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Effectiveness of Collaborative Tool Usage for Virtual Team Activities

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ABSTRACT
This research explores the use of collaborative tools and their relationship with team tasks to develop a better understanding of computer support of virtual teaming from the theoretical perspective of Adaptive Structuration Theory (AST). High-level IT executives from 53 large organizations surveyed were asked to identify: 1) which collaborative tools are used within their organizations; 2) their frequency of use; 3) how they are used; and 4) how successful the tools are. AST, which has previously been applied to studies of technologies supporting group work (Poole and DeSanctis, 1990) conceives of technology use as a social practice that emerges over time. Successful use of a technology is dependent upon the effectiveness with which groups appropriate and modify the technology to meet their needs. The research discusses the differences in how collaborative tools are used between high- and low-performing virtual teaming groups, as well as how different organization structures appear at different stages of virtual team development.

Keywords
Virtual teams, collaborative technologies, team tasks and activities, adaptive structuration theory

BACKGROUND
Globalization and advances in information technologies have spawned a new type of team structure—virtual teams. Virtual teams are small groups of people working across time and distance supported by new computer and communications technologies (Lipnack and Stamps, 1997). It is widely acknowledged that teams outperform individuals acting alone, especially when performance requires multiple skills, judgments, and experiences (Katzenbach and Smith, 1993; Mohrman, Cohen, and Mohrman, 1995). Consequently, organizations are investing large amounts of time, money, and effort to support virtual teams with an expectation that team effectiveness will justify the costs. Unfortunately, organizations often do not achieve expected returns. The challenge is how to fulfill the potential of virtual teams by effectively supporting them with information technology (Mankin, Cohen, and Bikson, 1996). Due to the scope of this study and limitations on the research-in-progress submissions, most of our findings will be presented at the conference.

Virtual Teams
From Johansen (1979; 1991) to Coleman (1997) most virtual team-based studies have focused on the technologies needed to support teams of workers that are separated by time, distance, and culture. However, Becker et al. (1999; 2001) proposed that the success of virtual teams (VTs) required more than merely good collaborative tools. They proposed that the success of virtual teams require an equally important amount of attention paid to developing a high-quality collaborative work group environment. For the sake of simplicity, this paper uses the term virtual team as a euphemism for the generally more accurate, but cumbersome term, non-co-located collaborative work group.

This research examines virtual teams from both social and technological perspectives. The social perspective conceives of teams as a group of people who come together for a specific purpose and proceed through stages of development. Tuckman (1965) proposes a popular model of team development with teams proceeding sequentially through four stages of development: Forming, Storming, Norming, and Performing. A fifth stage, adjoining, was added by subsequent researchers (Harris and Sutton, 1986). When positioned on a graph with time on the x-axis and performance on the y-axis, these five developmental stages of teams form a type of S-Curve. Tuckman’s classical hypothesis is that team performance may actually drop during the storming stage as the organization culture undergoes a sometimes-painful transformation. The technological perspective of this research acknowledges that virtual groups must employ technology and that the group’s tasks and technologies combine to form the context in which a group develops. Group outcomes are not directly affected by the technologies employed, but rather by how technologies are appropriated and used by the group (Chidambaram, Bostrom...
The Tuckman stage model is used as one dimension of our classification system for identifying which organizations are high- and low-performing virtual teams.

Collaborative Technology Tools

The technology investigated in this study includes the seventeen types of collaborative technology tools proposed by Johansen (1979, 1991) and Coleman (1997) with the web browser tool added as advocated by Becker et. al. (1999; 2001). In addition to being a collaborative tool in its own right, the web browser has richly enabled the integration of many other collaborative tools. The eighteen tools included in this study are: E-mail/ Electronic Messaging, Audio Conferencing, Collaborative Presentation Software, Conference Room Video-conferencing, Desktop Videoconferencing, Discussion Databases, Document Management Software, Electronic Whiteboarding, Group Authoring, GDSS, Group Scheduling and Calendaring, Knowledge Management systems, One-way Bulletin Boards (BBS), Personal Communication Tools (includes laptops, cell phones, pagers, etc.), Project Management Software, Remote Dial-Up Access, Web Browsers, and Work Flow Management Systems. The extent to which organizations actually utilize collaborative tools is the second dimension of virtual teaming classification system.

Collaborative Work Tasks and Activities

To identify ways in which technology supports virtual teams the authors identified ten (10) basic virtual team activities/tasks using extant literature. In lieu of the formal term collaborative work group activities, we use the term virtual team activities to describe the social- and task-oriented behaviors required for effective group functioning. These activities include the following five task-oriented activities: 1) Meeting planning and management (Chidambaram and Bostrom, 1993), 2) problem solving and decision-making (George, Easton, Nunamaker, and Northcroft, 1990; Chidambaram and Bostrom, 1993), 3) planning and task coordination (Chidambaram et al., 1991), 4) goal setting and 5) performance monitoring and evaluation. They also include the following five social-oriented activities: 1) communications for team support, 2) sharing information, 3) creative idea generation (George et al., 1990), 4) conflict resolution (Chidambaram et al., 1991; Dennis and Garfield, 2003), and 5) group leadership (DeSanctis and Poole, 1994).

Virtual Teaming Grid

The two-dimensional model (see Figure 1) for collaborative work group formation and collaborative tool implementation was adopted from Becker (2003). The authors propose that Virtual Team development ideally progresses from Quadrant I to Quadrant IV; however, the path is not generally linear. Our descriptive model suggests that effective virtual teams progress from Quadrant I (Low techno-groups) through Quadrant II (Teaming enthusiasts) and then “fall” into Quadrant III (Techno-enthusiasts) and ultimately emerge in Quadrant IV as a high performing virtual team. We propose to investigate the structural differences in the teams and their organizations for in the high- and low-performing virtual team quadrants, in particular.

Figure 1. Virtual Teaming Grid
METHODOLOGY

The Questionnaire
The thirteen-page survey questionnaire developed for this research poses a variety of in-depth questions on the following topics: 1) Which collaborative tools are being used by virtual teams and for what purposes? 2) How frequently is each tool being used? 3) What percentage of the company’s virtual teams are using each tool? 4) How effective are the virtual teams? 5) What factors are most important for increasing team effectiveness? 6) What are the most important factors for a successful implementation of virtual teams? and 7) What are the most significant changes made by the organization to support virtual teams? The survey includes a complete glossary of terms section, questions pertaining to demographic information on the organization and individual, critical factors for collaborative technology management and support, and the future use of collaborative tools.

Data
From 1998 to 2002 the University of North Texas’ Center for the Study of Work Teams (CSWT) and Information Systems Research Center (ISRC) conducted a cross-disciplinary benchmarking study of collaborative technologies used for virtual teaming. Approximately 160 surveys were mailed to more than sixty organizations. Usable replies from 53 organizations are included in the analysis for this study. All participating organizations were engaged in some form of virtual teaming activities. While the sample was primarily a convenience sample from organizations that were closely affiliated with one or both of the research centers, many of these organizations are Fortune 500 organizations. Industries responding included Manufacturing, Consulting, Oil and Gas, Computing Technology, Financial Services, and Healthcare organizations. Approximately 75% of respondents were information technology managers and directors, CIO’s and VP’s.

Measures for Technology and Team Effectiveness
The collaborative tools measure is defined as the weighted sum of its frequency of usage and its extent of usage for each of the eighteen collaborative tools. The frequency of usage (daily, weekly, monthly, yearly), and the extent of usage (percentage of employees that use the tool) for each collaborative tool were reported. For example, email was generally used daily (score 4 for daily usage, 3 for weekly usage, 2 for monthly usage, 1 for annual usage, and zero for not used) by nearly 100% of the employees in an organization; so its score would be close to 4.0. Tools with scores close to 4.0 were considered to be pervasive tools; hence, this metric was called a pervasiveness measure of collaborative tool utilization. Finally, the pervasiveness scores for all 18 tools were averaged together to get an overall collaborative technology tool score. The maximum average is 4.0 on this scale (x-axis on Figure 1).

Based on survey responses it is possible to create measures for both the stages of team development and the level of team effectiveness. The team-effectiveness measure is defined to be the product of the average of perceived team effectiveness and the perceived stage of development. Hence a team at the Norming stage (level 3), but with effectiveness of only 3.0 would result in a weighted average team effectiveness score of 9.0. The most effective teams (4.0 rating) at the Adjourning (or mature level 5) would have a team effectiveness score of 20.0 (y-axis on Figure1).

PRELIMINARY RESULTS AND ANALYSES
Our preliminary analysis as expected reveals a very wide diversity of tool usage for different kinds of activities (See Table 1). Email and audio conferencing are used for over 50% of all activities. Other popular collaborative tools for a large number of activities include conference room videoconferencing (47%), personal communication devices (cell phones, pagers, etc.; 45%), project management software (33%) and remote dial-up devices (31%). The activity that is least likely to be performed with collaborative tools is conflict resolution with audio conferencing, personal communication devices and conference room videoconferencing being the preferred forms of non-face-to-face mediation tools.

FUTURE DIRECTIONS FOR THIS RESEARCH IN PROGRESS
The authors propose to conduct the following additional research:

1. Group and analyze the data in Table 1 according to each organization’s stage of virtual teaming development (e.g., Quadrant I vs. Quadrant IV);
2. Group and analyze the data in Table 1 according to whether the collaborative activities are social and task-related activities in order to map these results into more classical Adaptive Structuration Theory;
3. Include additional measures of success and effectiveness from the survey instrument to the “yes”/“no” results in Table 1, so better understand how effectively the collaborative tools are supporting the collaborative team activities.

4. Expand and further substantiate the list of “Best Practices” already observed below.

| Best Practices Observed |

Becker et. al (2001) have noted the following significant differences between the management practices of the Quadrant I teams compared with the management practices of the Quadrant IV teams: Quadrant IV organizations placed a higher premium on collaborative tool training, ease of collaborative tool usage, quality and availability of technical support, and the importance of a face-to-face kickoff event for new virtual teams; while Quadrant I organizations placed more importance on the need for group facilitation or leadership. Finally, both groups placed high importance on the ability to communicate non-face-to-face, setting well defined goals, assessing performance, planning and managing task completion, and defining a standard set of collaborative tools.

Table 1. Collaborative Tools and Team Tasks

![Table](https://example.com/table.png)
SUMMARY AND CONCLUSIONS

We discovered that most organizations that consider themselves “virtual teaming” organizations are struggling with this issue. A taxonomy for eighteen collaborative tools was used to assess the pervasiveness of collaborative technology usage in each organization. Similarly, a taxonomy for ten different team activities was proposed to examine how the collaborative tools were used. Virtual Teaming organizations were group according to their apparent stage of virtual team development on our Virtual Teaming Grid. Differences in virtual team structures, organization structures, the nature of the work being performed, and collaborative tools they used were analyzed. While a number of management practices and characteristics of the high- and low-performing organizations emerged, the size of the sample precluded a rigorous analysis of the findings. However, there does appear to be sufficient evidence and incentive for additional studies of this nature.

REFERENCES