Perceived Individual Collaboration Know-How Development Through IT-Enabled Contextualization: Evidence from Distributed Teams

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Abstract

In today’s global market environment, enterprises are increasingly turning to use of distributed teams to leverage their resources and address diverse markets. Individual members of such structurally diverse distributed teams need to develop their collaboration know-how to work effectively with others on their team. The lack of face-to-face cues creates challenges in developing the collaboration know-how, challenges that can be overcome by communicating not just content, but also context. We derive a theoretical model from Te’eni’s (2001) cognitive-affective model of communication to elaborate how IT can support an individual’s communication of context in order to develop collaboration know-how. 263 individuals working in structurally diverse distributed teams using a variety of virtual workspace technologies to support their communication needs were surveyed to test the model. Results indicate that when individuals perceive their task as non-routine, there is a positive relationship between an individual’s perceived degree of IT support for communicating context information and their collaboration know-how development. However, when individuals perceived their task as routine, partial IT support for contextualization was associated with lower levels of collaboration know-how development. This finding is attributed to individuals’ misunderstanding of the conveyed context or struggling to utilize the context conveyed with partial IT support, making a routine task more prone to misunderstanding, leaving the user worse than if she had no IT support for contextualization. We end the paper by drawing theoretical and practical implications based on these findings.
INTRODUCTION

Faced with an increasingly global work environment, managers are concerned about developing employees’ know-how to collaborate in distributed teams (Brown and Duguid 1998, Hinds and Bailey 2003, Saunders 2000, Straus and Olivera 2003). Distributed teams (DTs) are defined as groups of people who interact through interdependent tasks guided by a common purpose, and work across space, time and organizational boundaries primarily through electronic means (Maznevski and Chudoba 2000). Employees are increasingly asked to work not only in DTs, but also in “structurally diverse” DTs that cross geographic locations, functional assignments, reporting managers and business units (Cummings 2004) in order to afford a broader representation of perspectives to spark innovation and speed implementation of new ideas across space and time (Majchrzak et al. 2004). Individuals working in DTs are often challenged by non-routine tasks. Under these conditions, individual members of DTs need to develop collaboration know-how in order to work effectively in the DT (Cramton 2001). Even when the tasks being performed by individuals in DTs are routine, members of DTs need to have the know-how to integrate their work and collaborate with other members of the team. In this paper, we describe how IT can be used to support the development of collaboration know-how among individuals in structurally diverse DTs.

THEORETICAL DEVELOPMENT

The Need for Collaboration Know-how

For individuals to work effectively in structurally diverse DTs requires collaboration know-how. Know-how has been defined as knowledge of current practices required to transform inputs into outputs as effectively as possible (Brown and Duguid 1998, Finholt et al. 2002). Blackler (1995), relying on Ryles’ (1949) concept of “knowledge how”, describes know-how as action-oriented, partly tacit, acquired by doing, and, as such, hard to circulate and needing to be developed individually (Brown and Duguid 1998).
An individual’s collaboration know-how refers specifically to knowledge about how to communicate one’s own ideas and integrate it with others’ ideas, including how to coordinate one’s actions and work with others on the team. This notion of collaboration know-how builds upon Grant’s (1996) concept of knowledge integration. A variety of virtual team researchers have chronicled the problems individuals face in knowledge integration such as different communication practices and interpretations of meaning (Cramton 2001, Hinds and Bailey 2003, Maznevski and Chudoba 2000, Majchrzak et al. 2000).

Malhotra et al.’s (2001) description of the lead engineer in a structurally diverse new product development DT offers an example of the need for individuals working in DTs to develop collaboration know-how. The lead engineer was responsible for integrating analytic results into new design iterations and leading design discussions around each iteration. His existing collaboration know-how involved asking each engineering specialist on the team to send him his analytic results, which he would then privately integrate to produce a new version of the design that would be the focus of the team’s next design discussion. However, the members of the DT complained that this practice violated the team norm that all information (including analytic results, evaluations of design ideas and suggestions for new ideas) should be posted in the virtual workspace for everyone to see. Yet, from the lead engineer’s perspective, having team specialists post their results to the virtual workspace yielded chaotic and unproductive design discussions as members focused only on the latest analytic results, failing to consider the impact of the analytic results from all the specialists, especially the ones that were shared earlier. After several weeks of frustrating design discussions, the engineer finally proposed a new practice for collaboration: a hyper-linked cross-team matrix in which each specialist would link his results (in a predetermined format) to each posted design drawing so that the team members could easily find, examine and discuss all the specialists’ results during design discussions. This suggestion was adopted and helped to make the design discussions more productive. At the end of the project – eight months after coming up with the matrix idea – the lead engineer attributed the
team’s creation of a radically new product design to the development of his collaboration know-how for managing the team.

**Need for Contextualization to Develop Collaboration Know-how**

Individuals in DTs face great difficulties in developing their collaboration know-how due to a lack of face-to-face sharing of non-verbal cues to help prioritize messages and content, repair communication misunderstandings and learn communication norms (Clark and Brennan 1991, Finholt et al. 2002, Hinds and Bailey 2003). Since structurally diverse teams are rarely brought together in face-to-face meetings (Majchrzak et al. 2004), members must rely on IT to support their collaboration know-how development (Malhotra et al. 2001, Malhotra and Majchrzak 2004). Finally, structural diversity poses additional challenges as the diversity of perspectives create greater opportunities for misunderstanding (Finholt et al. 2002, Maznevski and Chudoba 2000).

To overcome these difficulties of communicating across boundaries, some have suggested that individuals should communicate not just the content of a message, but its context as well (Brown and Duguid, 1998). Based on Habermas’ theory of communicative action, Te’eni (2001) elaborates a cognitive-affective model of communication, which highlights the sharing of contextual information in the development of know-how. His model proposes three facets of organizational communication:

1) *inputs* to the communication process (i.e., the organizational setting of the individuals involved in the communication),

2) communication *impact* (i.e., mutually agreed upon purposeful action, encompassing our narrower concept of collaboration know-how development), and

3) a cognitive-affective communication *process* (i.e., the choice of communication strategy and IT support for that strategy).

Examining the communication process, Te’eni proposes *contextualization* as one communication strategy. *Contextualization* is defined as the presentation of context information about a message structured for easy absorption, with context defined as information about the situation, intentions and
feelings about an issue or action, as owned, evolved and represented by each individual involved in the communication process. Weick and Meader (1993) similarly describe context for a decision as the explicit presentation of multiple perspectives and preferences regarding cause-effect links, definition and scope of decisions and understandings about whether there is a need for a decision at all. The communication of context can lead to more effective thinking (Tyre and von Hippel 1997) as it helps to prioritize information and interpret cues (Cramton 2001), share and frame issues and decisions (Mark 2002), and engage in sense-making about alternative views on cause-effect links and preferences for effects (Weick and Meader 1993). In doing so, communication of context helps to ensure that the content influences know-how development (Sussman and Siegel 2003).

The virtual team literature identifies the sharing of context as a major need of individuals in distributed teams (Cramton 2001, Hinds and Bailey 2003, Jarvenpaa and Leidner 1999, Weisband 2002). However, in this literature, the definitions of context are varied and include: organizational or geographic affiliation (Hinds and Bailey 2003, Maznevski and Chudoba 2000, Sproull and Kiesler 1986), situational awareness such as information about each person’s milieu or environment (Cramton 2001, Weisband 2002), and individual differences (Walther 1995). In contrast, Te’eni’s (2001) model, as well as Weick and Meader’s (1993) sense-making framework, stress the cognitive context associated with communication -- identification of alternative perspectives on, details about, and the nature of changes over time in the communicated content. Since our focus is a cognitive model of communication, we adopt the concept of cognitive context.

In addition to these primarily cognitive elements, Te'eni argues that another critical element that influences organizational communication is the relationship or affective element. Relationship, for Te'eni, includes trust and commitment. When trust (and commitment) is high, communications are more effective. In this paper, we specifically focus on the cognitive elements proposed in Te'eni's model, with trust and team size in our model as controls for the affective element. Although Te’eni only focuses on trust and commitment, team size has been strongly associated with participation and
the nature of interaction in teams (Gladstein 1984, Yeatts and Hyten 1998). As team size increases, the relationship between team members tends to suffer (Lichtenstein et al. 1997). Team size can also influence the team members’ motivation to collaborate (Huberman and Loch 1996). Similar issues related to team size have been observed in DTs (Riopelle et al. 2003). Therefore, we include team size as an additional control for affective influences in DTs.

**IT Support for Contextualization**

When individuals are geographically distributed, communication is mediated through a variety of IT systems. Boland et al. (1994) developed a theory of how IT can be designed and used to facilitate a contextualization strategy. Their theory elaborated on five aspects of a contextualization strategy\(^2\) that IT can support: 1) *ownership* (the IT system allows users to easily identify who authored a message), 2) *easy travel* (the IT system enables individuals to effortlessly move between messages to examine historical, analytic, motivational and situational layers), 3) *multiple perspectives* (the IT system enables comparisons of perspectives conveyed in a message against alternative perspectives on the issue, 4) *indeterminancy* (the IT system allows for partial and tentative messages), and 5) *emergence* (the IT system allows for the emergence of new categories, constructs and levels of abstraction for describing and organizing messages). IT functionalities that support each of the five aspects of an individual’s contextualization strategy were proposed to help organize and present context information in a way that facilitates sense-making.

Preliminary support for Boland et al.’s (1994) theory was found in qualitative research on a structurally diverse DT (Majchrzak et al. 2000; Malhotra et al. 2001). Individuals in the team reported the importance of indeterminancy (allowing for incomplete entries), ownership (highlighting authorship of entries in repositories) and easy travel (hot linking of individual workspaces with team workspace) as they used their IT system to discuss their work with others. However, this qualitative

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\(^2\) Boland et al (1994) suggested a sixth property, *mixed form*. We did not operationalize this property as our preliminary interviews with the DT leaders indicated that the technologies in use across all teams in our sample were equally capable of including all media formats such as text, pictures, graphs, etc.
research did not relate the type of IT support the individuals used for their collaboration know-how development. Moreover, the theory has not been tested in large samples of individuals engaged in DTs who use a variety of alternative IT systems to coordinate their work. In this study, our intent is to submit this theory to such a test.

Simply providing functionalities in a technology does not suggest that the technology is either appropriate for the situation (Goodhue and Thompson 1995), used as intended (DeSanctis and Poole 1994, Majchrzak et al. 2000), or deemed useful for contextualization by individuals of a DT (Malhotra et al. 2001, Mark 2002). The actual use and perceptions of usefulness are driven by the team’s norms in use for the IT (Majchrzak et al. 2000, Mark 2002). Example norms include whether emails are preceded with keywords indicating urgency, whether entries should be dropped into folders that represent a team-defined taxonomy of terms, or whether annotations are clearly identified so anyone not attending a virtual meeting knows who said what. However, it is hard to disentangle the impact of functionalities, the use of those functionalities, and the team norms that influence use (Majchrzak et al. 2000). Therefore, we do not try and disentangle these facets related to technology use, but rather adopt the notion of “fit” proposed by Goodhue and Thompson (1995), Goodhue (1998) and Goodhue et al. (2000) that integrates these various facets. Accordingly, our notion of “fit” focuses on an individual’s assessment of the degree to which the IT supports the five aspects of a contextualization strategy. Individuals in DTs are likely to perceive the IT system as providing varying levels of support for contextualization, with support ranging from none (none of the five aspects enabled) to high (most or all enabled).

Influence of Task Type on the Relationship Between IT Support and Collaboration Know-how Development

Thus far we have argued, following Boland et al. (1994), Te'eni (2001), and Weick and Meader (1993), that an individual in a DT will experience greater collaboration know-how development when they use a contextualization strategy supported by IT. However, Te'eni (2001) proposes that
contextualization as a communication strategy is needed particularly in situations that individuals perceive as non-routine because of the higher potential for misunderstanding arising from confusion over conflicting and multiple interpretations of causation. Individuals in DTs may perceive tasks as non-routine for several reasons: they may have a new role to perform, they are new to working in DTs, or the task the group faces is entirely new. Weick and Meader (1993) also argue that tasks that have the potential for misunderstanding have a greater need for contextualization. Thus, the more that a contextualization strategy is supported by IT, the greater collaboration know-how developed, particularly for individuals engaged in tasks perceived as non-routine.

For individuals performing tasks they perceive as routine, the issue may be different. In routine tasks, the problem is already defined, causal linkages are evident, the nature of the decision needing to be made is known, disagreements over preferences are less prominent (Weick and Meader 1993) and the solution requires knowledge aggregation rather than synthesis and integration (Hatano and Inagaki 1991). In such situations, while IT support may be helpful, partial IT support may generate confusion that hurts collaboration know-how development. Partial IT support refers to the case when individuals perceive some of the five aspects of the contextualization strategy not supported, such as when information is conveyed with historical referents but without the ownership needed to assess source credibility. Incomplete representations of context due to partial IT support may lead to a decreased ability of individuals to make sense of a situation that is thought to be known or well-understood (Mark 2002, Weick and Meader 1993). As such, the individual receiving this incomplete representation of context must now not only perform the task but at the same time also expend cognitive resources to resolve and reconcile the implications of the missing context – a process that an individual performing a non-routine task would be doing anyway. For the individual performing a routine task, this need to resolve and reconcile missing context may create confusion that causes the individual to reconsider the problem statement, preferences, and causal linkages to solutions. For example, an individual in a DT responsible for routine help desk support may be assigned the task of
putting together an FAQ list for global customers from suggestions posted in the virtual workspace by team members, a task she may perceive as routine, requiring collaboration know-how that involves simply aggregating and organizing posted suggestions from other members. However, if suggestions have some notes assigned but no rationale, ownership, or historical context, or some suggestions have some context information and others have none, the individual is unable to determine which suggestions are duplicates, how to organize and link the suggestions, and how to present the suggestions for easy customer use. As such, the collaboration know-how she was expecting to use through the virtual workspace would be insufficient for aggregating the posted suggestions in the virtual workspace, leading her to either return to email or phone, or redefine the problem. In either case, perceptions of collaboration know-how development through the virtual workspace would be harmed.

For non-routine tasks, the opportunity for misunderstanding already exists and thus the incremental improvements in understanding by knowing even partial context may outweigh any confusion caused by partial context support. In other words, communication about context, even if it is partial and fragmented, may be better than none when individuals perceive the task as non-routine. For example, in Malhotra et al's (2001) case study research on team members performing work they considered non-routine (new product development in a distributed setting), members reported that even when only six out of the eight distributed members used annotations, the partial annotations were better than none at all. Thus, when individuals are engaged in non-routine tasks, even partial IT support for contextualization may facilitate their collaboration know-how development.

In sum, we argue that the opportunities for misunderstanding when performing non-routine tasks are so great that collaboration know-how development will benefit from any IT support for contextualization even if the support is partial. When individuals perform routine tasks, however, partial IT support will lead to reduced collaboration know-how development as individuals not only
must perform the task, but at the same time expend cognitive resources to resolve and reconcile the implications of the missing context.

In Figure 1, we summarize our arguments into a hypothesized model. Since our focus is on the cognitive elements of contextualization, we have included two controls for the affective relationship among team members: team size and trust. In sum, we hypothesize:

**Hypothesis:** For individuals that are performing non-routine tasks, there is a linear positive relationship between their perceived collaboration know-how development and their perceptions of degree of support provided by IT for their contextualization needs. There is a curvilinear relationship between the development of collaboration know-how and perceived degree of contextualization support provided by the IT system for individuals engaged in routine tasks in distributed teams.

**FIGURE 1: RESEARCH MODEL**

**RESEARCH METHODS**

The study involved a cross-sectional survey of 263 individuals working in 54 structurally diverse DTs. We identified the 54 DTs through solicitation by DT consultants, professional organizations, collaboration tool providers and personal contacts. The solicitation promised a benchmarking report in exchange for participation. Upon contact, email exchanges or interviews were conducted to confirm that the team was structurally diverse and virtual. Out of the 90 contacts, 54 teams met the criteria.
The 54 teams were generally global: 75% included members from more than one national culture, with 60% including members 3 or more time zones apart or with different native languages. Half of the teams included members from more than one company; 60% of the teams included members from more than one organization and function; some teams came from multinational companies while other teams came from small firms. 33 companies in fifteen different industries were represented in the sample (e.g., telecommunications, consumer products, engineering design, medical device manufacturing). The DTs in our sample were performing a variety of tasks (e.g., consulting, corporate mergers, new product development).

Once a team was identified, a one-hour semi-structured interview with the team leader was conducted asking about the team’s objective and background, the practices used in the team to manage its distributed nature and the capabilities of the IT(s) being utilized by the team to collaborate. The team leader was also asked to nominate the manager to whom the team reported who could complete an evaluation of the team outputs and process to date (using a scale by Ancona and Caldwell (1992)). We used this team evaluation to confirm that the team was judged by others in the company to be successful. We wanted to study only high performing teams as this allowed us to control for poor performance as a possible factor influencing collaboration know-how development. Finally, the team leader was asked to encourage team members to complete a 35-minute online survey. For smaller teams (6-10 members), all members of the team filled out the survey. For larger teams (>10 member), we received responses from 50% of the team members on average. Team members received a summary report that compared their team (aggregated across team members) to the aggregate statistics of all teams in our sample.

Surveyed members reported spending only 2.5% of their time on the team in face-to-face meetings with all other members, and only 15% of their time in face-to-face meetings with any other member. Thus, the individuals could not use face-to-face meetings to support their contextualization needs. Members were asked if they had worked with none, few, half, most or all of the other members of the
team. On average, members reported working with only a “few” of the other members of team. In addition, they reported being highly dependent on each other to perform their task (measured using the scale by Kirkman and Shapiro 2000). Thus the strategic diversity of the team coupled with interdependence and low familiarity among team members suggested contextualization needed to be conveyed during discussions.

The 54 teams used a wide variety of IT applications to support their virtual collaboration including Lotus Notes, Groove, Livelink, Microsoft products, NetMeeting, Webex and E-Room. A variety of functionalities integrated into the virtual team room technologies were used, ranging from application-sharing software to calendaring, from intelligent search tools to expert directories, from instant messaging to discussion threads. All teams used telephone conferences on a regular basis in addition to their repositories. Thus, the DTs in our sample used a range of IT applications to support contextualization.

**Measures**

Table 1 shows the items that comprise the constructs, which are the main focus of this study. Standardized instruments for most of the constructs do not exist and thus needed to be created for this study. In light of this, we paid particular attention to pilot-testing and the verification of discriminant validity among the constructs in order to avoid biases resulting from common method variance. We return to this issue later in the Construct Validity section.

**TABLE 1: Measurement of Constructs**

<table>
<thead>
<tr>
<th>CONSTRUCT and ITEMS</th>
<th>Pre-normalized MEAN (SD)</th>
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<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td></td>
</tr>
<tr>
<td>COLLABORATION KNOW-HOW DEVELOPMENT</td>
<td>3.6 (.7)</td>
</tr>
<tr>
<td>“Working in this distributed team is helping me learn…:”</td>
<td></td>
</tr>
<tr>
<td>1. How to streamline the team’s internal processes</td>
<td>3.7 (.8)</td>
</tr>
<tr>
<td>2. How to reduce redundancy of information and knowledge in the team</td>
<td>3.5 (.9)</td>
</tr>
<tr>
<td>3. How to coordinate the efforts of everyone on the team</td>
<td>3.7 (.9)</td>
</tr>
<tr>
<td>4. How to rapidly implement new team ideas</td>
<td>3.6 (.9)</td>
</tr>
<tr>
<td><strong>Independent Variable</strong></td>
<td></td>
</tr>
<tr>
<td>DEGREE OF IT SUPPORT FOR CONTEXTUALIZATION</td>
<td>4.1 (3.5)</td>
</tr>
<tr>
<td>(OWN, TRAVEL, etc. refer to the Boland et al.’s (1994) contextualization needs; these labels were not shown to the respondents)</td>
<td></td>
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</table>
Perceived Collaboration Know-How Development

To develop our measure of individual collaboration know-how development, following the procedure used by Cummings (2004), we first conducted interviews with a sample of fifteen managers involved in managing structurally diverse DTs to identify the different types of collaboration know-how that need to be developed if individuals are to effectively perform in these teams. We supplemented these interviews with a review of earlier qualitative research (Majchrzak et al. 2000; Malhotra et al. 2001). Further, we examined available instruments for measuring knowledge sharing effectiveness (e.g., Gold et al. 2001). Together, these sources suggested that, in structurally diverse DTs, four areas of collaboration know-how are particularly useful to an individual performing in such teams: 1) how to streamline the team’s internal processes, 2) how to reduce information redundancy...
within the team to optimize diversity of opinions, 3) how to coordinate individual members’ efforts, and 4) how to rapidly implement new team ideas. We preceded these items with the stem, “Working in this distributed team is helping me learn...”, and used a five-point agree/disagree response scale. We pilot-tested the scale on eight individuals who were members of different structurally diverse DTs. A reliability (alpha) coefficient of .83 was obtained on the full sample for the four items, indicating strong inter-item covariance.

Degree of Perceived IT Support for Contextualization

To develop the scale for the degree of IT support for contextualization, we used Boland et al.’s (1994) five aspects of a contextualization strategy that can be supported by IT: ownership, easy travel, multiplicity, indeterminacy and emergence. We conducted exploratory interviews with 12 individuals not in our sample who used a variety of virtual workspaces to identify ways in which they used the workspaces to meet each contextualization need. This led to a list of 15 items (3 items for each aspect). Piloting of the 15 items on eight individuals engaged in different distributed groups not in our sample led to the dropping of four items (one for each of four aspects) that did not apply equally across different types of groups and workspaces. Preceding the 11 remaining items was the question: “Does your team use a virtual workspace or centralized repository to communicate and coordinate their work?” If the respondents reported no use of such a workspace, they skipped all eleven questions. We included this question to ensure that individuals’ perceptions of support for contextualization needs was directed at the virtual workspace and not other technologies or tools (e.g. email, audio-conferencing) they might have available to them.

As indicated in the theory section, we wanted our items to simultaneously capture the use (rather than mere presence) of technology functionalities and implicit group norms that influence use. For this reason, using the notion of “fit” proposed by Goodhue and Thompson (1995), we preceded each of the items with the stem, “The virtual workspace technology (or data repository) used by the team has enabled me to...” We felt that the word “enabled” encouraged respondents to consider how the
technology functionalities and enabling norms surrounding the use of the technology helped them perform their work. Response scale choices were 1 (strongly disagree) to 5 (strongly agree). Across the sample of 263 individuals, we obtained a reliability (alpha) coefficient of .89 for the 11 items.

We had argued that confusion associated with partial support might lead to less collaboration know-how for individuals performing routine tasks. Therefore, average support across items could not be used because higher averages might result from a few needs being highly supported even though other needs were not supported at all. To avoid this, we created an index based on a count of the number of contextualization needs that individuals agreed (4) or strongly agreed (5) were enabled. This index represents a conservative assessment of support as it counts even modestly supportive technology as non-supportive. Nevertheless, the correlation between this more conservative count and an average of the item measures’ full response scale was .88 (p<.001). This indicates that while our index may have been more conservative, it also captured a general assessment of support.

*Perceived Task Non-Routineness*

Perrow’s (1967) task routine-nonroutine continuum is an aggregation of two underlying task characteristics - task variety and task analyzability. We sought a scale that conceptually integrated both characteristics in as few items as possible. The scales reviewed by Withey et al. (1983) measure variety and analyzability separately and use a larger number of items. For these reasons, we decided to use the three-item scale developed by Goodhue and Thompson (1995) that was intentionally structured to combine both analyzability and variety. We adopted Zigurs and Buckland’s (1998) definition of task to refer to the group's problem as it is presented to the individual. Thus, we asked individuals to assess the degree to which they perceived the group’s problem to be non-routine. We expected significant individual variation even within groups because the structural diversity within the team meant that some people may have performed the task previously while others would find the same task to be quite novel. The three-item scale demonstrated adequate measurement qualities (Cronbach’s alpha of .76).
Control Measures

We included two controls in our analysis: trust and team size. Trust was measured with five items from the Krishna and Shrader (1999) scale used by the World Bank and academic scholars (e.g., Paldam 2000, Paldam and Svendsen 2003). The scale was developed by The World Bank based on a review of 26 studies conducted in 15 countries worldwide. We replaced the word “trust in community” in the scale with “trust in the distributed team.” We used this instrument because it had been validated in the context of globally diverse respondents (multiple countries and cultures) – a context typical of the individuals included in our sample. A reliability (alpha) coefficient of .81 was obtained for the scale. Team size was obtained from the team leader, and varied from 6 to 50 members (with a median of 10 and mean of 13).

Construct Validity

We assessed construct validity by confirming the four-factor structure of the 23 items, by assessing discriminant validity and examining common method variance. We conducted a confirmatory factor analysis using the Bentler-Weeks model (Bentler and Weeks 1979, 1980) and EQS 4.02 (Bentler 1993) with elliptical re-weighted least squares (ERLS) estimation. A four-factor model was estimated restricting each of the 23 items to be an indicator for one and only one of the four latent factors, including collaboration know-how development (4 items), degree of IT support for contextualization (11 items), task non-routineness (3 items) and trust among group members (5 items). Covariances among the 4 factors were allowed to be freely estimated, and all covariances among residuals were constrained to zero. The factor loadings from this model were all large (above 0.60), and estimated factor inter-correlations were all small, ranging from to .04 to .36 (See Appendix A for the details of CFA model parameters). Overall, the 4-factor model fit well (Bentler 1990, Bentler and Bonett 1980), as indicated by the Bentler-Bonett normed fit index (NFI=.91), the Bentler-Bonett non-normed fit index (NNFI=.96), the comparative fit index (CFI=.97), the average absolute covariance residual (.017) and the average off-diagonal absolute covariance residual (.018). This simple 4-factor model
(with uncorrelated residuals) yielded a $\chi^2=342.0$. Compared to a complete independence model of the data ($\chi^2=3958.7$), this simple 4-factor model provided a significant ($p<.001$) reduction in $\chi^2$.

In order to establish discriminant validity (following Sirdeshmukh et al. 2002), an analogous confirmatory 4-factor model was also estimated using EQS and restricting the correlations among the 4 latent factors to 1.0, which represents an extreme case of no discriminant validity among the 4 factors. All 3 fit indices were considerably attenuated compared to the 4-factor model with factors allowed to correlate freely (both NFI and NNFI = .59 and the CFI = .63), and the average absolute covariance residuals were greatly inflated (.084 and .091 off-diagonal). In addition, the reduction in chi-square test comparing the model with all factor inter-correlations set to 1.0 ($\chi^2 = 1605.3$) to the model described above with freely estimated factor inter-correlations ($\chi^2 = 342.0$) was also significant ($p<.01$).

Following Podsakoff et al.’s (2003) review, we adopted their recommendations and assessed the extent of common method variance by estimating a confirmatory 5-factor model, including a fifth unmeasured latent methods factor. Each of the 23 items were allowed to load on one of the 4 theoretical factor constructs, and all were allowed to load on the fifth methods factor, which was constrained to be uncorrelated with the other 4 factors. The fit indices for this 5-factor model were barely greater than the original 4-factor model described above (NFI = .93, NNFI=.97 and CFI=.98), and the average absolute covariance residuals actually doubled in size (.033 and .036 compared to .017 and .018 for the 4-factor model). The reduction in chi-square test comparing the 4-factor model ($\chi^2 = 342.0$) with the 5-factor model including a common methods factor ($\chi^2 = 290.7$) was not significant, suggesting little or no common methods variance.

We then examined the correlation coefficients among the four main constructs and group size, which are shown in Table 2 below. Apparent from the table are the relatively low correlations, further indicating both that common method variance is unlikely to be an issue, and that the variables are measuring different constructs. Following Szulanski (2000), discriminant validity was further demonstrated by forming a 95% confidence interval (CI) for each of the inter-correlations above (not
involving group size) and comparing the upper bounds of each 95 % CI to the maximum possible correlations between the scales given measurement error. For each construct pair, discriminant validity is demonstrated if the 95% CI upper bound is less than the maximum possible correlation between the construct pair. The upper bounds on the 95 % CI ranged from .14 to .41. The maximum possible correlation between each pair of measures is calculated as the square-root of the product of their corresponding reliability coefficients as reported above. The 4 alphas ranged from .76 to .89, and the 6 maximum possible correlations ranged from .78 to .86. All 6 construct pairs easily passed this test of discriminant validity.

Table 2. Correlations Among Constructs (N=263)

<table>
<thead>
<tr>
<th></th>
<th>Collaboration Know-how development</th>
<th>Degree of IT Support for Contextualization</th>
<th>Task Non-Routineness</th>
<th>Trust among Group Members</th>
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<tbody>
<tr>
<td>Degree of IT Support for Contextualization</td>
<td>.27**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Non-Routineness</td>
<td>.12*</td>
<td>.12*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust among Group Members</td>
<td>.30**</td>
<td>.02</td>
<td>.14*</td>
<td></td>
</tr>
<tr>
<td>Group Size</td>
<td>.08</td>
<td>.01</td>
<td>-.14*</td>
<td>-.07</td>
</tr>
</tbody>
</table>

*p<.05; ** p<.01

Analysis Strategy

Our first step was to determine whether our expectations for an individual-level analysis were appropriate by evaluating the extent to which individuals on the same team agreed with each other. For each variable, we calculated an intra-class correlation. Small values of the intra-class correlation (below .70) would suggest low agreement among team members and would confirm that an individual-level analysis was appropriate (Shrout and Fleiss 1979). Three individuals were randomly selected from the 48 teams with 3 or more responses to assess the reliability of any randomly selected team member. All intra-class correlations were well below George’s (1990) suggested criterion of .70: collaboration know-how development (.15), degree of IT support for contextualization (.47), task non-routineness (.29), and trust (.15). These low values of the intra-class correlations confirm that a team-level analysis was not viable, and that the dependencies among individual team members are small enough for an individual-level analysis. Moreover, the small correlations suggest that the social forces
that act on group members to create similar psychological states towards trust, IT fit, and tasks in a team may be less powerful in structurally diverse DTs.

Our hypothesis proposed an interaction effect of collaboration know-how on task non-routineness and IT support, which we tested using hierarchical moderated multiple regression (HMMR). We chose HMMR over structural equation modeling (SEM) and partial least squares (PLS) approaches: a) in order to include in the analysis the continuous nature of the moderator variable, b) to avoid Carte and Russell’s (2003) Error 9 in which differences in path coefficients across sub-samples are confounded with differences in the measurement model estimated for latent constructs, and c) because if we followed Chin et al.’s (2003) recommendations for an integrated PLS model and computed interaction terms among the 11 items for IT support and the 3 items for task non-routineness, the number of interaction terms would have been impractical for our sample size.

The HMMR strategy allowed us to estimate and test the linear effects of IT support for contextualization and task non-routineness on collaboration know-how development, controlling for the linear effects of trust and group size. In addition, the HMMR approach allowed us to test for the hypothesized quadratic effect of IT support for contextualization on collaboration know-how development moderated by task non-routineness. All of these analyses are based on correlations using a sample size of N=263. As indicated by Algina and Olejnik (2003), this sample provides power (0.90) adequate to detect correlations as small as 0.20 (alpha = .05, 2-tailed). With a probability less than 10% of missing a correlation as small as 0.20, this study utilizes an adequate sample size. For all analyses, predictor variables were standardized to have a sample mean of zero and a sample standard deviation of 1.0. All product variables (quadratic terms and interaction terms) were computed using standardized components, as suggested by Aiken and West (1991).

RESULTS
In preparation for testing our hypothesis, we first examined the presence of a quadratic effect of the Degree of IT Support for Contextualization on Collaboration Know-how Development for the complete sample, regardless of the presence of a moderator effect of Task Non-routineness. We included in Step 1 the controls (Team Size and Trust in Team Members) and the linear main effect of Degree of IT Support for Contextualization. In Step 2, we included the quadratic term for Degree of IT Support for Contextualization. The results are shown below in Table 3. The quadratic effect was not significant, indicating that the dip in Collaboration Know-How Development due to partial IT support is not experienced by all individuals in the sample. The results also indicate a significant linear effect for IT support. This suggests that regardless of task type, IT support is an important predictor of Know-How Development.

Table 3. Regression of Collaboration Know-how Development on Squared IT-Support-for-Contextualization

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Collaboration Know-How Development</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust in Team Members</td>
<td>.30</td>
<td>5.39***</td>
<td>.31</td>
</tr>
<tr>
<td>Team Size</td>
<td>.10</td>
<td>1.78</td>
<td>.10</td>
</tr>
<tr>
<td>Liner Main Effect</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of IT Support for Contextualization</td>
<td>.26</td>
<td>4.68***</td>
<td>.22</td>
</tr>
<tr>
<td>Quadratic Effect</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Degree of IT Support for Contextualization)²</td>
<td>---</td>
<td>---</td>
<td>.10</td>
</tr>
</tbody>
</table>

Adjusted R-Squared: .16
Change in R-Squared: .01
F: 17.88***
Df: 3 & 260

*p < .05  ** p < .01  *** p < .001. The betas reported are standardized beta coefficients, N=263

We then tested the interaction effect of Task Non-routineness and the quadratic effect of Degree of IT Support for Contextualization. We included the linear interaction effect as a control. To calculate the quadratic interaction effect, we standardized the scores for Task Non-routineness and the quadratic effect for Degree of IT Support and multiplied them. We then included the variables from the previous
analyses as Step 1, with the quadratic interaction effect as Step 2. The results are shown in Table 4 below.

Table 4. Regression of Collaboration Know-how Development on IT-Support-for-Contextualization-Squared Moderated by Task Non-routineness

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Collaboration Know-How Development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td></td>
<td>(\beta)</td>
</tr>
<tr>
<td><strong>Controls</strong></td>
<td></td>
</tr>
<tr>
<td>Trust in Team Members</td>
<td>.29</td>
</tr>
<tr>
<td>Team Size</td>
<td>.10</td>
</tr>
<tr>
<td><strong>Direct Effects</strong></td>
<td></td>
</tr>
<tr>
<td>Degree of IT Support for Contextualization</td>
<td>.21</td>
</tr>
<tr>
<td>((\text{Degree of IT Support for Contextualization})^2)</td>
<td>.10</td>
</tr>
<tr>
<td>Task Non-routineness</td>
<td>.08</td>
</tr>
<tr>
<td><strong>Moderating Linear Effect</strong></td>
<td></td>
</tr>
<tr>
<td>Degree of IT Support for Contextualization X Task Non-routineness</td>
<td>.07</td>
</tr>
<tr>
<td><strong>Moderating Quadratic Effect</strong></td>
<td></td>
</tr>
<tr>
<td>((\text{Degree of IT Support for Contextualization})^2 \times \text{Task Non-routineness})</td>
<td>---</td>
</tr>
<tr>
<td>Adjusted R-Squared</td>
<td>.17</td>
</tr>
<tr>
<td>Change in R-Squared</td>
<td>---</td>
</tr>
<tr>
<td>(F)</td>
<td>9.77***</td>
</tr>
<tr>
<td>(Df)</td>
<td>6 &amp; 256</td>
</tr>
</tbody>
</table>

\(* p < .05 \) \( ** p < .01 \) \( *** p < .001 \). The betas reported are standardized beta coefficients, \(n=263\).

Following Aiken and West (1991), to determine if the precise nature of the interaction effect was as hypothesized, we conducted a split sample regression. We split the sample at the mean of Task Non-routineness yielding a sample of 147 respondents with high non-routine tasks and 116 with low non-routine tasks. There were 30 ties at the mean; three different ways of distributing the ties yielded the same results. Regressions were conducted on each sample separately. The results of the split sample are shown in Table 5 below. As with Tables 3 and 4, the control variables in Table 5, trust was found to have a significant relationship with collaboration know-how development, while size was not significantly related to collaboration know-how development.

Table 5. Regressions of Collaboration Know-How Development on IT-Support-for-Contextualization-Squared

<table>
<thead>
<tr>
<th>Collaboration Know-How Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Task Non-Routineness</td>
</tr>
</tbody>
</table>

21
The results in Table 5 provide support for our hypothesis. In case of routine tasks, there is a curvilinear relationship between individuals’ perceptions of IT support for contextualization and collaboration know-how development (quadratic effect is significant). On the other hand, when the task is perceived to be non-routine this relationship is linear (significant linear effect). As suggested by Aiken and West (1991, p. 12), it is important to probe any significant interaction effect to fully understand its meaning. One of the most powerful means of probing is to plot the relationship between the predictor variable and the dependent variable for different levels of the moderator variable. In Figure 2, we plotted Collaboration Know-how Development as a function of IT Support for Contextualization for the two levels of Task Non-routineness. In addition, as called for by Aiken and West, to graphically visualize the complex interaction, Degree of IT Support for Contextualization was partitioned into thirds. This categorization was done only for the graph, not for the analysis. The plot clearly demonstrates that when individuals perceive they are performing routine tasks, the quadratic relationship found in the regression shows a dip in Collaboration Know-how Development for moderate levels of IT Support for Contextualization. In contrast, when individuals perceive they are performing non-routine tasks, there is no such dip, resulting in the complete absence of any quadratic (non-linear) relationship between IT Support for Contextualization and Collaboration Know-how Development.

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>(n=116)</th>
<th>(n=147)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust in Team Members</td>
<td>$\beta$</td>
<td>$T$</td>
</tr>
<tr>
<td></td>
<td>.41</td>
<td>4.99***</td>
</tr>
<tr>
<td></td>
<td>.14</td>
<td>1.74</td>
</tr>
<tr>
<td></td>
<td>$\beta$</td>
<td>$T$</td>
</tr>
<tr>
<td></td>
<td>.22</td>
<td>2.86***</td>
</tr>
<tr>
<td></td>
<td>.05</td>
<td>.67</td>
</tr>
<tr>
<td>Team size</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.14</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>.05</td>
<td>.67</td>
</tr>
<tr>
<td><strong>Direct Effect</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of IT Support for Contextualization</td>
<td>$\beta$</td>
<td>$T$</td>
</tr>
<tr>
<td></td>
<td>.14</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>.30</td>
<td>3.38**</td>
</tr>
<tr>
<td>(Degree of IT Support for Contextualization)$^2$</td>
<td>$\beta$</td>
<td>$T$</td>
</tr>
<tr>
<td></td>
<td>.22</td>
<td>2.54**</td>
</tr>
<tr>
<td></td>
<td>.10</td>
<td>.12</td>
</tr>
<tr>
<td><strong>Adjusted R-Squared</strong></td>
<td>.22</td>
<td>.13</td>
</tr>
<tr>
<td>$F$</td>
<td>8.99***</td>
<td>6.33***</td>
</tr>
<tr>
<td>$DF$</td>
<td>4 &amp; 111</td>
<td>4 &amp; 142</td>
</tr>
</tbody>
</table>

* $p < .05$  ** $p < .01$  *** $p < .001$. The betas reported are standardized beta coefficients, n=263
DISCUSSION

In sum, we predicted that IT support for contextualization would affect individual collaboration know-how development in structurally diverse DTs. Based on a survey of 263 individuals engaged in structurally diverse distributed teams, we found that degree of IT support for contextualization was related to individuals’ collaboration know-how development moderated by task non-routineness. That is, the positive linear relationship was found particularly among individuals performing non-routine work. For individuals performing routine work, a curvilinear relationship was found in which partial levels of IT support were associated with less collaboration know-how development.

Limitations of the Study

This study suffers from four significant limitations. First, although we have statistically demonstrated that common method variance is not likely to be a major issue for our study, we acknowledge that in cross-sectional studies using perceptual measures there is always the potential for
common method variance. Future studies should minimize the common method variance by collecting data on more objective measures of collaboration know-how development. Perhaps, coding of the entries in a team’s repository to assess an individual’s unique contribution as the team progresses through its life cycle may provide a proxy for collaboration know-how development. Alternatively, if coworkers or team leaders are sufficiently knowledgeable about their team members, they could be asked to rate individual team members’ growth in collaboration know-how during the team’s life-cycle. Moreover, IT support can also be measured objectively through log files indicating the extent of use of technology functionalities. Ideally, follow-on research will explore the relationship of collaboration know-how development with objective technology features as well as their subjectively assessed fit. Task non-routineness was also assessed attitudinally as individuals were performing different aspects of the group’s task and had varied past experiences. Exploring the correspondence between subjective and objective measures of the task that individuals perform and how that affects the moderator role of task type is a worthwhile focus of future research.

Second, causation has not been demonstrated. Since earlier case study research of a single team’s progress through its life cycle demonstrated causality between the use of technology and individuals’ ability to contribute to the team’s outputs (Majchrzak et al. 2000, Malhotra et al. 2001), our effort in this study was focused on exploring the relationship between IT support for contextualization and collaboration know-how development across a large sample of individuals. Future studies should attempt to assess causation by following individuals in a set of diverse teams through their life cycles to study how their use of IT to support contextualization influences their development of individual collaboration know-how. In addition, we did not examine the link between collaboration know-how development and team performance. Future research should examine the link that collaboration know-how development in individual team members leads to more effective team processes, which then leads to a better team performance. Such a study would also provide the opportunity to explore if IT
support for contextualization is able to compensate when team processes, leadership, or composition are inadequate.

Another limitation of this study is that we restricted our sample to high performing teams. It may be that the relationship between IT support for contextualization and collaboration know-how development found for high performing teams is not the same in teams that have lower levels of performance. Future research studies should explore the relationship between IT support for contextualization and collaboration know-how development over a wide range of teams – including low performing and high performing teams in the sample.

A fourth limitation is that our measures were developed specifically for this study. Further research needs to be conducted with these measures to determine their validity and reliability. The fact that the intra-class correlations were so low despite these individuals being members of an identifiable and high performing team with a team leader and team deliverables is an interesting finding in and of itself. At the very least, this finding suggests that, for DTs – especially structurally diverse DTs – the individuals in a team may not provide sufficient influence on each other to affect some psychological attitudes (such as trust). For such attitudes, treating the individuals as a group may overstate the relational impact of other team members. This raises the interesting question: In structurally diverse DTs, do team members share the same types of psychological attitudes as typically found in collocated teams?

Finally, our study is limited to the specific criteria of our sample: structurally diverse distributed teams. Such a limitation is an advantage for empirical testing because of the criticality of collaboration know-how development and the reliance on IT support for knowledge sharing in such teams. However, further research is needed to determine if the relationship between IT support for contextualization and collaboration know-how development found here extends to hybrid teams or to teams that are less diverse. This relationship may not be observed in hybrid teams as members are not as dependent on technology to share context. While, in less structurally diverse teams, member may already share
sufficient context to interpret others’ knowledge content without having to use IT support to share context explicitly. This would suggest that IT support for contextualization may be of particular benefit only to a subset of the entire population of DTs: those that are structurally diverse, primarily virtual, and composed of members performing what they perceive to be non-routine tasks.

**Theoretical Implications**

Our study follows recommendations by Markus et al. (2002) to develop theories of principles for designing IT systems. We suggest that the five aspects of a contextualization strategy supported by IT constitute five design principles. The advantage of these design principles is that they are generalizable across IT applications. Moreover, they may be applicable, beyond communication-oriented technologies, to include knowledge management systems that support individual ongoing sense-making processes (Faniel and Majchrzak 2003).

Having shown an empirical link between IT support for contextualization and collaboration know-how development, alternative theories for why contextualization helps should be explored. We relied on theory offered by Te’eni (2001) and Weick and Meader (1993) to argue that contextualization helps to develop collaboration know-how. Communicated context provides people with the memory and metaphors for describing cause-effect links, exploring preferences for some effects over others, and constructing moderately consensual definitions of whether there is a need for a decision and what the decision is about. However, an alternative perspective on contextualization focuses on communication of social rather than cognitive context (Sproull and Kiesler 1986). This perspective provides an equally viable explanation for the value of contextualization. For example, Cramton (2001) and Walther (1995) suggest that a lack of social context cues in communication creates a lack of individuating information about other team members, which leads to stereotypical misattributions. Comparing the social versus cognitive context explanations may lead, in some situations, to different hypotheses. For example, when team members are familiar with each other and have a strong group identity, the individuating explanation would hypothesize that less misattributions occurs even without much IT-
supported cognitive contextualization. In contrast, the cognitive perspective would argue that even with social contextual cues made apparent during interactions, cognitive context information (such as alternative perspectives on an issue) is still needed. Therefore, further research should explore the differential value of each perspective of contextual information.

In an effort to develop generalizable design principles for effective communication among individuals in a DT, we have examined IT support of distributed teams through a “contextualization” lens. An alternative to the contextualization lens is that the value of IT support for DTs is in the coordination benefits it provides by increasing visibility into others’ work (Olson et al. 2002), enabling co-creation and manipulation of boundary objects (Star 1989; Carlile 2002), allowing easy movement between sub-activities (Olson et al. 2002), and evenly distributing information among team members (Cramton 2001). The relationship between support for contextualization and collaboration know-how development suggests that IT support for contextualization provides value above and beyond enabling coordination. However, this hypothesis deserves testing in future research.

Our study represents an initial attempt at empirically demonstrating the value of ideas developed by Boland et al. (1994) and Hedberg and Jonsson (1978) that IT systems and work practices that support the exchange of contextual information are related to knowledge development. These researchers incorporated contextualization support within a broader concept of support for an active inquiry and sense-making process. Although our intention in this study was simply demonstrating a variance-based relationship between IT support for contextualization, task routineness, and collaboration know-how development, the model by Te’eni (2001) for organizational communication and work by Weick and Meader (1993) suggest that future research should explore the relationship in more detail with a process-based model. In Figure 3, we show a process-based model that summarizes a proposed process by which a contextualization strategy is selected, enabled by IT support, results in sense-making moderated by task non-routineness, and leads to collaboration know-how development.
Having demonstrated the relationship among the three shaded constructs, we encourage future research to explore this complete process.

![Diagram of Communication Process]

Our study also has implications for task-technology theories as they apply to individuals in distributed groups. Information richness theory (Daft & Lengel 1986), TIP theory (McGrath 1991; McGrath & Berdahl 1998), and the theory of task-technology fit in group support system environments (Zigurs & Buckland 1998) collectively present a set of contingencies that drive individuals’ media choices based on the ambiguity or equivocality of the message they are sending and the objective richness capacities of the media. Using these theories, the virtual team literature has argued that, for conveying very simple messages, a lean medium (such as email) is most efficient because it eliminates communication of extraneous information (e.g., Hinds and Bailey 2003). For tasks that individuals perceive to be non-routine (because they have a new role with an old task or they are new to the group that has performed this task earlier or it is an entirely new task), they are encouraged to communicate their richer information with multi-channel and interactive electronic media. When these tasks are non-routine, the richest of media (i.e., face-to-face) has been recommended. However, our study findings differ from the tenets of the task-technology paradigm presented above in two respects. First, our
sample consisted of structurally diverse teams whose members did not have the benefit of the richest media of face-to-face contact and yet they effectively performed non-routine work (e.g. strategic planning, new product development). Moreover, collaboration know-how development still occurred for these individuals. This suggests that, in contrast to both the task-technology theories and virtual team literature that argues for the importance of face-to-face contact (e.g. Bhappu et al. 2001, Cramton 2001, Hinds and Bailey 2003, Mannix et al. 2002, Maznevski and Chudoba 2000), face-to-face is not required for non-routine tasks when IT provides contextualization support. Second, the dip in collaboration know-how development found with routine tasks when IT support for contextualization was partial suggests that it may not be the richness of the media that contributes to collaboration know-how development, but rather the level of support for contextualization that the media provides.

These findings lead us to join calls in the literature that question the value of media richness models in general (Markus 1994, Carlson and Zmud 1999) and specifically for explaining how individuals perform effectively in distributed groups (Saunders 2000). For individuals in structurally diverse DTs, we suggest replacing the concept of media richness with a concept of contextualization richness, made possible through the alignment of technology support and work practices. We argue that future research should focus on rich contextualization support for individuals in DTs. Such research could answer the important question of whether electronically mediated communication can supercede face-to-face communication when IT provides ways for individuals to more efficiently learn, organize, retrieve, and compare alternative and emergent perspectives on a problem. Finally, a focus on contextualization support may help to elaborate why an IT system may have unintended negative effects. We observed a negative effect of partial contextualization support for individuals performing a routine task, which was ameliorated when higher levels of support were provided. Thus, a contextualization support lens may be helpful, for example, by suggesting that reasonably comprehensive cognitive contextualization support may be more important than the choice of any one media.
**Practical Implications**

Managers are struggling to identify ways to effectively manage and leverage the opportunity provided when a group of diverse individuals, each of whom represents different constituencies that cross organizational, geographical, and functional boundaries, are brought together to solve a problem (Bhappu et al. 2001, Majchrzak et al. 2004). With this structural diversity comes the potential for conflict and process losses (Hinds and Bailey 2003, Mannix et al. 2002), but also the potential for increased knowledge creation and performance (Bhappu et al. 2001, Cummings 2004).

Our results suggest a way of managing the structural diversity among these individuals. This can be achieved by facilitating the sharing of contextual information between individuals that leads to gaining the collaboration know-how needed to manage their interdependent work. Our results also suggest that by following a set of theoretically-derived principles when designing IT support and accompanying work practices, managers of DTs can encourage the sharing of contextual information. These design principles are not limited to or constrained by specific technologies or teams, but rather are overarching guidelines. The eleven items used to measure IT support for contextualization can be used by managers to benchmark any technology and the team’s work practices to assess adherence to the spirit of these design principles (DeSanctis and Poole 1994). Managers should assess their virtual workspaces not only from a functionality perspective (such as hyper-linking, templates, integration of instant messaging, electronic whiteboards, revision history, and synchronous meeting support), but also from the perspective of the contextualization needs of the individual members of the DT.

Finally, our findings alert managers to the fact that support is a matter of degree, and that, when individuals perform routine tasks, partial support may be worse than no support at all. Moreover, the routineness of a task assigned to the team may not correspond to the routineness experienced by some individuals on the team. Managers who plan to provide only partial support for collaboration (e.g., by providing some technology functionalities but not others and not establishing norms for the use of these functionalities) and are not aware of how individuals on the team assess the routineness of the
tasks they are performing, may find that their efforts to provide technology support for their teams fail to achieve desired benefits. It may be better for such managers to not provide any support. However, an even better strategy may be for managers to consider providing all eleven IT functionalities associated with IT support for contextualization found in this study, and then assess the degree to which these functionalities fit the contextualization needs of their virtual employees. In either case, our results indicate that attention should be paid to IT support if employees are to learn how to collaborate virtually in the 21st century.

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Appendix A. Results of CFA

Know-how Development

IT Support for Contextualization

Task Non-Routineness

Trust

* KH=knowhow; IT=IT support; NR=task nonroutineness; TR=Trust; #’s=item #’s in Table 1