Team Size and Technology Fit: Participation, Awareness, and Rapport in Distributed Teams

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***Abstract*— In this paper we investigate the effects that team size has on geographically distributed team behavior and technology choice. We report results from a survey of distributed team members conducted within a large, multi-national technology manufacturing organization. Responses indicate that members of smaller teams participated more actively on their team, were more committed to their team, were more aware of the goals of the team, had greater awareness of other team members, and were in teams with higher levels of rapport. Larger teams are more conscientious than smaller teams in preparing meeting agendas. Team size was also associated with different technology choice: larger teams adopted technology to support the coordination of asynchronous work, while smaller teams adopted technology that primarily supported collaboration. We discuss the implications of distributed team size for team performance and technology adoption.**

***Index Terms*— Computer-mediated communication, computer-supported cooperative work, distributed teaming, rapport, team size, virtual teams.**

I. Introduction

Distributed team size is an important issue that warrants careful consideration because the availability of network connectivity and widespread collaboration technology use may encourage such teams to grow unchecked. While travel budgets and conference room space limit how many people can participate in collocated work teams, the main constraint on the size of distributed teams is the scalability of the collaboration technology used by the team. As scalability limitations become less of a factor the virtual conference room can expand at least in theory towards a nearly infinite space [1].

A commonly held assumption underlying the decision to adopt a team-based organizational structure is that teams outperform individuals, especially when performance requires multiple skills, judgments, and experience [2]. Yet this assumption is highly debatable; among the many compelling arguments against the superior performance of teams over individuals are the process losses arising from the logistical demands of teaming and the effects of team size on performance. Findings from a survey of teams in companies in the United States indicate that 66% had at least one member who was permanently assigned to a location geographically distant from the rest of the team [3]. Among these distributed teams, 31% of the members were not collocated with the others on their team. The trend towards reengineering organizations around teams has occurred in parallel with the proliferation of computer-mediated communication technology, rise in telecommuting, and increased reliance on information technology in organizations [4]. Over the last decade, many global corporations have deliberately leveraged collaboration technologies and the practice of telecommuting to overcome the logistical demands of organizing a geographically dispersed workforce into teams and to exploit expertise that is distributed across their organizations. The resulting organizational form is known as the distributed team (i.e., work teams that use technology to communicate with one or more geographically remote members) [5]. The word virtual team was originally used to describe teams that conduct meetings in electronic meeting spaces, but the concept has evolved to apply to geographically dispersed teams using a gamut of collaboration technologies including teleconferencing [6]--[10]. Communication in "virtual teaming may be as elaborated as a 3-D rendered electronic environment or as mundane as a conference call" [5, p. 6]. Thus the term virtual simply connotes "virtual collocation" [11, p. 162]. We prefer the term "geographically distributed team," and use it here because we believe it more precisely describes the teams we studied.

The teaming trend and wiring of the workplace have laid the organizational and technological groundwork for distributed teams. Recent academic studies of distributed teaming at Boeing Corporation [11], [12] and management texts [7] have identified some features of distributed teams that may distinguish them from collocated work teams. Factors that could be considered unique to distributed teams are the coordination problems caused by transfer of physical deliverables, the fact that membership on such teams often spans organizational boundaries, and the empirical evidence that a single employee will have occasion to participate on multiple teams when teams become geographically distributed. Furthermore, distributed teams have been studied from the perspective of various social variables including trust [8], [9]

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identity [13], leadership [10], [14], and culture [15], [16]. Others have studied distributed teams from the task perspective, reporting that even such complex, domain-specific communication tasks, such as business process re-engineering and internet infrastructure design, can be successfully managed by distributed teams using computer-mediated communication technologies [17], [18]. However, despite studies which have addressed social aspects of distributed teams, scant research exists that examines the effects of team size on distance collaboration. We believe team size warrants study because it is a likely candidate to affect fundamental team behaviors of participation, rapport, and awareness that underlie complex social behaviors of trust, identity, and leadership.

Next we discuss academic research regarding the size of work teams vis-à-vis distance collaboration. This discussion provides the conceptual foundation for the seven hypotheses which we subsequently outline. After this, we present a description of our research setting and methodology, then a detailed look at our results as they relate to each hypothesis. Finally, we discuss interpretations and limitations of our findings in the Discussion section.

II. Distributed Team Size

Since the early 1990s, organizational forms based on collocated subunit structures were being deemed obsolete by academic and industry specialists alike [2], [19]; they have been called "blunt instruments" for the delicate and complex intellectual tasks demanded by today's global economy [19]. As noted above, carefully conceived research examining the social and technological variables of distributed teams has increased over the last 10 years in keeping up with the popularity of distributed teams. Yet one variable that has received surprisingly little attention in the study of distributed teams is that of team size. This is especially surprising when we consider that since the 1950s, the fields of social psychology and organizational behavior have had an active research agenda examining how group size affects participation and process. Large team size has been linked to lower participation in group activities [6], [20]. As the size increases, the disparity between who participates and who does not increases dramatically [21]. This data was interpreted by Shaw to reveal that in large groups, group structure becomes better defined as size increases, for example in adopting different roles, particularly that of leader [22]. In addition to level of participation, group size has been associated with other effects. Larger size leads to more conformity to group norms [22], less motivation to perform [23], and lower satisfaction, as measured along a variety of dimensions (e.g,. [24]—[26]).

Thus, although larger groups provide obvious advantages of having more diverse expertise, skills, and problem-solving approaches, they entail more coordination costs than smaller groups. Combining work, arranging schedules, and remembering each member's particular expertise become more difficult as team size increases. It is not uncommon for distributed teams to consist of large numbers of members. Electronic communication technology, such as email and application-sharing, in conjunction with data sharing technology such as expertise systems, help to compensate for the disadvantages of team size by maintaining availability and expertise data on teammates and by establishing a continuous, synchronous channel of communication between geographically remote participants. Mark et al. report on the successful collaboration of one large distributed team in a global company that invited all interested parties, irrespective of geographical location, to join in on their distributed team meetings [11]. This study provided qualitative and quantitative evidence that although many barriers still exist for adopting technology across distances (e.g., hardware incompatibility or lack of infrastructure), technology can engage a large number of team members from nearly any geographic location in constructive collaboration as a distributed team. However, common sense tells us that limits exist on the size that a team can expand to, even given current technological capacities, without compromising participation or performance. Yet, the effects of size on distributed teams are largely unknown.

What we do know is that the more group members there are on a team, the less opportunity each member has to participate during a meeting. In a distributed team the question becomes, who is less likely to participate? There has been some discussion on the main site advantage in distributed teams; this concept explains why those members located at the main company site participate more in the team whereas those members located in remote sites feel less connected to the team [11], [13]. We also know that nonparticipation and poor performance are more visible in smaller groups [27]. Quite simply, we are more accurate at keeping a mental record of who is participating and who is not when the number of team participants is fairly small. We would expect similar effects on visibility in distributed teams, especially during synchronous work. When a distributed team is small, we would expect that other members are more aware of the effort of each individual. There should be less free riding, as would occur in a larger team where behavior is less visible.

Additionally, we believe team size may affect media choice. Existing theories on technology choice may be focused too narrowly on the act of information exchange. These theories identify information exchange as the driving factor affecting the choice of media. For example, Daft et al. conclude that a rich, or high, bandwidth medium such as the phone is the technology of choice for highly equivocal tasks, such as salary negotiation [28]. Synchronous exchange of information that the high bandwidth phone affords is better suited to such tasks, compared to other media such as email. Conversely, low bandwidth media such as printed mail are better suited for non-equivocal tasks, such as communicating purchase orders. The related theory of social presence of Short et al. concludes that some media allow more social cues to be transmitted during communication than other media [29]. For example,

audio and printed media fail to convey a number of visual cues present in face-to-face interaction, such as facial expression, eye contact, gestures, and proximity. Social presence theory suggests that users match the communication task to the social cues afforded by a technology. Again, the level of analysis is on the act of exchanging information--when we want to communicate with others, we select technology to fit the character of the information exchange task before us.

A. Hypotheses

When we began this study, we suspected that there may be a hidden cost to large team membership enabled by technologies such as a virtual team room. We also suspected that other variables, besides information exchange, may drive the fit of a technology to a team. We focused particularly on variables that we believe are associated with team size. In this section we describe our hypotheses.

H1: *Team size should affect the level of participation in a distributed team. Members of smaller distributed teams should participate more in the team than members of larger distributed teams.*

Previous research on participation in physically collocated teams shows that smaller sized teams have higher participation among the members. Though distributed teams differ from collocated teams in that telephone and/or computer-mediated communication is used, we would still expect to see effects of size on participation. The behavior of team members in smaller teams should be more visible than in larger teams. Because nonperformance is also more visible, we expect that participation in small teams would be higher in a greater proportion of the team's members.

H2: *Team size should affect the knowledge that teammates have about other members. Members of smaller distributed teams should have more knowledge about others' work roles, expertise, and communication styles.*

As a consequence of participating more in the team, members of smaller distributed teams should have more awareness about other team members. In particular, we expect that in smaller teams, people are more likely to learn the work roles and expertise of other members. Because smaller teams would have chances for more intimate communication (due to more participation), we expect that members would learn when others are available for communication and how willing they are to communicate. We expect that a large team size would diminish these types of awareness.

H3: *Team size should affect the level of rapport among the team members. Members of smaller distributed teams should have greater rapport than members of larger distributed teams.*

As a consequence of participating more in the group, we expect that members of smaller distributed teams will have developed better *rapport*. We define rapport as enjoyment in interacting and working together with other team members. A team with high rapport would have members who like and respect each other. We expect that in smaller teams there would be more informal interaction enabling rapport to be developed. In larger distributed teams, interaction should be more formal, or more unequally weighted toward the team leader, hindering the development of rapport.

H4: *Team size should affect the commitment of the members. Members of smaller distributed teams should have greater commitment to the team than members of larger distributed teams.*

Small teams who are physically collocated have been shown to have higher cohesion than larger teams [24]. We expect that in small distributed teams--where people know and like other team members--higher levels of cohesion would develop. As a result, members of smaller distributed teams should have higher commitment to the team compared to members of larger distributed teams.

H5: *Team size should affect the knowledge of team goals. Members of smaller distributed teams should have a clearer understanding of the team goals than members of larger distributed teams.*

We expect that in smaller teams, people would have more of a chance to discuss team goals and evaluate whether their team's actions are consistent with these goals. In a larger distributed team, we expect the participation to be more dominated by the team leader, and members may have less of a chance to question whether actions are consistent with the goals.

H6: *Team size should affect the procedures in the team. Larger distributed teams should have better-defined procedures and should maintain them better than smaller distributed teams.*

Because larger teams require more coordination, we expect that larger teams will have developed better-defined team structures and procedures concerning aspects such as the team agenda and minutes.

H7: *Team size should affect the choices for technology to support the distributed team. Larger distributed teams should choose technologies that support coordination and team logistics, whereas smaller teams should choose technologies that support communication and collaboration.*

As larger teams require more coordination than smaller teams, we expect that larger teams will be more likely to adopt technologies that support team coordination and logistics. As smaller teams require less coordination, we expect that their technology choice for the team would rather support communication and collaboration. We do not believe that large teams would use coordination technology to the exclusion of all other technologies, but rather that the adoption patterns of large teams would differ from small teams with regard to satisfying a more pressing need for coordination.

III. Research Setting and Methodology

A. Research Setting

In winter of 2000, a management group at a large multinational technology manufacturing corporation named Simcon (a pseudonym) met to discuss productivity issues at

what was called the Productivity Summit. All business groups that had a vested interest or had something to contribute were invited to attend. Through brainstorming and discussion, the outcome of this session identified that the corporation was wasting a lot of time and money due to meeting ineffectiveness. As the issue was further scrutinized, it became clearer that very specific problems could be linked to distributed team meetings. Simcon is a highly dispersed corporation that almost exclusively leverages meetings to bring teams together to get work done. Simcon also has a philosophy of hiring the best person for the job, regardless of geographic location. With tremendous, rapid growth, this quickly presented challenges as employees struggled to work together across time zones, distance, or other cultural barriers.

Old norms provided the flexibility of frequent travel to meet face-to-face. Because of this, employees did not have to invest time in learning new skills required in distributed team situations. However, as travel budgets became limited, teams struggled even more to accomplish tasks and meet deliverables. It was determined that being ineffective in distributed teams was a much more critical issue than in the past. The corporation no longer had the ability to compensate for the lack of skills by traveling to meet face-to-face. Thus, the productivity summit met and decided that teams had to get better at working together --while apart --and the research described here was conducted.

B. Methodology

This research methodology and findings described here represent the initial study spawned by the research summit's mandate to examine distributed teaming at Simcon. Eighteen teams were identified in the organization that met the criteria of having well-defined team membership and being willing to participate in the study. We operationalized our seven research hypotheses into a 72-question survey. We used two strategies to achieve this operationalization; for some questions we directly appropriated the language from our hypothesis and applied it in the survey question. We also used closely related concepts in the survey questions. For example, for Hypothesis 3 regarding rapport we directly asked respondents to rate the extent to which they agree that good team rapport currently exists. We also asked about dimensions of teamwork, trust, and truthfulness. A web link to this survey was emailed to 204 members of 18 different teams across Simcon. Tables II through VIII present the survey questions. The tasks the teams were engaged in were diverse. All participants were assured that strict anonymity and confidentiality would be maintained. Codes were used instead of names.

There was no systematic relationship of task type to team size. Examples of teams and their tasks were a project team designed to develop relocation policies, a taskforce established to standardized hazardous waste removal practices across manufacturing sites, and a knowledge management team established to share lessons learned associated with troubleshooting production technology at different manufacturing sites.

The overall response rate was 89% (181 responses). The teams ranged in size from 4 members to 18 members. The response rate for individual teams ranged from 28% to 100%. Team members were initially asked a set of background questions such as, How long have you been at Simcon? What is your job title? The rest of the survey used a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree) for items such as, I know the goals of the team and A clear agenda is published at least 24 hours prior to team meetings. For questions pertaining to frequency (Table 2), the scale was 1 = infrequently and 7 = frequently--for example: How often do you normally participate actively in team meetings (by asking questions, presenting ideas, etc.)? Teams selected for our study had similar relative levels of geographic dispersion, that is, the proportion of members who were located in different countries was similar across all teams. A post hoc analysis on responses received proved this to be true (an ANOVA on geographic dispersion showed no effect for size).

In order to test our hypotheses, we needed to be able to compare smaller versus larger teams. As we could find no precedent as to how many people constitute a small or large team, we considered teams with 9 or fewer members to constitute a smaller team, and teams with 14 or more members to constitute a larger team. Thus, in our analysis we included only those responses from people who were members of teams of 9 people or less, and responses of people from teams of 14 people or more. While we cannot definitively claim that 9 people are a small team, this division of our data enables us to compare the effects of smaller and larger teams. The smaller team sizes ranged from a team size of 4 to 9 people. The larger team sizes ranged from 14 to18 people. After coding the data to reflect this criteria for small and large teams, there were a total of 39 responses from people of smaller teams and 70 responses from people of larger teams for a grand total of 109 responses. The responses from 72 members of mid-sized teams (ranging from 10 to13 persons) were omitted. Table I shows the breakdown of the responses according to team size.

[see Appendix: Table I]

IV. RESULTS

Our first hypothesis addressed the relationship between participation and team size. Three questions shown in Table II specifically addressed H1. A MANOVA shows that responses from all three questions indicate that members of smaller teams, compared to larger teams, participate significantly more in team meetings.

[see Appendix: Table II]

The mean response from members of smaller teams to the question, How often do you normally participate actively in team meetings (by asking questions, presenting ideas, etc.)? is

higher than from members of larger teams. Interestingly, the members of smaller teams reported that they were encouraged significantly more by their team leader or meeting facilitator to interact with their team members between meetings compared to members of large teams. This encouragement appears to result in more interaction, since the response to the question, How often do you normally participate between meetings (using collaboration tools)? is higher for smaller teams. Thus, smaller teams apparently are encouraged to participate and are responding to that encouragement by interacting with their team members via collaboration technology more often than are members of larger teams. Our data support our first hypothesis.

Our second hypothesis stated that members of smaller distributed teams should be better acquainted with their teammates and have more awareness about their work roles, expertise, and willingness to communicate with others on the team. Compared to small teams, we proposed that large team size would provide less opportunity to cultivate these types of awareness. We considered four of our survey questions to address the amount of awareness that team members have of others on their team (Table III).

[see Appendix: Table III]

A MANOVA performed on these questions showed a significant difference in the degree of favor of smaller teams. Members of the small teams claimed they knew others on their team better on a personal basis, were better acquainted with their work roles and expertise, and knew more about the means by which they could communicate with their teammates, compared to larger teams. Thus, our data supported the second hypothesis.

Our third hypothesis stated that smaller distributed teams will develop better rapport compared to larger teams. Smaller distributed teams should have greater rapport than larger distributed teams. Six of the survey questions addressed rapport (see Table IV).

[see Appendix: Table IV]

A MANOVA shows that responses to these questions generally support this hypothesis, reaching a significance level of .06. Smaller teams have higher levels of rapport. Compared to those on larger teams, people from smaller teams reported that they enjoy interacting more with their team members, feel more strongly that they are working as a team, are communicating more openly and with trust, are maintaining an environment of truth, and that their team spent sufficient time in the initial meetings to develop rapport. Consistent with this, smaller teams agreed more strongly than larger teams that there currently exists good team rapport. Thus, our data supported our third hypothesis.

Our fourth hypothesis stated that as a result of knowing more about the other team members, members of smaller distributed teams should have higher levels of commitment to the team. Six questions in our survey addressed this hypothesis (see Table V).

[see Appendix: Table V]

The results of the MANOVA indicate that significantly higher levels of commitment exist among smaller teams compared to larger teams. Members of smaller teams reported more often completing their work on time, contributing their best work to their team, and keeping commitments to their team. Smaller teams also reported higher levels of satisfaction associated with working on their team, compared to members of larger teams. Larger teams reported that they multi-task more during meetings, which is an indication that they are not engaged with the team during meetings. Thus, our data supported our fourth hypothesis.

Our fifth hypothesis stated that the knowledge of team goals would be affected by team size. We proposed that members of smaller distributed teams should have better knowledge of the goals of their team. Three of our survey questions addressed team goals (Table VI).

[see Appendix: Table VI]

A MANOVA showed that members of smaller teams were significantly more aware of the goals of their team compared to members of larger teams. The former reported that they were more likely to know the goals of their team, that their team goals were more clearly defined, and that they were more likely to take responsibility for enforcing the agreed processes, goals, and ground rules. The data clearly supported our fifth hypothesis.

Because larger teams require more coordination, our sixth hypothesis stated that larger teams will develope better defined procedures concerning aspects such as the team agenda and minutes. Three questions addressed team procedures, focusing on the agenda and minutes (Table VII).

[see Appendix: Table VII]

A MANOVA shows that for larger teams, it was significantly more likely that a clear meeting agenda is published prior to, and in advance of, meetings, and that the agenda is sufficiently detailed. Again, our hypothesis was supported.

Our seventh hypothesis stated that, team size should affect the choices for technology to support the distributed team. We asked each respondent to report how frequently they used technology to interact with their teammates between meetings (Table VIII).

[see Appendix: Table VIII]

A MANOVA shows that there is a significant difference between responses of smaller and larger team members.

Simcon provided a variety of collaboration technologies (e.g., NetMeeting™ and eRoom™) to its teams yet did not mandate their use. Our data indicated that team members availed themselves of different technology depending on the size of the team to which they belonged. Larger teams were more likely to adopt technologies that support team coordination and logistics, compared to smaller teams. The data showed that large teams used Simcon's web-based meeting support technology more than small teams. The meeting support technology stored a meeting calendar for the team, displayed agendas, and provided a central repository for meeting minutes. The coordinating features of this technology appeared to be a better match to the needs of larger teams than smaller teams.

Small teams, on the other hand, were less likely to adopt meeting facilitation software but were more likely to adopt technology that supported synchronous collaboration such as application sharing (NetMeeting™) and information spaces (eRoom™). These technologies differed from the meeting support websites used by larger teams to the extent that they enabled virtual meetings and water cooler discussions via synchronous communication tools (e.g., chat), whiteboards for brainstorming, and screen sharing for group presentations. The meeting support websites offered only asynchronous collaboration in the form of document sharing. We argue that smaller teams reported higher levels of adoption of technology such as application sharing technology and information spaces due to the fact that they had less pressing coordination issues than larger teams.

V. Discussion

Our hypotheses were all supported by our data. Compared to members of larger teams, we found that members of smaller teams participated more actively on the team; were more aware of the goals of the team; were better acquainted with other team members' personalities, work roles, and willingness to communicate; and reported higher levels of rapport. We also found that members of larger teams reported that their teams were more conscientious in coordinating activities such as preparing meeting agendas, compared to smaller teams. Here we must address the question of whether the larger teams that participated in our study were inherently different than smaller teams across task dimensions. For example, a relatively larger proportion of members of larger teams could have served in advisory capacities by simply overseeing decisions rather than actively participating in debate. A larger proportion of work of this nature could have affected the decision to adopt technology that mediates coordination. Yet our analysis of the qualitative responses collected about team tasks identified no systematic differences in the type of tasks between large and small teams.

Our results lead us to consider reasons why our hypothesis concerning team size and technology choice (Hypothesis 7) was confirmed. We found that larger teams adopted technology to support coordination of asynchronous work whereas smaller teams adopted collaboration technology. We now speculate that since larger teams maintain their formal procedures better than smaller teams (at least for agendas), they pay more attention to their coordination processes. We hypothesize that this attention to coordinating activities in the larger teams influences them to adopt technology designed to facilitate coordination. On the other hand, smaller teams are able to coordinate themselves more effectively without formal coordination mechanisms. For example, people in a smaller team may pick up the telephone to arrange something with another member (they reported knowing when other teammates were available and willing to communicate). As a result, we hypothesize that this is the reason that the technology they chose to adopt facilitated collaboration rather than coordination. These findings lead us to challenge the media choice theories that promote the act of information exchange as the driving force behind technology choice [27], [29]. The findings suggest to us that the choice of technology may be driven by the context of use, (i.e., by the coordination needs of a distributed team based on its size rather than the singular need of information exchange). Thus, we propose that a broader level of analysis is needed when considering technology choice. The size of the communicating body may influence the choice of communication media as strongly as the character of the communication task. The fact that the communication tasks that our teams in this study engaged in differed across both large and small groups supports this theory. Because team size rather than communication task influenced technology choice, we propose that there may exist a fit between team size and media. Research is required to explore this notion further, yet we feel this study may shift the level of analysis in the study of technology choice; it may shift it from the granular level of information exchange to a higher, more contextualized level of group composition.

This study also raises the question, what constitutes the boundaries of a distributed team? As Mark et al. discussed, people from anywhere in a geographically distributed organization can connect to teams to participate in meetings [11]. Rather than develop the expertise they needed to speak knowledgeably on a technical topic, the team members in the Mark et al. study simply located the appropriate expert in the company and connected them to the team. The technology itself may impose boundaries on membership, but it may also break down boundaries. With some types of technologies, it may be difficult to join a meeting due to the need for complimentary, proprietary software, yet joining a meeting may also be as simple as obtaining a telephone number and password for a teleconference via email. One consequence of highly dynamic teams is that core members of any given team may not be aware of who the other members of the team are. There may, in fact, be levels of membership: core members and peripheral members. The study reported here targeted teams whose membership was well-defined, (i.e.,where one's role in the team dictated one's responsibilities). What our study

does not address is the emergent team structure of fluid distributed team membership.

A limitation of our study is that we only sampled teams from one large multinational corporation. It is not clear whether our results would apply to other global corporations. Simcon is unusual in the attention that they pay to making distributed teams work. Other corporations may have resistance at some company sites, for example, in not allocating financial resources for the conferencing hardware and software required to conduct distributed team meetings. We would nevertheless expect our results of the difference between larger and smaller teams to generalize.

Another potential limitation of this study is in how we defined smaller and larger teams. We deliberately used the terms smaller and larger to connote a comparison, so as not to label our teams small and large. It is not clear what constitutes a small team: a dyad, 4 people, or 10 people? Similarly, it is not clear what constitutes a large team: 14 people or 100? As we only tested these two groups (team sizes of 4 to 9 versus team sizes of 14 to19), we cannot say whether our results would hold for teams comprised of different sizes. For example, there may be a size threshold, above which the differences are no longer distinguishable.

Furthermore, we made every effort to have an unbiased sample, yet selection bias could have arisen from the fact that we administered our survey via the web; it is possible, for example, that only technically savvy individuals responded.

The findings from this study have implications for technology adoption. They suggest that certain types of teams may be more apt to adopt one kind of technology over another. This finding is by no means a predictive model of adoption. Nor does it offer any insight into team performance, as do formal interaction models of task/technology fit [30]. Nevertheless, we have found that smaller teams adopted collaboration technology, while larger teams were more apt to adopt technology designed to assist in their coordination efforts. Although technology use was entirely discretionary at Simcon, one can imagine a context where a mismatch exists between technology and team size. Some researchers have proposed that virtually collocated teams have unique technology requirements [12]. While we do not challenge this assumption, we put forth the possibility that some of these unique requirements might arise from factors such as size, which are independent of the virtuality of such teams. We also argue that an understanding of adoption patterns can assist us in our effort to design for adoption. We posit, for example, that building communication functionality into meeting management software could increase levels of collaboration among large teams. By increasing collaboration, we refer to increasing the participation, commitment, and awareness of others. In other words, we recommend putting the most immediate need of large teams first--this being coordination technology--and technologically piggybacking communication functionality onto this. We predict that doing so would not only increase the levels of adoption of communication technology among larger teams but also ultimately improve communication among those teams.

VI. Conclusions

Our findings imply that the size of a distributed team does matter. Size is a factor in participation, awareness of others, technology choice, rapport, commitment, and participation. Thus, when planning to implement distributed teams, and to deploy technology to support teams, management needs to consider team size. Perhaps as importantly, they need to consider the potential of the team to grow in size given the available technologies to support growth. To the extent that it highlights the adverse effects of large team size, this study represents a cautionary tale. One undeniable benefit of virtually collocated teaming is that adding members to a team requires little effort and cost relative to face-to-face teams. Our findings indicate that the lure of virtual collocation may in fact undermine its effectiveness when team size is permitted to expand unchecked.

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APPENDIX

Table I. Number of respondents according to team size.

	Number of respondents
Smaller teams	
4	4
6	7
7	11
9	17
Total Smaller	***39***
Larger teams	
14	7
15	12
17	15
18	36
Total Larger	***70***

Table II. Means (with standard deviations) for questions addressing participation.

Participation	**Smaller Team**	**Larger Team**	**F-value N=109**
I am encouraged by my team-lead/facilitator to interact often with my team members between meetings (for example, via telephone calls, email, face-to-face, etc.).	5.63 (1.17)	5.10 (1.38)	F(3,91)= 7.72, p<.001
How often do you normally participate actively in the team meetings (by asking questions, presenting ideas, etc.)?	4.71 (1.01)	3.86 (1.19)	
How often do you normally participate between meetings (using collaboration tools)?	3.85 (1.15)	3.16 (1.21)	

Table III. Means (with standard deviations) for questions addressing awareness of other team members.

Awareness	Smaller Team	Larger Team	F-value N=109
I am acquainted with the other members of my team (I know other members on a personal basis; I understand their working styles and cultures).	5.05 (1.65)	4.33 (1.58)	
I am acquainted with their work roles.	5.74 (1.20)	5.14(1.39)	F(4,101)=2 .66, p<.04
I am acquainted with other members' areas of expertise.	5.33 (1.30)	4.87 (1.38)	
I am acquainted with how willing they are to communicate (either face-to-face, via the telephone,	6.03 (1.14)	5.31 (1.20)	

Table IV. Means (with standard deviations) for questions addressing team rapport.

Rapport	Smaller Team	Larger Team	F-value N=109
I enjoy interacting with my team members.	6.23 (0.81)	5.60 (1.10)	
I feel like we are working together as a team.	5.64 (1.20)	5.19 (1.32)	
I communicate openly and with trust to others on my team.	6.31 (0.83)	5.94 (0.94)	
My team maintains an environment of truth, working to avoid dishonesty and covertness.	6.11 (0.83)	5.83 (0.92)	F(6,76)= 2.13, p<.06
I feel that sufficient time was dedicated in the first few meetings to build team rapport (good interaction between team members).	5.09 (1.71)	4.44 (1.27)	
I feel that there currently exists good team rapport (good interaction between team	6.10 (0.94)	5.37 (1.56)	

Table V. Means (with standard deviations) for questions addressing commitment of the team members.

Commitment	Smaller Team	Larger Team	F-value N=109
More often than not, I complete my work on time.	6.26 (0.80)	5.66 (1.15)	
I contribute my best work to the projects I work on with this team.	5.95 (1.11)	5.36 (1.54)	
Working on this team is a satisfying experience.	5.87 (0.93)	5.14 (1.42)	
I wish I could focus my efforts elsewhere than on the responsibilities I have in association with this team.	3.26 (1.60)	3.28 (1.62)	F(6,85)= 2.66, p<.02
I make a point to keep my commitments to the team and its members.	6.31 (0.73)	5.79 (0.84)	
How much time do you spend multi-tasking during meetings (for example, reading email, surfing the web, talking with other people, etc.).	2.33 (0.93)	3.00 (1.23)	

Table VI. Means (with standard deviations) for questions addressing goals of the team.

Goals	Smaller Team	Larger Team	F-value N=109
I know the goals of the team.	6.51 (0.14)	6.03 (0.11)	
Team goals were clearly defined.	6.13 (0.86)	5.79 (1.09)	F(3,104)= 3.54,p<.02
The team members take responsibility for enforcing the agreed processes, goals, and ground rules.	5.53 (1.22)	4.90 (1.22)	

Table VII. Means (with standard deviations) for questions addressing procedures.

Procedures	Smaller Team	Larger Team	F-value N=109
Is a clear agenda published at least 24 hours prior to the meeting?	4.29 (1.25)	4.94 (1.01)	
Are minutes published within 24 hours of the meeting?	3.81 (1.41)	4.06 (1.11)	F(3,97)= 3.02, p<.03
The agenda is sufficiently detailed.	4.32 (1.25)	4.71 (0.95)	

Table VIII. Means (with standard deviations) for questions addressing technology choice.

Technology choice I use the following techniques to communicate with team members between meetings:	Smaller Team	Larger Team	F-value N=109
Telephone conferencing combined with NetMeeting™	3.00 (1.22)	2.14 (1.23)	
eRoom™	2.50 (1.44)	1.68 (1.18)	F(3,91)= 7.60, p<.001
Web Meeting Manager™	1.20 (0.61)	1.66 (1.22)	