of videoconferencing ($p <= 0.001$), dataconferencing ($p <= 0.01$), proprietary groupware ($p <= 0.001$), and EMS ($p <= 0.01$). Similarly, significant directional associations were detected between IT function size and the adoption *status* of videoconferencing ($p <= 0.001$), dataconferencing ($p <= 0.01$), proprietary groupware ($p <= 0.001$), and EMS ($p <= 0.001$)

Table 3a: Chi-square tests between organization size and IT adoption status

Collaborative IT	Adoption Status	Firm Size [N]			Pearson Chi-Square		
		Small	Medium	Large	Value	df	Sig. [p <]
E-mail	NA	0	0	1	1.96	2	0.374
	A	29	45	37			
Teleconferencing	NA	3	4	1	1.82	2	0.402
	A	26	41	37			
Videoconferencing	NA	13	11	2	14.51	2	0.001
	A	16	34	36			
Dataconferencing	NA	11	13	3	9.90	2	0.007
	A	17	28	35			
Web-based Tools	NA	14	17	16	1.07	2	0.585
	A	13	26	22			
Proprietary Groupware	NA	19	12	6	20.70	2	0.000
	A	9	33	31			
Electronic Meeting Systems	NA	23	25	17	10.28	2	0.006
	A	4	18	20			

NA = Non-adopters A = Adopters

Table 3b: Chi-square tests between IT function size and IT adoption status

Collaborative IT	Adoption Status	IT Function Size			Pearson Chi-Square		
		Small	Medium	Large	Value	df	Sig. [p <]
E-mail	NA	0	1	0	1.56	2	0.459
	A	36	43	32			
Teleconferencing	NA	3	5	0	3.72	2	0.156
	A	33	39	32			
Videoconferencing	NA	17	9	0	21.50	2	0.000
	A	19	35	32			
Dataconferencing	NA	15	9	3	10.19	2	0.006
	A	20	31	29			
Web-based Tools	NA	17	16	14	1.81	2	0.405
	A	16	28	17			
Proprietary Groupware	NA	20	14	3	15.32	2	0.000
	A	16	30	27			
Electronic Meeting Systems	NA	30	19	16	14.08	2	0.001
	A	5	23	14			

NA = Non-adopters A = Adopters

To understand the relationship between size and aggregate adoption status of IT to support collaboration, we calculated the total number of ITs that had been adopted in each organization. If an organization had adopted all the seven clusters, a score of 7 was given and if only one of the IT cluster's had been adopted, the organization received a score of 1. Such an approach has been used in IT adoption studies when exploring a class of ITs (Grover and Goslar, 1993). We used a one-way ANOVA to test for differences in mean adoption of the seven IT clusters between the organization size and IT function size groupings. Since the size-related categories are ordered (small, medium, and large), we also used a linear contrast to test if there is a significant linear increase in aggregate adoption status from small to medium to large organization and IT function sizes.

Tables 4a and 4b summarize the results. There were significant differences in mean adoption between the three organization size groups and the three IT function size groupings. Given that the group sample sizes are unequal, the unweighted results of linear contrasts suggest that there is a significant (at $p <= 0.001$) linear increase in the aggregate IT adoption status as we move from small to large size-related ordered groupings. Therefore, the results suggest that larger organizations and larger IT functions are likely to adopt more ITs to support collaboration than their smaller counterparts.

Table 4a: Mean adoption of seven logical clusters of ITs by organization size and IT function size

Variable	Size Category	N	Mean Aggregate Adoption	SD
Organization Size	Small	29	3.93	1.58
	Medium	45	5.00	1.64
	Large	38	5.74	1.18
IT Function Size	Small	36	4.03	1.50
	Medium	44	5.20	1.69
	Large	32	5.72	1.11

Table 4b: ANOVA analysis to compare mean aggregate IT adoption across size-related variables and contrasts across group means

Organization Size				F	Sig. [p <]
Aggregate Adoption Status	Between Groups	(Combined)		12.31	0.000
		Linear Term	Unweighted	24.44	0.000
			Weighted	24.13	0.000
IT Function Size				**F**	**Sig. [p <]**
Aggregate Adoption Status	Between Groups	(Combined)		11.85	0.000
		Linear Term	Unweighted	21.95	0.000
			Weighted	22.38	0.000

Size and Adoption Level

As mentioned earlier, the original adoption scale (1 to 5) was re-coded to 0 to 4. Since 0 represented a non-adopter of IT, adoption *level* was measured by a range from 1 to 4. We used ANOVA to test for differences in IT adoption *level* between small, medium, and large organization size and IT function size groupings. Results from both the individual IT cluster standpoint and from aggregate (all clusters combined) levels are shown in tables 5a and 5b. Once again, contrasts across adoption *level* means between size-related groups were also used to test for relations among aggregate adoption *level* means in the size-related groupings. Note that adoption *level* analysis does not include non-adopters. Therefore aggregate adoption *level* mean was computed by averaging the adoption *level* across only the adopted IT clusters as opposed to all IT clusters.

Table 5a: Comparison of mean adoption level among seven logical clusters of ITs by organization size

Collaborative IT	Organization Size	N	Mean Adoption Level	SD	F	Sig. [p <]
E-mail	Small	29	3.90	0.41	2.73	0.07
	Medium	45	3.60	0.65		
	Large	37	3.51	0.87		
Teleconferencing	Small	26	2.96	1.25	1.75	0.18
	Medium	41	2.44	1.16		
	Large	37	2.73	1.02		
Videoconferencing	Small	16	2.19	1.17	0.12	0.89
	Medium	34	2.21	1.09		
	Large	36	2.08	1.08		
Dataconferencing	Small	17	2.35	1.32	0.14	0.87
	Medium	28	2.18	1.02		
	Large	35	2.20	1.11		
Web-based Tools	Small	13	2.85	1.14	3.93	0.02
	Medium	26	1.92	1.02		
	Large	22	1.95	1.00		
Proprietary Groupware	Small	9	3.11	1.05	0.67	0.52
	Medium	33	2.73	1.13		
	Large	31	2.61	1.17		
Electronic Meeting Systems	Small	4	1.00	0.00	1.05	0.36
	Medium	18	1.61	1.04		
	Large	20	1.70	0.80		
All ITs Combined	Small	29	2.98	0.78	5.21	0.007
	Medium	45	2.53	0.64		
	Large	38	2.49	0.63		

Significant differences in adoption *level* were detected only for e-mail ($p < 0.10$) and web-based tools ($p < 0.05$) between small, medium, and large organizations. Interestingly, smaller organizations had higher adoption *levels* for both these IT clusters than their larger counterparts. When exploring the adoption *level* of all IT clusters combined, the results also suggest an interesting trend. Smaller organizations had significantly higher adoption *levels* ($p < 0.01$) than their larger counterparts. A linear contrast was used to test for any significant linear decrease in aggregate adoption *level* from small to medium to large organizations. Once again, since the group sample sizes are unequal, the unweighted results of linear contrasts were used. The *F* statistic (8.58) to test the contrast was found to be significant ($p = 0.004$), suggesting that there is a significant linear decrease in the aggregate IT adoption *status* as we move from small to large size organization groupings.

There were also significant differences in the adoption *level* of e-mail ($p < 0.10$) and videoconferencing ($p < 0.05$) between organizations with small, medium, and large IT functions. In both these cases, organizations with large IT functions had the highest adoption *level*. However, organizations with mid-sized IT functions had the lowest adoption *level*.

From the aggregate adoption standpoint, there were significant differences in adoption *level* between organizations with small, medium, and large IT functions ($p < 0.05$). Organizations with larger IT functions had higher aggregate adoption level than those with small IT functions. However, organizations with mid-size IT functions had lowest adoption *levels*, indicating a non-linear relationship. A quadratic polynomial contrast was requested in ANOVA. Given the unequal sample sizes of IT function, we used unweighted results of quadratic contrasts were used. The *F* statistic (6.75) to test the contrast was found to be significant ($p = 0.011$), suggesting that there is a significant quadratic relationship between IT function size and aggregate adoption level of collaboration ITs.

Table 5b: Comparison of mean adoption level for seven logical clusters of ITs by IT function size

Collaborative IT	IT Function Size	N	Mean Adoption Level	SD	F	Sig. [p <]
E-mail	Small	36	3.67	0.63	2.47	0.09
	Medium	43	3.49	0.86		
	Large	32	3.84	0.45		
Teleconferencing	Small	33	2.64	1.22	1.40	0.25
	Medium	39	2.49	1.21		
	Large	32	2.94	0.95		
Videoconferencing	Small	19	1.95	1.22	3.90	0.02
	Medium	35	1.89	1.05		
	Large	32	2.56	0.95		
Dataconferencing	Small	20	2.00	1.12	2.03	0.14
	Medium	31	2.06	0.96		
	Large	29	2.55	1.21		
Web-based Tools	Small	16	2.38	1.20	0.74	0.48
	Medium	28	1.96	1.00		
	Large	17	2.18	1.13		
Proprietary Groupware	Small	16	2.88	1.20	0.18	0.83
	Medium	30	2.67	1.09		
	Large	27	2.70	1.17		
Electronic Meeting Systems	Small	5	1.80	1.30	0.83	0.44
	Medium	23	1.43	0.79		
	Large	14	1.79	0.89		
All ITs Combined	Small	36	2.74	0.80	3.42	0.036
	Medium	44	2.43	0.63		
	Large	32	2.80	0.61		

DISCUSSION AND CONCLUSIONS

The objectives of this paper were twofold. We wanted to investigate the pattern of adoption of IT to support task-oriented collaboration and to explore the effects of size-related variables on adoption of IT to support collaboration in U.S. organizations. We are not aware of a single macro-level study that has focused on investigating the pattern, status, and the level of adoption of a class of collaborative technologies across organizations. With so much emphasis on group work and team collaboration to accomplish tasks, it is imperative that efforts be undertaken to inform practice and research regarding the extent to which IT is supporting task-oriented collaboration. This study begins to fill this gap in past research. We now turn to a discussion of our research results.

Adoption Patterns

We found that e-mail and audio teleconferencing technologies are currently the most heavily adopted IT clusters for supporting task-oriented collaboration. Over 90% of the organizations reported that these technologies are available to at least some members of their organizations. While substantial majorities of respondents indicated that proprietary groupware, dataconferencing, and videoconferencing were available in their organizations, significantly fewer reported adoption of web-based tools, and less than 40% reported the availability of EMS. Thus the pattern of adoption of different ITs to support collaboration varies considerably.

The popularity of e-mail and audio teleconferencing to support collaboration suggests that these technologies may be able to support collaboration to a larger extent than was originally predicted by media richness theory. Some researchers have been questioning the validity of media richness theory. It has been reported that managerial communication using e-mail is capable of being "rich" (Lee, 1992) and that managers preferred to use e-mail for communication despite the fact that it was considered a lean media by media richness theory (Markus, 1994). Recent evidence also supports that many end-users have experienced e-mail communication episodes where "rich messages" were exchanged (Ngwenyama and Lee, 1997) even though e-mail lacks immediate feedback capability, and it is a single channel that sifts out cues and reduces language diversity in communication.

Although from a collaboration standpoint it appears that simple, inexpensive, easy to use technologies like e-mail and audio conferencing can widely support task-oriented collaboration, these ITs still have only limited capabilities. For example, recent research suggests that e-mail may be effective in accomplishing group tasks that involve generation of ideas, brainstorming, planning, and scheduling but less effective in group tasks that involve choice, negotiation, and execution (Wilson, 2002). Conventional wisdom suggests that tasks and requirements often vary in collaboration projects. Clearly, no single IT cluster can effectively support all collaborative tasks. The task-technology fit theory supports this notion and suggests that performance impacts will result only when "a technology provides features and support that 'fit' the requirements of a task" (Goodhue and Thompson, 1995, pp. 212). Even though the focus of task-technology theory was on individual performance, we believe that it is also valid for group performance during collaboration. There have been dozens of practitioner reports and research papers published over the last decade that clearly make a strong case for the support many technologies can provide in task-oriented collaboration. Our own experiences have shown that multiple IT clusters are needed and required to enhance the quality of task-oriented collaboration in group work.

Adoption Status

Does size matter? Since few studies have focused on a class of technologies to address this question, our analysis provides interesting insights to explain some of the inconsistent findings of past investigations.

When the focus is on individual IT adoption status, our analysis suggests that size-related variables (organization and IT function size) may not be associated with the adoption of relatively inexpensive and easy to use collaboration tools such as e-mail, audio teleconferencing, and web-based tools.

However, size is associated with the adoption status of collaboration tools that are more costly to acquire, fairly complex to use, require a technical support infrastructure, and/or need dedicated facilities. The adoption of videoconferencing, dataconferencing, proprietary groupware, and electronic meeting systems can be viewed from this standpoint. Therefore, size-related variables apparently do not alone explain the adoption status of every collaborative IT.

However, when considering the aggregate status of adoption of a class of technologies, our analysis suggests that larger organizations are likely to adopt more collaborative technologies than their smaller counterparts. Perhaps the greater physical dispersion of larger organizations, the greater presence of distributed teams, and availability of greater resources to devote to the acquisition of ITs that can support task-oriented collaboration may explain this association. Similarly, the general trend also suggests that organizations with larger IT functions are likely to adopt greater numbers of ITs to support collaboration than organizations that have smaller IT functions. This is understandable, since many of these technologies are fairly complex and may require significant technical support for successful adoption.

Adoption Level

When we consider the adoption level of individual IT clusters amongst the adopters, organization size may be of less significance for the majority of these IT clusters. However, for e-mail and web-based tools, we found that smaller organizations had adopted these inexpensive IT clusters to significantly higher levels than their larger counterparts. While the results are quite significant for web-based tools (it should be noted that medium and large sized organizations have almost the same adoption levels), they are barely significant for e-mail. When exploring the effects of IT function size on adoption level of individual IT clusters, the results are somewhat puzzling. While we found that organizations with larger IT functions may adopt e-mail and videoconferencing (once again the results for e-mail are barely significant) to a greater level than those with smaller IT functions, we also found that organizations with mid-sized IT functions had the lowest adoption level for both of these IT clusters.

At the aggregate level, our results provide interesting findings. Smaller organizations had higher level of aggregate adoption than their larger counterparts. Thus, while larger organizations tend to adopt a greater number of the technologies to support task-oriented collaboration than their smaller counterparts, smaller organizations make the adopted ITs available to a greater proportion of their end-users than their larger counterparts. Perhaps, the more homogeneous structure of smaller organizations and the greater heterogeneity in larger organizations can explain this effect. End-users in small organizations often perform multiple roles and exhibit greater cohesiveness. As a result, there are likely to be fewer distinct groups with dissimilar needs. Thus smaller organizations may be evaluating adoption of ITs based upon the common requirements of the entire organization. This, coupled with the fact that smaller organizations typically have limited resources for technology adoption, may be leading to situations where fewer ITs are adopted but once adopted they are made accessible to larger proportion of end-users.

On the other hand, end-users in large organizations typically perform specialized tasks, resulting in greater heterogeneity and the presence of multiple organizational sub-groups with unique characteristics. Members of each sub-group may prefer to adopt a specific IT to collaborate because it may better support their task needs and collaboration environment. Thus, large organizations may be more likely to adopt multiple collaborative ITs based upon the specific needs of specialized groups. The adoption decision for a particular IT may be driven by the preference of a critical mass of users within a group in an organization. This, coupled with the greater amount of resources available for technology adoption in large organizations, may be leading to situations where a greater number of different ITs are being adopted by the multiple sub-groups. Though a specific IT may be accessible to all members in a sub-group, it may not necessarily be available to members of all the different sub-groups, and therefore, will be

available to a smaller proportion of all organizational end-users.

When exploring the impacts of IT function size at the aggregate level, the results are once again, somewhat puzzling. While there are significant differences in aggregate adoption level of ITs between organizations with small, medium, and large IT functions, the trend is not linear. Organizations with larger IT functions had the highest adoption levels of IT clusters and those with mid-sized IT functions had lowest adoption level of IT clusters. Although we did find organization size to be associated with IT function size, there were twenty mid-sized organizations that had small IT functions. Given a limited data set, we deployed a grouping scheme that we thought would be logical. Perhaps our classification of IT function size may not have been optimal. As a result, our findings related to association between IT function size and adoption level (individual and aggregate) should be interpreted with caution. Table 6 summarizes our findings exploring associations between size-related factors and adoption of collaborative ITs investigated in this study.

Like every research investigation, our study has some limitations. First, the analysis presents only a snapshot of IT adoption to support collaboration. We are not able to discuss how these patterns of adoption are changing over time. A longitudinal approach will help shed light on these trends, and the researchers intend to pursue this method in coming years.

Second, a single respondent was used to collect data from each organization. However, the majority of our respondents held senior level positions in their respective organizations. Given that our intention was to investigate organizational level adoption of IT to support task-oriented collaboration across a subset of organizations, we can certainly argue that these respondents add credibility to our research. Moreover, we did request that the survey be completed by the person most knowledgeable about IT support for task-oriented collaboration.

Third, only U.S. organizations were included in our study. With greater emphasis on a global perspective, this research needs to be extended to other regions and cultures and this effort is already underway in several countries.

Table 6: Summary of findings: organization size and IT adoption

Size-Related Variables	**Association with Adoption**			
	Status		Level	
	Individual ITs	Aggregate Across ITs	Individual ITs	Aggregate Across ITs
Organization Size	Yes (positive) with adoption of videoconferencing, dataconferencing, proprietary groupware, and EMS	Yes (positive)	Yes (negative) with adoption of e-mail and web-based tools	Yes (negative)
IT Function Size	Yes (positive) with adoption of videoconferencing, dataconferencing, proprietary groupware, and EMS	Yes (positive)	Significant differences detected (but not linear) for e-mail and videoconferencing	Significant differences detected (but not linear)

Finally, there are some limitations posed by the non-probability sampling technique selected for this study and the low response rate of our study. Since our study included surveying member organizations of SIM (a premier society for the dissemination of current IT practices), the membership of the society may not be representative of the general population of U.S. organizations. Clearly, a random sampling approach would have yielded much more reasonable estimates of characteristics of U.S. organizations as they relate to the adoption pattern, adoption status, and adoption level of IT to support collaboration. As a result, the findings from this study should be interpreted with some caution. Coupled with the fact that the study had a somewhat low response rate, the generalizability of our study findings may also be limited to organizations with profiles similar to member organizations of SIM.

However, despite the limitations, we have added to the existing body of research by exploring the adoption of seven IT clusters to support task-oriented collaboration. In addition, we have also tried to address an empirical inconsistency about size-related effects on IT adoption. We know for certain that IT clusters are being adopted to support collaboration. Virtually all organizations reported the adoption of some form of IT for collaborative support. While the focus of this paper was primarily on size-related predictors of IT adoption, other predictor categories of adoption may be important and need to be investigated in the context of collaborative ITs.

Overall, our research findings open up several avenues for future investigations. Why is it that some of the IT clusters have relatively lower adoption? Are they highly specialized and appropriate for supporting fewer tasks? Are the ITs poorly designed? Are they a poor fit to organizational needs? Are they still too costly to acquire? Do organizations find it difficult to justify investments to acquire these collaborative technologies? Is it difficult to convince users to try these technologies? Are developers doing a poor job of demonstrating the benefits? Does the success of these systems depend on an internal champion and collaboration manager? What are the other barriers to adoption of these ITs? These are important issues and should be addressed in future research so that developers can be more informed as they undertake initiatives to refine, build, and deliver the next generation of collaborative tools.

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