

**Getting it Together:
Temporal Coordination and Conflict Management in Global Virtual Teams**

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Abstract

Virtual teams that operate asynchronously must do without mechanisms that synchronous teams have to coordinate their activity and manage conflict. The purpose of this study is to examine the effects of temporal coordination on virtual teams supported by asynchronous communication technology (Lotus Notes®). Specifically, we evaluate the moderating role of a temporal coordination mechanism, process structure, on the relationship between conflict management behavior and virtual team performance. We report on the results of an experiment with 175 individuals residing in the U.S. and Japan organized into 35 five-person teams. Our findings show that the way virtual teams manage internal conflict is a crucial factor in their success and temporal coordination has some significant moderating effects.

New pressures facing organizations have led many to suggest the use of global virtual teams¹. Simultaneously, recent technological advances are enabling new ways of structuring, processing, and distributing work and communication activities to overcome boundaries of time and space (Boudreau, Loch, Robey, & Straub 1998). In particular, new technologies are providing the means for *dispersed* (different place), *asynchronous* (different time) virtual work. Establishing links and connections is no longer a question of technical feasibility. The key question is, how can organizations create virtual teams that work effectively?

Extant theory of how teams operate is largely based on work done in non-virtual teams. Among the taken for granted assumptions in theory from non-virtual teams is that teams operate more or less in the same space and time; i.e., synchronously. Synchronous communication is assumed in most treatments of team functioning - for instance, in understanding how teams manage internal conflicts that could impede team functioning. Yet virtual teams cannot necessarily rely on traditional social cues and mechanisms, leaving them without a crucial mechanism for handling problems of team functioning. In such cases, the use of temporal coordination mechanisms imposed upon a team can be valuable because it can substitute to some extent for the cues that would naturally be available to members in a traditional face-to-face context (McGrath 1991; Ocker et al. 1995-1996).

Here, we perform an experiment testing the premise that the use of a temporal coordination mechanism can improve the performance of virtual project teams, specifically by affecting the way in which such teams experience and resolve conflicts. We draw on small group and information systems theory to examine key social processes underlying cooperative work in asynchronous virtual project teams. We report on the results of an experiment with 175 graduate students residing in the U.S. and Japan. Individuals were organized into 35 five-person teams dispersed across four research sites in the

¹ A global virtual team is a group of geographically and temporally dispersed individuals who are assembled via technology to accomplish an organizational task (Townsend, DeMarie, & Hendrickson 1998; Jarvenpaa & Liedner 1999). We focus on project teams - defined as time-limited, non-repetitive groups charged with producing a one-time output (Cohen & Bailey 1997).

U.S. and Japan. The virtual project teams communicated solely via Lotus Notes®, a widely used groupware system and application development platform.

TEMPORAL COORDINATION CHALLENGES

While there seems to be great potential for virtual teams, there are several fundamental sociotechnical difficulties in execution. Synchronous interaction is an orderly process wherein verbal and nonverbal cues help regulate the flow of conversation, facilitate turn-taking, provide immediate feedback, and convey subtle meanings. In lean asynchronous communication environments, the conveyance of cues is hindered, feedback is delayed, and there are often interruptions or long pauses in communication (McGrath 1991). In an asynchronous discussion, the norm is for many topics to be active at the same time with team members making contributions at different times (possibly on different topics) (Ocker et al. 1996). This can increase information overload and may reduce the synergy of the team if there is no linkage among the responses. In addition, long time lapses between communication events can lead to discontinuous and seemingly disjointed discussions (Ocker et al. 1996). This suggests that a significant challenge facing virtual teams is coordinating the temporal patterns of group behavior (McGrath 1991; Warkentin, Sayeed, & Hightower 1997).

Virtual teams must find workable substitutes for temporally coordinating their interactions and flows of information (Ocker et al. 1996; McGrath 1991). Temporal patterning is concerned with the rhythms by which groups synchronize their activities. Three generic temporal patterning problems are inherent in any group activity: temporal ambiguity, conflicting temporal interests and requirements, and scarcity of temporal resources (McGrath 1991). Teams typically use a variety of coordination mechanisms to manage temporal problems; e.g., scheduling (deadlines), synchronization (aligning the pace of effort among members), and allocation of resources (specifying time spent on specific tasks) (McGrath 1991).

Past research suggests that coordination mechanisms can encourage and facilitate communication, which in turn tends to surface alternative perspectives, debate, and potentially

disagreements (Ocker et al. 1996; Walther 1995). It is well known that teamwork is a communication and coordination-intensive effort characterized by complex group dynamics and the potential for conflict (Putnam 1986; Rahim 1992; Steiner 1972). Past research has considered various underlying social processes that determine team effectiveness. In particular, research has shown that conflict management behavior is an important determinant of group processes and performance (Baron 1989; Putnam 1986; Schweiger, Sandberg & Rechner 1989; Thomas 1992; Van de Vliert & De Dreu 1994). An important first step toward understanding how virtual teams work effectively is to explore how temporal coordination affects virtual teams' conflict management behaviors and performance.

Conflict in Virtual Teams

In virtual teams, the dispersed asynchronous communication context renders many of the usual forms of social control in teams inoperable (e.g., direct supervision, physical proximity, shared experiences, social trust) (Jarvenpaa et al. 1998). Virtual teams typically communicate via technology that is lean, low in social presence, and low in interactivity (Zack 1993). In other words, a groupware system like Lotus Notes® does not have the same capacity to convey the multiple cues that characterize human conversation. Gestures and nonverbal nuances, cues of social influence, symbolic content, and contextual cues are not captured or transmittable. This makes interaction and consensus building difficult (Straus 1996; Dennis 1996). As a result, effective communication in an asynchronous computer-mediated communication environment tends to require a great deal of effort (Smith & Vanacek 1990; Straus 1996). All of these communication and coordination difficulties create the potential for conflict in virtual teams that must be managed effectively (Jarvenpaa et al. 1998; Ocker et al. 1996; Turoff, Hiltz, Bahgat, & Rana 1993). Thus, while there are certainly many potential interesting factors to study about virtual teams, we focus on conflict management because it is a fundamental issue for effective virtual team performance given the inherent communication and coordination challenges they face.

TEMPORAL COORDINATION AND CONFLICT MANAGEMENT

One way to address the communication challenges facing virtual teams is to introduce temporal coordination mechanisms to the way virtual teams work. We define temporal coordination mechanism as a process structure imposed to intervene and direct the pattern, timing, and content of communication in a group (Ocker et al. 1995-1996; McGrath 1991). We expect that the introduction of a process structure will change the way virtual teams manage conflicts, with measurable performance consequences (Walther 1995, 1997). Next, we briefly review the relevant conflict management literature and discuss how we expect temporal coordination to affect the causes and consequences of virtual team conflict.

Conflict Management Behaviors.

Past research has identified various behaviors manifested by team members during conflict (Ruble & Thomas 1976; Poole, Holmes, & DeSanctis 1991; Sambamurthy & Poole 1992; Miranda & Bostrom 1993-1994). We draw on work by Rahim (1983, 1992) and Thomas and Kilmann (1974) that delineates five conflict handling modes to describe conflict management in organizational work groups: *avoidance*, *accommodation*, *competition*, *collaboration*, and *compromise*.

Avoidance behavior is characterized by evasiveness and failure to confront other parties. People demonstrating this behavior are apathetic toward conflicting points of view and outcomes in general. Accommodation behavior is characterized by an obliging concern for others. Competition behavior is characterized by each party pursuing his/her own interest without regard for others. This behavior involves concealment of information, competitiveness, and negative attitudes toward alternative solutions. Competitive interactions typically involve the use of power and domination as one party tries to force its views on the other. Collaboration behavior is characterized by attempts to identify and achieve outcomes that satisfy the interests of all parties involved. This behavior emphasizes openness to others' points of view, objective consideration of all information, and shared problem-solving toward a jointly optimal solution. Finally, compromise behavior is characterized by

intermediate concern for self and others. The parties acknowledge differences in preferences and then work toward settling on some intermediate position.

Effects on Virtual Team Performance

Drawing on past small group and information systems research, we expect that the five conflict management behaviors will have differential effects on performance in virtual teams, and temporal coordination will moderate these effects. We expect avoidance and accommodation conflict management behaviors to be detrimental to team performance. Both of these conflict management behaviors result in incomplete critical evaluation of alternatives, which in turn, decreases the quality of the decision. We expect *avoidance* to hurt team performance because it entails lack of involvement by a team member in the decision task. In a virtual team, this behavior would be manifested as absence or nonresponse. Avoidance by one (or more) team member(s) implies that the team does not have its full range of resources brought to bear on the decision task. For temporary teams convened to accomplish a task, any time wasted not working productively will have negative consequences on performance (Jarvenpaa et al. 1998). *Accommodation* is a negative conflict management behavior because it entails passive involvement in the team task. Thoughtless agreement by one party prohibits a team from achieving its full potential for synergy through collaboration. Past research suggests that accommodation behavior tends to create efficiencies in that decisions are made more quickly (Trubisky, Ting-Toomey, & Lin 1991). However, since such outcomes entail a one-sided process of giving-in rather than an integrative consensus-building process, this implies that information and alternatives are not fully considered and debated thereby decreasing the team decision quality.

For *avoidance* and *accommodation* conflict management behaviors, we expect temporal coordination to mitigate the negative effects of these behaviors on performance by counteracting the unassertive nature of these behaviors. Avoidance behavior is manifested as non-participation or non-response and accommodation is characterized by such actions as going along with others, agreeing without critical evaluation, and giving in to others' positions. A temporal coordination mechanism that

provides a sequenced procedure for work and problem-solving activities can reduce the detrimental effects of these behaviors (e.g., required submission of individual decisions, required review of team member opinions, required revision and submission of individual decisions). If the temporal coordination mechanism can help capture and integrate individuals' input into the team decision process, then the negative effects of avoidance and accommodation behaviors should be attenuated.

- H1. *Avoidance* conflict management behavior (a) has a *negative* effect on virtual team performance, and (b) temporal coordination *weakens* this negative effect.
- H2. *Accommodation* conflict management behavior (a) has a *negative* effect on virtual team performance, and (b) temporal coordination *weakens* this negative effect.

Competition is traditionally viewed as a negative conflict management behavior because one party disregards other team members' perspectives. Past small group research on non-virtual teams suggests that efforts by individuals to dominate or control group decision and communication processes result in reduced social integration, lower team cohesion, and poorer team performance (Gully, Devine, & Whitney 1995; Cohen & Bailey 1997). However, past research also suggests that competitive conflict management behaviors may be difficult to perceive in dispersed asynchronous communication contexts because normative influences are substantially reduced by the leanness of the communication media (Tan, Watson, Clapper, & McLean 1998). That is, while individuals may believe that they have *expressed* competitive conflict management behaviors, other team members may not perceive or *experience* them because of the communication constraints imposed by the technology.

Lean communication environments are characterized by reduced (or eliminated) nonverbal, paralinguistic, status, and other cues pertaining to social context. This type of environment can create a sense of anonymity and depersonalization, thereby potentially reducing individuals' inhibitions in group discussions and encouraging them to be assertive (Siegel et al. 1986). At the same time, it can make normative and competitive influences considerably more difficult to convey (Walther 1997). In a lean communication environment like Lotus Notes®, it is difficult, if not impossible, for other participants to perceive emotionally-laden content and cues. Competitive power plays may not be

perceived as such by virtual team members; rather such behavior may simply be viewed as increased participation (Walther 1997). Therefore, we do not expect competition behavior to have the typical negative effect on team performance predicted by extant conflict theory. Instead, we expect competition behavior to have a positive effect on performance. In addition, we expect temporal coordination to increase the positive effects of competition behavior on performance by encouraging exchange and interaction within the team.

H3. *Competition* conflict management behavior (a) has a *positive* effect on virtual team performance, and (b) temporal coordination *strengthens* this positive effect.

Past small group research suggests that *collaboration* and *compromise* conflict management behaviors should be beneficial to team performance. These two behaviors are cooperative, problem-solving approaches to managing team conflict. They both reflect some joint level of concern for the task as all parties seek full information and work purposefully toward a solution. The distinction between collaboration and compromise behaviors is the level of concern exhibited and the degree to which the solution is integrative versus intermediate (Lewicki, Weiss, & Lewin 1992; Rahim 1992). In virtual project teams, the solution-orientation of compromise and collaboration behaviors should be associated with greater task-focus, goal congruity among members, increased participation, and therefore, increased quality of team performance (Townsend et al. 1998). For these same reasons, we expect temporal coordination to increase the positive effects of collaboration and compromise behaviors on performance by encouraging even more problem-solving. For time-limited project teams, a temporal coordination mechanism should help organize and focus team interactions such that information is revealed more quickly and more effective work is enabled. This should increase the productivity and performance of the team (Jarvenpaa et al. 1998).

H4. *Collaboration* conflict management behavior (a) has a *positive* effect on virtual team performance, and (b) temporal coordination *strengthens* this positive effect.

H5. *Compromise* conflict management behavior (a) has a *positive* effect on virtual team performance, and (b) temporal coordination *strengthens* this positive effect.

METHODOLOGY

Experimental Design

To test the hypotheses, we conducted an experiment with 175 graduate students residing in the U.S. and Japan, organized into 35 five-person teams. The experimental condition was the presence or absence of a temporal coordination mechanism. In this study, a process structure was designed to serve as a temporal coordination mechanism for organizing team communication, sequencing work, and facilitating problem-solving activities. As recommended by McGrath (1991), the process structure included schedule deadlines, guidelines for coordinating the pace of effort, and specifications for time spent on tasks. Table 1 describes the details of the coordination mechanism.

----- Insert Table 1 about here -----

In the study, 17 teams were randomly assigned to the experimental condition. The remaining 18 teams were not given the process structure for temporal coordination or any other guidance regarding how to proceed with their team activities. These 18 teams received instructions that reiterated the team task and final deadline. Each team consisted of five members drawn from four geographically dispersed universities (one university in Japan and three universities in the U.S.). Thus, the members of the 35 teams were geographically and temporally dispersed to varying degrees. The exercise was conducted over a 15-day period, with eight days devoted to team collaboration.

The 35 teams communicated solely through custom designed and access controlled Lotus Notes® discussion forums. Notes® enables dispersed asynchronous by classifying entries into main topics and responses. Every message has a time stamp and reveals the identity of the author. The team Notes® forums were designed with ease-of-use in mind and differed according to the experimental conditions (as described in Table 1). For the manipulation, we embedded elements of the process structure in the specially designed Notes® forums. All participants accessed the forums via a Web

browser and the Lotus Notes® databases were automatically opened and closed by the researchers according to a pre-defined schedule.

Experimental Task and Procedure

The experimental task was adapted from a widely used business simulation (Boyd, Walker & Larréché 1998). The case involves a global company developing international marketing strategies and participants acted as members of a global management team. Participants were provided with a brief summary of the case and task. The case included background information on the company, its market planning procedures, product and market information, and the results of market surveys. The task asked participants to: (1) recommend specific marketing strategies for foreign markets, and (2) explain the team's rationale for its decision in a one-page written summary.

Participants were instructed to complete the task individually (Deliverable 1) and in their respective teams (Deliverable 2). Individual completion of the task provided an opportunity to consider the details of the case and formulate one's own opinion prior to team interaction. The team decision required reconciliation of different views and consensus on a quantitative solution and a qualitative rationale to support the team decision. Each participant was also instructed to complete a follow-up questionnaire (Deliverable 3).

Measures

Independent variables. Perceptions of conflict management behaviors were measured at the individual level because they represent the subjective viewpoint of each participant's expression of specific conflict management behaviors (Dennis & Kinney 1998). Nineteen measures for the five conflict management behaviors were adapted from Rahim (1983). The detailed questionnaire items are reported in Appendix A.

Dependent variables. The dependent variable of interest is virtual team performance. In this study, we defined performance as the quality of the team rationale used to support the team decision. We used three indices of decision quality: range, organization, and depth (Diehl & Stroebe 1987).

Range is the degree to which the team's decision rationale covers a maximum range of relevant issues. *Organization* is the degree to which the team's decision rationale is well-structured and reflective of the inter-relationships and intra-relationships among the relevant issues. *Depth* is the degree to which the team's decision rationale explores issues deeply. Four expert raters, blind to both the hypotheses and conditions of the exercise, independently assessed the team rationales. Each rationale was scored on the three indices on a scale from 1 (very low) to 5 (very high). Inter-rater reliability for each dependent variable was acceptable (.84 for range, .86 for organization, and .96 for depth) (James, Demaree, & Wolf 1984). The responses of the four raters were averaged for each performance quality index.

Manipulation check. For the 17 teams assigned to the experimental condition, we reviewed all of the Notes® postings to ascertain whether or not these teams had followed the assigned process structure. We content coded each team's postings relative to the step-by-step process instructions. The analysis indicated that all of the teams assigned to the condition did indeed follow the steps as laid out in instructions.

ANALYSIS AND RESULTS

Our analysis was conducted in two main steps: (1) confirmatory factor analyses of the conflict management behavior measures, and (2) a series of seemingly unrelated regression (SURE) analysis for hypothesis testing.

Confirmatory Factor Analysis

We used LISREL to conduct a confirmatory factor analysis (CFA) of the five conflict management behaviors. Consistent with Anderson and Gerbing (1988), we evaluated the psychometric properties of the independent measures. The CFA resulted in a $\chi^2=210$ with 142 degrees of freedom. Since the χ^2 index is less than twice the degrees of freedom, it suggests that the fit is good. Furthermore, the CFA fit indices (GFI=0.86, CFI=0.92, and IFI=0.92) all exceeded the critical levels

(Bentler & Bonett 1980). The standardized loadings of all measurement items to their respective constructs were highly significant ($p \leq .05$), demonstrating that the scales for the constructs have convergent validity. No confidence intervals of the ϕ values for the measurement model contain a value of one ($p < 0.01$), suggesting that the constructs possess discriminant validity (Anderson & Gerbing 1988; Bagozzi & Phillips 1982).

Examinations of the modification indices, residuals, and overall fit indices revealed no substantial departures from unidimensionality. The construct reliabilities range from 0.70 to 0.88, indicating that the measures are reliable. Examination of the patterns of item-item correlation and item-total correlation further indicated that there were no deviations from the internal and external consistency criteria suggested in the literature (Anderson & Gerbing 1988). Thus, we conclude that the conflict management behavior measures are valid.

Analysis

We tested our hypotheses in a system of three seemingly unrelated regression estimation (SURE) models to maximize the efficiency of the estimation (Johnston 1984) in several steps. First, we performed SURE analysis without any interaction terms assuming that the main effects of the five conflict management behaviors on performance differed across the experimental condition (temporal coordination). Second, we conducted SURE analysis with an interaction term specified to represent our temporal coordination manipulation (i.e., teams with the manipulation are coded as “1” and teams without it are coded as “0”). The moderated SURE model tests whether the effects of the conflict management behaviors on performance differ across the experimental condition. Following recommended guidelines for testing interaction effects, the main effect of the five conflict management behaviors and the experimental manipulation were included in each model. Next, the two SURE models were compared to test the significance of the interaction effect. The F-test comparison of the two SURE models is significant at the 95% confidence level, supporting our hypothesis that temporal

coordination interacts with the effects of the conflict management behaviors on virtual team performance. We report the final results in Table 2 ².

----- *Insert Table 2 about here* -----

Results

The results in Table 2 provide mixed support for our five hypotheses (H1 through H5). For all five conflict management behaviors, we expected positive interaction terms. Avoidance behavior has a significant negative effect on performance and temporal coordination significantly weakens the negative effect of avoidance behavior on performance (H1 supported). Accommodation behavior has no significant effect on performance and temporal coordination has no moderating effect (H2 not supported). Competition behavior has a significant positive effect, but temporal coordination has no moderating effect (H3 partially supported). Collaboration behavior has a significant positive effect on performance, but temporal coordination has no moderating effect (H4 partially supported). Contrary to our expectations, compromise behavior has a significant negative effect on performance, but consistent with our expectations, temporal coordination has a positive moderating effect (H5 partially supported).

DISCUSSION

Our results concerning the effects of temporal coordination on conflict management behavior provides some insight into how virtual teams work. Table 2 indicates that the conflict management behaviors have varied effects on team performance and temporal coordination moderates certain effects. Table 2 also suggests that all effects are consistent across the three dependent measures of performance (range, organization, and depth).

First, as expected, we found that *avoidance conflict management behavior* has a significant negative effect on performance. We also found that the interaction effect is significant and positive.

² To increase confidence in the structure of our moderator model and eliminate competing hypotheses, we also empirically tested alternative mediation model structures. Following Judd & Kenny (1981) and Baron & Kenny (1986), we performed a series of regression analyses. Our analysis indicates that the hypothesized moderated model structure has superior explanatory power.

Thus, the presence of a temporal coordination mechanism significantly weakens the negative effect of avoidance behavior on virtual team performance. An important element of our process structure was the automatic posting of the initial individual decisions into the team discussion forum in Notes®. Frequently, information that is critical to a task does not get contributed to group discussion, particularly when it is unique or held by individual team members (Stasser & Stewart 1992; Dennis 1996). Past research suggests that group members may withhold information because of evaluation apprehension or conformity to majority pressures (Steiner 1972). By automatically revealing team members' initial positions, imposing intermediate tasks (e.g., required reviews), and allocating specific time limits for specific tasks, our results suggest that our coordination mechanism counteracted tendencies to "watch and wait" (Moreland & Levine 1992) and thus, reduced the negative effect of avoidance conflict management behavior on performance.

Second, contrary to our expectation, *accommodation conflict management behavior* had no significant effect on performance. The interaction term was also non-significant. By definition, accommodation is an unassertive behavior characterized by a tendency to concur with and conform to the majority position rather than take an opposing minority position. Accommodation behaviors are focused more on maintaining team harmony than on negotiating integrative, optimal solutions. Accommodation involves conceding to others and giving in to teammates' positions. It may be that in a lean, asynchronous communication environment like Notes®, the nonverbal cues that convey "going along" or agreeing may be masked. As a result, it is possible that, no matter how much an individual may *express* accommodation, the team does not *experience* it. This may be a beneficial artifact of the computer-mediated communication environment since past research in traditional, non-virtual teams has found that accommodation behavior usually has a negative effect on performance. This suggests that it is essential to distinguish between individual *expression* versus team *experience* in research on virtual teams (O'Connor, Gruenfeld, & McGrath 1993).

Third, as expected, *competition conflict management behavior* has a significant positive effect on performance. This effect is not moderated by the presence of the temporal coordination mechanism. Our finding suggests that a lean communication asynchronous environment like Notes® may have mitigated the negative connotations associated with competition behaviors because aggressive emotions or competitive dominance may not be interpreted as such by others. Our finding supports McGrath's (1984) speculation that time constraints make competition behaviors feasible without loss of effectiveness for one-time project work groups. Similarly, Moreland and Levine (1992) argued that for time-limited groups like ours, resolution is possible only when (1) a group member with sufficient authority imposes a diagnosis on the group, or (2) a majority of the members agree on their own diagnosis of the problem. It may be that time pressure reduced the opportunity for leisure in reaching agreement, thus domination may have emerged in the interest of efficiency and effectiveness. Our task and research context exemplify these conditions: our teams were time-limited, temporary project teams.

Fourth, as expected, *collaboration conflict management behavior* is positively related to performance. This effect is not moderated by the presence of the temporal coordination mechanism. Past research has consistently shown collaboration behavior to positively affect team outcomes in other research and task contexts (Cohen & Bailey 1997; Farmer & Roth 1998; Miranda & Bostrom 1993-1994; Ocker et al. 1996; Poole et al. 1991). Our finding is an important extension that demonstrates the robustness of the benefit of collaboration conflict management behavior in the virtual team context.

Fifth, counter to our expectations, *compromise conflict management behavior* is significantly negatively related to performance. This is an interesting and counterintuitive result that leads to deeper insights regarding effective teamwork in asynchronous communication environments. The temporal coordination manipulation significantly weakens the negative main effect. The task in our study is a no-right answer decision-making problem that requires collaborative writing. For such a task, a team must interact to explore and reconcile differences in perspectives and produce a document that

represents a unified, group voice (Horton & Biolsi 1994). Insufficient or ineffective interactions will reduce the team's iterations on the end product, and as a result, the quality will suffer. Groups tasked with a collaborative writing problem often face coordination difficulties due to delays in exchanging and cycling work among members of a team (Forman & Katsky 1986). In our study, the asynchronous communication environment and the time/space dispersion of participants made real-time interaction impossible. It may be that compromise behavior was manifested as "cutting-and-pasting" content in order to develop a middle-of-the-road, representative team document. To the extent that there was little effort spent integrating the separately produced components, the final work product would be of poorer quality. This may explain the negative main effect of compromise conflict management behavior on performance in our results.

Interestingly, we found that temporal coordination significantly weakens the negative effect of compromise conflict management behavior on performance. Consistent with Horton and Biolsi (1994) and Ocker et al. (1996), this suggests that a structured work process smoothed the flow of work for the collaborative writing aspect of the task by pacing the intermediate activities and prompting the exchange and cycling of work. It may be that the process structure prompted consideration and integration of new, divergent perspectives into each member's thought process. Our results suggest that the temporal coordination mechanism instigated the necessary dialog and cognitive processes for teams to coalesce toward consensus, thereby reducing the negative effects of compromise behavior.

Research Implications

Asynchronous virtual teams operate without the usual temporal modulators that coordinate the ebb and flow of team interactions so they can manage their activities and resolve conflicts. In this study, we explored one way to address the temporal coordination challenges facing virtual teams. Introducing a process by design appears to change the way teams manage conflicts, with observable performance consequences. We argued and found that conflict theory that is applicable to synchronous groups may not be wholly transferable to asynchronous groups due to the fundamental

differences in the communication environment. Specifically, we found that competition and compromise conflict management behaviors have effects on team performance that are counter to predictions by extant theory. In addition, we found that the presence of a temporal coordination mechanism, process structure, mitigates the negative effects of avoidance and compromise conflict management behavior on performance.

Technological tools tamper with the time and space of group work (McGrath 1991). Future theorizing about the causes and consequences of conflict and other group processes in virtual teams needs to take this into account. In particular, lean communication media tend to reduce the redundancy of cues needed to regulate information flow, thereby increasing potential chaos or noise in group communication. This suggests that lean asynchronous communication environments like Lotus Notes® require deliberate creation of the social norms that regulate communication and work (McGrath 1991). We developed a temporal coordination mechanism based on the traditional notions of temporal flow and synchronization of group interaction, and examined its moderating effect on conflict management in virtual teams. This study is an important first step toward extending and testing conflict theory in a dispersed asynchronous communication environment.

CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

Researchers have just begun to explore teams dispersed across time and space. Little is yet known about what social processes will facilitate virtual team interaction or how they impact performance. While a multitude of research issues exists, we explored how the use of a temporal coordination mechanism can affect virtual team performance by affecting the way these teams experience and resolve conflicts. Our findings suggest several important directions for future research concerning temporal coordination and conflict in virtual teams.

First, future research should explore alternative media and the evolution of media choice over time in virtual teams. By limiting communication strictly to Lotus Notes®, our research design provided a unique opportunity to investigate virtual team interaction free from influences of other

types of media. Temporal coordination in virtual teams is the most difficult in a purely asynchronous communication environment. Although use of asynchronous technology is increasingly commonplace when team members are dispersed and as travel budgets are cut, there are other communication media to consider. Future research should examine the effects of mixed media synchronicity (e.g., Lotus Notes, telephone, chat, videoconferences) on virtual team conflict behavior and performance.

Second, future research should explore the relationship between different types of tasks and the communication media. The robustness of the relationships we studied should be examined relative to different task and media characteristics. Decision-making tasks (such as ours) are characterized as moderately conflict-provoking whereas negotiation and judgmental tasks are highly conflictual in nature (McGrath 1984). Social presence theory (Short et al. 1976) suggests that relationship building (e.g., the building of trust) is highly salient for teamwork on conflictual tasks. Thus, communication media that convey low social presence (such as text-only communication provided by Notes® in this study) may prove less effective for tasks requiring high personal involvement. Future research should explore the effects of alternative combinations of task type and media on the temporal coordination challenges facing virtual teams.

Finally, an interesting challenge for future research would be to more precisely sort out the impacts of the temporal coordination mechanism. Future research might decompose the process structure to identify which components have what effects on conflict and conflict management. This would likely require the use of multiple methods to analyze virtual team behaviors; e.g., content analyses of actual messages, interviews with participants, and case studies of virtual teams working in organizational settings. This should yield a deeper understanding of the temporal causes and consequences of conflict in virtual teams.

Increasing global competition and advances in technology have led to increased deployment of global virtual teams. However, the task of electronically connecting dispersed organizational sites is far simpler than the task of coordinating and facilitating teamwork. Lotus Notes® or other groupware

technologies cannot transform virtual teams into effective collaborators. Virtual teams must find ways to synchronize their activities and manage conflict in order to be successful. We must continue to explore how to make virtual teams work effectively when the central medium of the team's process is technology.

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TABLE 1
Details of the Experimental Design and Process Structure Manipulation

Start of Experiment:

Assignments given to all participants on Day 1. Initial individual decision were to be posted to Notes® forum by Day 5.

Control Teams (No Process Structure)

Team Forums open on Day 5 <ul style="list-style-type: none"> Assignment and final deadline of Day 15 was reiterated 	No guidance provided regarding how to proceed with task
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Experimental Teams (Process Structure Manipulation)

<i>Details of Process Structure</i>	<i>Purpose</i>
Team Forums open on Day 5 Step 1. Team Introductions <ul style="list-style-type: none"> Introduce self by completing a “personal profile” electronic form (name, university, work experience, degree program, personal information) Share with team any personal time constraints (e.g., out-of-town, at work, etc.) 	Step 1 simulates initial introductions and socialization typical in face-to-face meetings Step 1 intended to overcome limitations of the communication context in conveying social cues (e.g., background, experience) (Jarvenpaa et al. 1998)
Step 2. Posting of individual “revised” positions. <ul style="list-style-type: none"> Individual decisions were automatically (electronically) deposited into the appropriate team forums and made available for review on Day 5 Each team member instructed to review and consider the initial positions of other team members After review, each team member instructed to post a “revised” individual position Instruction did not imply that an individual position must change 	Step 2 simulates individual members sharing their initial thinking/decision regarding the task; allows all members to consider his/her position relative to other team members Step 2 intended to begin to surface similarities/differences in decisions and thinking of all members
Instruction: Complete Steps 1 and 2 by Day 7	Scheduled deadline, coordinates pace of effort, and specifies time spent on specific tasks (Ocker et al. 1996; McGrath 1991)
Step 3. Team coordinator summary. <ul style="list-style-type: none"> Randomly assigned team coordinator instructed to review all “revised” individual positions, looking for similarities/differences Team coordinator instructed to write and post a brief summary, i.e., current thinking of the team summary in order to begin team discussion 	Step 3 simulates typical activity in a face-to-face meeting wherein one member summarizes the initial thinking (consensus/lack of consensus) of the team from which discussion commences
Instruction: Complete Step 3 by Day 9	Scheduled deadline, coordinates pace of effort, and specifies time spent on specific tasks (Ocker et al. 1996; McGrath 1991)
Step 4. Reach decision consensus & write rationale <ul style="list-style-type: none"> Choose team member to draft rationale based on discussion Review and revise rationale, as desired. Post team decision and rationale to team deliverables database 	Step 4 intended to facilitate collaborative writing task and move team forward to resolution of effort
Instruction: Complete Step 4 by Day 13	Scheduled deadline, coordinates pace of effort, and specifies time spent on specific tasks (Ocker et al. 1996; McGrath 1991)

TABLE 2
Seemingly Unrelated Regression Analysis *with* Process Structure Effects:
Standardized Regression Coefficients

Independent Variables	Hypothesis (sign)	Dependent Variables:		
		Range	Organized	Depth
Intercept		1.80* (.55)	1.76* (.46)	2.09* (.55)
Structure ^a		-.35 (.89)	-.22 (.74)	-.32 (.89)
Avoidance Behavior	-	-.20* (.08)	-.19* (.07)	-.22* (.08)
Accommodation Behavior	-	.02 (.14)	.00 (.11)	-.01 (.14)
Competition Behavior	+	.27** (.13)	.16*** (.11)	.33* (.14)
Collaboration Behavior	+	.45* (.14)	.34* (.11)	.44* (.14)
Compromise Behavior	+	-.45* (.11)	-.27* (.09)	-.39* (.11)
Structure*Avoidance Behavior	significant interaction	.27** (.13)	.27* (.11)	.32* (.13)
Structure* Accommodation Behavior	significant interaction	-.17 (.21)	-.20 (.17)	-.14 (.21)
Structure*Competition Behavior	significant interaction	-.09 (.19)	-.17 (.16)	-.21 (.19)
Structure*Collaboration Behavior	significant interaction	.12 (.20)	.12 (.16)	.09 (.20)
Structure* Compromise Behavior	significant interaction	.40* (.15)	.32* (.13)	.38* (.15)
System Weighted R ² = .41				

Notes:

^aStructure=1 if the person is in the structured team; Structure=0 if the person is in the non-structured team;
System Weighted R²=.41;

* significant at 99% confidence level; ** significant at 95% confidence level; *** significant at 90% confidence level

APPENDIX A

Conflict Management Behaviors: Measurement Items and Construct Reliabilities

All 5-point Likert scales scored 1 for “almost never” and 5 for “almost always”.

Avoidance 1-2 (Reliability 0.72)

When my team experienced some conflict, ...

- 1 I tried to keep my disagreement with my teammates to myself in order to avoid hard feelings.
- 2 I tried to avoid unpleasant exchanges with my teammates.

Accommodation 1-4 (Reliability 0.70)

When my team experienced some conflict, ...

- 1 I accommodate to the wishes of my teammates.
- 2 I gave in to the wishes of my teammates.
- 3 I went along with the suggestions of my teammates.
- 4 I allowed concessions to my teammates.

Competition 1-5 (Reliability 0.74)

When my team experienced some conflict, ...

- 1 I used my power to win in a competitive situation.
- 2 I used my authority to make a decision in my favor.
- 3 I used my influence to get my ideas accepted.
- 4 I used my expertise to make a decision in my favor.
- 5 I was generally firm in pursuing my side of the issue.

Collaboration 1-6 (Reliability 0.88)

When my team experienced some conflict, ...

- 1 I collaborated with my teammates to come up with decisions acceptable to us.
- 2 I tried to bring all our concerns out in the open so that the issues could be resolved in the best possible way.
- 3 I tried to work with my team members to find solutions to a problem that satisfy our expectations.
- 4 I exchanged accurate information with my teammates to solve a problem together.
- 5 I tried to work with my teammates to find solutions to a problem that satisfy our expectations.
- 6 I tried to investigate an issue with my team members to find a solution acceptable to us.

Compromise 1-2 (Reliability 0.75)

When my team experienced some conflict, ...

- 1 I proposed a middle ground for breaking deadlocks.
- 2 I tried to find a middle course to resolve an impasse.

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