

---

# Virtual Team Research

## An Analysis of Theory Use and a Framework for Theory Appropriation

Shu Z. Schiller

*Wright State University*

Munir Mandviwalla

*Temple University*

Recent information systems research has studied various aspects of virtual teams. However, the foundations and theoretical development of virtual team research remain unclear. We propose that an important way to move forward is to accelerate the process of theorizing and theory appropriation. This article presents an in-depth analysis of the current state of the art of theory application and development in virtual team research. We identify the frequency, pattern of use, and ontological basis of 25 virtual team–relevant theories. A researcher’s tool kit is presented to promote future theory application and appropriation. The tool kit consists of a descriptive and analytical database of theories relevant for virtual team research. We also present a framework for appropriating virtual team theories based on seven criteria. A detailed example demonstrates the application of the theory appropriation framework. The article contributes to the literature by presenting the state of the art of theory use in virtual team research and by providing a framework for appropriating reference-discipline theories.

**Keywords:** *virtual team; theory; theoretical foundation; analysis; choice; appropriation*

Virtual teams are increasingly seen as a new form of organizational structure given the growth of interorganizational alliances and the adoption of advanced information technology (IT) for computer mediated communication (CMC; Kayworth & Leidner, 2001-2002). Although there

---

**Authors’ Note:** We would like to thank Heinz Klein and Gabriele Piccoli for their helpful comments on earlier versions of this article. We also thank the reviewers and the editors of the special issue for their insightful and detailed comments.

is little consensus about how to define virtual teams (Fiol & O'Connor, 2005), most researchers agree that virtual teams have the following key features: (a) Members interact through interdependent tasks guided by common purposes (Lipnack & Stamps, 1997), (b) they use CMC or telecommunication media substantially more than face-to-face communication (Anawati & Craig, 2006; Fiol & O'Connor, 2005; Griffith & Neale, 2001), and (c) they are geographically dispersed from each other (Cohen & Gibson, 2003; Griffith & Meader, 2004). We adopt these attributes of virtual teams in this article and observe that, despite significant research, the foundations and theoretical development of virtual team research remain unclear along with the standardized definition. A theoretical base is important because it serves the purpose of structuring research questions and research methodologies. The application of theory provides a conceptual framework for deriving propositions, hypotheses, recommendations, and also suggestions as how to structure the research domain (Klein, 2002).

Some published reviews have provided a valuable overview of virtual team research; however, they have not specifically analyzed the theoretical foundations. For example, Powell, Piccoli, and Ives (2004) analyzed articles published on virtual team research between 1991 and 2002, summarized the research themes, and proposed future topics. Powell et al. listed 15 theoretical perspectives and concluded that there is no unifying theory currently available for virtual team research. Martins, Gilson, and Maynard (2004) reviewed empirical articles on virtual teams and identified constructs such as team inputs, team processes, team outcomes, and moderators of team performance.

Researchers have recommended that future virtual team research should be theory based and include both development of new theories and explicit identification of the appropriation of existing theories. Despite similar conclusions by several researchers, there has been little progress in the development of new theories in virtual team research. Given the relatively slow progress in the development of new theories, it is very important for any scholar to be able to choose and appropriate existing theories effectively from within the information systems (IS) domain and, perhaps more importantly, from reference disciplines.

Scott Schneberger and Mike Wade have organized a Web site titled "Theories Used in IS Research" (<http://www.istheory.yorku.ca/>), where IS scholars worldwide have contributed summaries of 48 theories used in IS research. This theory repository is a positive development. Yet a repository is only the first step; we also need tools and concepts that can assist a

researcher to identify and appropriate the most relevant theory for a particular phenomenon.

To respond to the need to carefully apply the most relevant theories to IS research, we focus in this article on the theoretical foundations in a specific area of research, virtual team research. We build on prior research work by conducting a broader and deeper analysis of theoretical perspectives in the context of virtual team research, based on the available and suitable publications on this topic. The goal of our study is to better understand theory use in virtual teams and to guide future theory-based virtual team research. Our article has three objectives. First, we will explore the theoretical foundations of current IS research on virtual teams. Second, we will analyze the identified theories in various perspectives and provide a descriptive repository for theories for virtual team research. Third, we will introduce a framework that researchers can use to appropriate theories. To demonstrate how this framework can be applied, we will analyze one theory. These elements will comprise a “theory tool kit” for researchers to use to select and apply relevant theories to virtual team related topics. Specifically, this article addresses the following research questions:

- What is the state of the art of theory use in virtual team research?
- What are the characteristics of theories used in virtual team research?
- How should we appropriate a theory in virtual team research?
- What are the strong points and challenges of using a specific theory in conducting virtual team research?

## **Method**

The purpose of our study is to analyze the theories currently used and to construct a framework to be used for theory selection in virtual team research. We apply archival research to identify previous theories and construct the framework by integrating several well-known existing frameworks available in the literature for theory appropriation and assessment.

## **Sampling**

We used a two-step sample selection method to identify existing theories. First, we sampled virtual team articles from 18 top journals (shown in Table 1). The selection of these journals was based on their ranks in

**Table 1**  
**Articles Selected for Investigation**

	Journal	Number of Articles Selected	Articles
1	<i>Academy of Management Journal</i>	1	Montoya-Weiss, Massey, and Song (2001)
2	<i>Behaviour &amp; Information Technology</i>	1	Archer (1990)
3	<i>The DATA BASE for Advances in Information Systems</i>	1	Balthazard, Potter, and Warren (2004)
4	<i>Decision Sciences</i>	2	Schmidt, Montoya-Weiss, and Massey (2001); Warkentin, Sayeed, and Hightower (1997)
5	<i>Group Decision and Negotiation</i>	1	Qureshi and Vogel (2001)
6	<i>Human Communication Research</i>	1	Walther and Burgoon (1992)
7	<i>IEEE Transactions on Professional Communication</i>	8	Krumpel (2000); Lee (2000); Lind (1999); Lowry and Nunamaker (2003); Ocker (2005); Robey, Khoo, and Powers (2000); Scott and Timmerman (1999); Tan, Wei, Huang, and Ng (2000)
8	<i>Information &amp; Management</i>	3	Murthy and Kerr (2003); Paul, Seetharaman, Samarah, and Mykytyn (2004); Peffers and Tuunanen (2005)
9	<i>Information Resources Management Journal</i>	1	Majchrzak, Rice, King, Malhotra, and Ba (2000)
10	<i>Information Systems Journal</i>	1	Warkentin and Beranek (1999)
11	<i>Information Systems Research</i>	4	Belanger, Collins, and Cheney (2001); Galegher and Kraut (1994); Sia, Tan, and Wei (2002); Zak (1993)
12	<i>Journal of Electronic Commerce in Organizations</i>	1	Axelsson (2003)
13	<i>Journal of Management Information Systems</i>	5	Chidambaram, Bostrom, and Wynne (1990-1991); Jarvenpaa, Knoll,

(continued)

**Table 1 (continued)**

Journal		Number of Articles Selected	Articles
14	<i>Journal of Organization Computing</i>	1	and Leidner (1998); Kayworth and Leidner (2001-2002); Massey, Montoya-Weiss, and Hung (2003); Pauleen (2003-2004)
15	<i>MIS Quarterly</i>	5	Chidambaram and Bostrom (1993)
16	<i>Management Science</i>	1	Chidambaram (1996); Dennis and Garfield (2003); Griffith, Sawyer, and Neale (2003); Majchrzak, Rice, Malhotra, King, and Ba (2000); Piccoli and Ives (2003)
17	<i>Organization Science</i>	7	Ahuja, Galletta, and Carley (2003) Ahuja and Carley (1999); Cramton (2001); Hinds and Bailey (2003); Jarvenpaa and Leidner (1999); Maznevski and Chudoba (2000); Staples, Hulland, and Higgins (1999); Walther (1995)
18	<i>Small Group Research</i>	1	Hollingshead, McGrath, and O'Connor (1993)
Total		45	1990-2005 (first quarter)

Hardgrave and Walstrom (1997); Lowry, Romans, and Curtis (2004); Mylonopolous and Theoharakis (2001); and Peffer and Ya (2003). These rankings were constructed by IS academics, and they tend to emphasize journals that publish research conducted by IS researchers. There are other excellent journals, such as the *Journal of Applied Psychology and Human Resource Management*, that have published articles relevant to teams; however, they typically do not publish IS-centric research and are thus not included in journal rankings and were not included in our sample. Although this approach excludes some good journals, it is consistent with our focus, which is to assess the state of the art of virtual team theory use and appropriation in the context of IS.

Second, using the journals listed in Table 1, we conducted a search for articles by using the search terms *virtual* and *team*, *virtual* and *group*, *dispersed* or *distributed collaboration work* or *group*, and *computer mediated*

*communication*. The search generated 85 virtual team research articles published between 1990 and the first quarter of 2005.

Third, we followed an objective method to identify theories. Each article was processed as follows: (a) careful reading of the abstract, introduction, literature review or model development (or similar section), and discussion sections; (b) analysis of all figures and tables for theoretical statements such as causal linkages in figures or hypotheses; and (c) search for keyword *theory* in the text of the article. Once we identified a theoretical section, we carefully read the theoretical foundations and research model development. Only articles that used part of a specific theory, a theory, or theories to construct a research model or to perform substantial analysis were selected into the sample. Articles that used theories only in general citations but not as the foundation of research were excluded. Articles that cited only the previous literature documenting the theory without using the theory as the research foundation were also excluded from our sample. We believe that this process is fairly robust because it is unlikely that causal statements that are the foundation of all theories were missed. Moreover, we observed that articles that do use theory tend to announce that fact loudly and clearly; it was only in the older articles that we found theory use hard to find and understand. However, it is possible that articles that simply apply a theoretical tradition without explicitly referring to it could have been excluded.

As a result of this process, among the 85 virtual team research articles selected, 40 were excluded, leaving 45 articles in the sample for analysis. These 45 articles, published between 1990 and the first quarter of 2005, all used clear and specific theoretical foundations. The theory search process identified 25 theories in total from these articles. Table 1 shows the authors and years of publication of the 45 articles journal by journal.

## Analysis

### *Frequency of Theory Use*

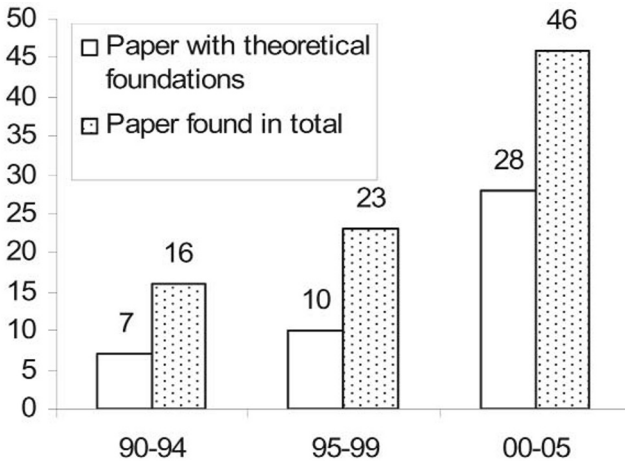
Our sample has 45 articles with explicit theoretical foundations. Some articles cited multiple theories. Twenty-five theories were used 58 times in total. Eleven theories (44%) were used more than once. Of these, five theories (20%) were each used four times or more. Fourteen theories (56%) were used only once. Table 2 presents the complete list of identified theories with frequency of use.

**Table 2**  
**Frequency of Use of Theories in Virtual Team Research**

Name of Theory	Frequency of Use
Adaptive structuration theory	9
Media richness theory	6
Social information processing theory	5
Social presence theory	5
Time, interaction, and performance theory	4
Contingency theory	3
Social identity or deindividuation theory	3
Swift trust theory	3
Conflict management behavior theory	2
Media synchronicity theory	2
Task circumplex model	2
Business action theory	1
“Big Five” personality model	1
Commitment theory	1
Control theory	1
Dialogue theory	1
Learning theory	1
Network and organization form theory	1
Punctuated equilibrium model	1
Role theory	1
Social comparison theory	1
Self-efficacy theory	1
Team knowledge transfer model	1
Task–media fit theory	1
Team performance model	1
Total number of theories, 25	Total frequency of use, 58

The theory most frequently used (nine uses) is adaptive structuration theory (AST). Media richness theory (MRT), social information processing (SIP) theory, and social presence theory (SPT) rank in second place. Time, interaction, and performance (TIP) theory ranks third, followed by contingency theory, social identity or deindividuation (SIDE) theory, and swift trust theory. It is not surprising that AST ranks the highest, because it “emphasizes the interplay between technology and the social process of technology use, illuminating how multiple outcomes can result from implementation of the same technology” (DeSanctis & Poole, 1994, p. 142). On the other hand, AST is also a broad, process-oriented theory and is not

**Figure 1**  
**Trend of Theoretical Foundation Use in Virtual Team Research**  
**(1990-2005)**



Note: Papers of 2005 were collected January to March.

necessarily intended for very specific explanation and prediction. Its limitations are “weak consideration of the structural potential of technologies in general and advanced IT in particular, the focus on institutional levels of analysis, and the reliance on purely interpretive methods” (DeSanctis & Poole, 1994, p. 142). It is possible that the high frequency of use of AST suggests that we are still trying to identify the key explanatory constructs in virtual team research.

A historical time analysis of the sample yields some interesting results. Figure 1 illustrates the increasing trend of theory use in virtual team research from 1990 to 2005. The figure compares the total number of virtual team articles with the number of articles that have theoretical foundations in 1990 to 1994, 1995 to 1999, and 2000 to 2005 (the 2005 data include only the first quarter of the year). Seven articles had explicit theoretical foundations in the first five years (43.8% of the total), 10 articles in the middle five years (43.5%), and 28 articles in the last five years (60.9%). The trend shown in the figure confirms that researchers have based their



**Table 3**  
**Use of Theoretical Foundations in Different Categories**  
**of Virtual Team Research**

Team Inputs 14 Theories	Team Processes 22 Theories	Team Outputs 22 Theories
<u>Members:</u>	<u>Communication:</u>	<u>Task performance:</u>
“Big Five” personality model	Adaptive structuration theory	Adaptive structuration theory
Dialogue theory	Media richness theory	Business action theory
<u>Context:</u>	Media synchronicity theory	Contingency theory
Adaptive structuration theory	Task–media fit theory	Dialogue theory
Contingency theory	Team knowledge transfer model	Media richness theory
Control theory	Time, interaction, and performance theory	Network and organization form theory
Learning theory	<u>Social interaction:</u>	Social information processing theory
Media richness theory	Adaptive structuration theory	Task circumplex model
Network and organization form theory	Big Five personality model	Task–media fit theory
Role theory	Conflict management behavior theory	<u>Effectiveness:</u>
Self-efficacy theory	Control theory	Adaptive structuration theory
Social identity or deindividuation theory	Dialogue theory	Business action theory
Social information processing theory	Media richness theory	Commitment theory
Team performance model	Network and organization form theory	Conflict management behavior theory
Time, interaction, and performance theory	Punctuated equilibrium model	Dialogue theory
	Self-efficacy theory	Learning theory
	Social comparison theory	Media richness theory
	Social identity or deindividuation theory	Media synchronicity theory
	Social information processing theory	Punctuated equilibrium model
	Social presence theory	Self-efficacy theory
	Swift trust theory	Social information processing theory
	Team performance model	Task circumplex model
	Time, interaction, and performance theory	Time, interaction, and performance theory

virtual team studies on theories more frequently in recent years. This encouraging result shows that researchers are responding to the call by editorial boards in top journals to work on theory-based research, a promising result for overall IS research.

*The Components of Virtual Team Research*

Powell et al. (2004) proposed that the focus of virtual team research can be divided into three main categories: team inputs, team processes, and

team outcomes. We adopted their framework in our study to map the 25 identified theories (as shown in Table 3).

There are two subcategories under each research focus category in Table 3. These subcategories were constructed by induction, a method similar to that used in Orlikowski and Iacono (2001). We followed a two-step process to create Table 3. First, each researcher individually categorized the theories using the input–process–output scheme. We calculated an initial percentage agreement interrater reliability of 67%. Second, we achieved 100% agreement by discussing each difference of categorization in detail to improve our understanding of each theory and further refine Table 3. Table 3 should be seen less as an attempt to pigeonhole theories and more as a lens into the dimensions of each theory. The categories provide a means for appropriating theory and make it easy to see what theories are available given a particular subtopic; the categories are not intended to provide a unified theoretical model of virtual teams.

Fourteen theories (56%) fit into the category of team inputs; the categories of team processes and team outputs each included 22 theories (88%). This breakdown is not particularly surprising in retrospect; the results reflect the characteristics of virtual teams. Team members interact with each other in the virtual context. The extensive use of CMC increases the importance of communication and therefore changes social interactions between team members. Communication is the key to exchanging information and knowledge in the process of performing tasks in virtual teams. The nature of the task determines the level of difficulty of performance and has a direct effect on the effectiveness and success of a team.

The results shown in Tables 2 and 3 reveal the general research interest or the “hot” areas in virtual teams research, reflected by the use of theories. For example, the two tables taken together show that the subcategory of social interaction ranks highest in number of times used as a research foundation. The social aspects of traditional teams have been studied for a long time in management areas such as human resources and organizational behavior. Therefore, research on social interactions in virtual teams, because it is an extension from and also a comparison to research on traditional teams, may be popular with researchers because it raises many interesting research questions. On the other hand, if we can assume that the use of many different theories equates with complexity, then the results reveal that social interaction is likely the most complex area of virtual team research and may require multiple theoretical perspectives to be fully understood and explained.

Perhaps most importantly, the results support Weber's (1987) concept that a "strategic hypothesis" (p. 7) is emerging in IS research. A strategic hypothesis is one that is interesting and relevant and the product of parsimonious research. In other words, in aggregate and over time, virtual team researchers are converging on what they believe is the most important topic of study.

In contrast, some subcategories show few theories applied during the period of analysis. For instance, two theories, "Big Five" personality model and dialogue theory, were related to the attributes of virtual team members. It is likely that researchers assume that these variables will have only a minor effect on the performance or effectiveness of virtual teams; it is also possible that the topics are just not interesting enough.

On the whole, this analysis provides some empirical evidence that researchers do tend to look for strategic hypotheses. However, the heavy use of theories in research on social interaction and the lesser use of theories in other virtual team research subcategories may also be interpreted as a weakness in virtual team research, suggesting that we do not yet know for sure what variables will explain a significant amount of the variance.

Another potential weakness may be a lag effect in the application of theory in the business environment. For example, globalization, outsourcing, and "off-shoring" are key topics in the practitioner literature. Given that virtual teams are more likely to be involved in multicultural and multilingual functions, constructs such as cultural background and language might require more theoretical attention. Additionally, if we continue to focus on assumed key variables such as social interaction for theory selection and appropriation, there is another subtle danger. It is possible that the applied theories may mistakenly explain the outcomes of other phenomena. It is therefore important that researchers carefully establish the boundary conditions or the context of the variables.

### *Ontological Analysis*

Virtual team research can be viewed as one subset of IS research. Theories used in IS research are large in number and diverse (Lee, Lee, & Gosain, 2004). Lee et al. (2004) classified theories used in IS research into 10 categories and developed a three-dimensional ontological framework:

1. The phenomenon analyzed is categorized as *behavior*, *cognition*, *design*, or *outcomes*. *Behavior* focuses on the activities or actions of the subjects, as do the technology acceptance model and theory of planned behavior (Lee et al., 2004). *Cognition* emphasizes the mental process of individuals, as do human cognition theory and inductive learning theory. *Design*

focuses on the process of design and construction of ideas. *Outcomes* focuses on the results of actions.

2. The analytical unit of interest is categorized as *individual, group, organization, or market or interorganization*.
3. The objectives of the theoretical framework are categorized as *descriptive, normative, prescriptive, or developmental*. According to Lee et al. (2004, p.551), descriptive approaches focus on how and why people behave the way they do. Normative approaches focus on ideal behavior. Prescriptive approaches focus on the choices constrained by reality. Developmental approaches focus on understanding system development, design, and implementation.

To provide an analysis of the ontological characteristics of theories used in virtual team research, we apply Lee et al.'s framework to the 25 theories identified in our study (as shown in Table 4).

Each of the 25 theories was analyzed and categorized based on the phenomenon studied, the unit of analysis, and its objectives. For example, SPT suggests that the fewer the channels that are available within a medium the less attention is paid by the interaction partner to the presence of other social participants' interactions and that, consequently, social presence declines as messages become more impersonal (Short, Williams, & Christie, 1976). SPT focuses on the behavioral activities (interactions) of the partners who communicate through media. The theory operates at an individual level because it relies on the concept of *presence*, which emphasizes an individual's sense of awareness of other communication partners and that individual's perception of social interaction. In addition, SPT is prescriptive because it suggests that the awareness of social presence is constrained by the channels of the communication medium. In summary, SPT is categorized as a behavior–individual–prescriptive theory based on its ontological attributes.

Ten theories, including AST and contingency theory, were already analyzed in Lee et al. (2004). We therefore adopted the ontological analysis of these theories directly from Lee et al. For the 15 theories that did not appear in Lee et al., we performed the analysis based on the definitions of the three dimensions in the ontological framework. Both of the authors analyzed the 15 theories and generated the results concurrently. Table 4 shows the results of the ontological analysis.

The categorization of theories used in virtual team research based on the ontological framework is summarized in Table 5. More than half (56%) of the theories used in virtual team research are behavioral theories. Theories

**Table 4**  
**Ontological Analysis of Theories in Virtual Team Research**

Name of Theory	Phenomenon Analyzed	Analysis Unit	Objectives	Included in Lee, Lee, and Gosain (2004)?
Adaptive structuration theory	O	O	P	Yes
“Big Five” personality model	C	I	D	
Business action theory	B	O	D	
Commitment theory	B	I	N	
Conflict management behavior theory	B	G	D	
Contingency theory	O	O	P	Yes
Control theory	O	I	DV	Yes
Dialogue theory	B	I	P	
Learning theory	B	I	N	
Media richness theory	B	I	P	Yes
Media synchronicity theory	B	I	P	
Network and organization form theory	D	O	DV	
Punctuated equilibrium model	B	G	DV	
Role theory	C	I	D	Yes
Self-efficacy theory	C	I	D	Yes
Social comparison theory	B	G and O	D	Yes
Social identity or deindividuation theory	C	I	D	
Social information processing theory	C	G and O	D	Yes
Social presence theory	B	I	P	Yes
Swift trust theory	B	I	P	
Task circumplex model	D	I	P	
Task–media fit theory	B	I	P	Yes
Team knowledge transfer model	B	G	N	
Team performance model	O	G	P	
Time, interaction, and performance theory	B	G	N	

Note: Under Phenomenon Analyzed, B = behavior; C = cognition; D = design; O = outcomes. Under Analysis Unit, I = individual; G = group; O = organization; M = market or interorganization. Under Objectives, D = descriptive; N = normative; P = prescriptive; DV = developmental.

Lee et al.’s (2004) classification and analysis are reproduced for the 10 theories included in their analysis. We applied their framework to the 15 theories that were not included in their analysis.

**Table 5**  
**Comparison of Distribution of Characteristics of Theories**  
**in Virtual Team Research with Information Systems (IS) Theories**

	Percentage of Theories in Virtual Team Research	Percentage of IS Theories
Phenomenon analyzed		
Behavior	56	29
Cognition	20	20
Design	8	15
Outcomes	16	36
Analysis unit		
Individual	52	39
Group	26	8
Organization	22	30
Market or interorganization	0	9
Not applicable	0	14
Objectives		
Descriptive	32	44
Normative	16	21
Prescriptive	40	23
Developmental	12	12

Note: Ontological analysis of IS theories was obtained from Lee, Lee, and Gosain (2004, p. 553).

focused on the individual level account for 52% of all the theories used in virtual team research. In reference to the objectives of theories used in virtual team research, prescriptive theories rank the highest (40%), followed by descriptive theories (32%).

Virtual team research is one of the subareas of IS research in general. We are interested, from the perspective of ontological foundations for these theories, in how the theories used in virtual team research compare to IS theories in general, which were obtained from Lee et al. (2004, p. 553). Table 5 summarizes the percentages of virtual team theories in each category, compared with those for IS theories based on the three dimensions of ontological analysis.

The ontological classifications show that there is a difference between the distribution patterns of the theories used in virtual team research and those of IS theories in general. In reference to the unit of analysis, it seems that virtual team research has primarily focused on the individual and group level of analysis (a total of 78%). Compared to IS theories, a much larger percentage of theories in virtual team research are at the group level (26%

compared to 8% of IS theories). This is not surprising because a certain amount of virtual team research is conducted on the level of the group, for example, on the interactions between virtual team members. What is perhaps more surprising is that so many of the theories (52%) operate at the individual level even though conceptually it seems obvious that certain key phenomena, such as group performance, should be studied at the group level. The results also mirror the well-documented inference problems of researchers trying to understand organizational or group phenomena but needing to ask the individuals in order to get the data. Given the difficulty of measuring group-level issues, the results may reflect a convenience bias on the part of researchers. The results may also reflect an implicit assumption of researchers that many key team issues are the amalgamation of individual issues. Additional research and reflection is needed to better understand why so many theories operate at the individual level and whether the reasons are poor theory appropriation, a lack of real team-level structures, or a lack of useful team-level theories.

In the category of phenomenon analyzed, 56% of theories used in virtual team research are behavior theories, compared to 29% of IS theories. More IS theories are focused on outcomes (36%) than are theories used in virtual team research (16%). In reference to the category of objectives, the percentage of prescriptive theories used in virtual team research (40%) is more than in IS research theories (23%). The percentage of descriptive theories used in virtual team research (32%) is less than that in IS theories (44%).

The results show that virtual team theories do not follow the ontological pattern of IS theories. We believe this is appropriate because no component should be identical in structure or composition with the higher level structure. Theories in virtual team research should first reflect the characteristics of virtual team research itself, by focusing on interpersonal activities such as individual cognition and interpersonal behavior among team members. However, it is also to be hoped that theories in virtual team research could fill in some of the blanks identified by our work. For example, the topic of how to design and implement a virtual team accounts for only a very small portion of research compared to behavior, cognition, and outcomes studied by scholars.

#### *Discussion of Current Theory Use*

In our study, we identified 85 virtual team research articles, of which 45 (53%) had clear theoretical foundations. Almost half of virtual team research articles (40 articles, 47%) did not have a theoretical basis. Most of these articles used literature citations instead of explicit theories. As

discussed earlier, a higher percentage of the more recent articles do include a theoretical component; however, the overall low percentage shows that studies in this area are more focused on identifying phenomena and providing descriptive exploration. Therefore, there is a need to continue to accelerate theoretically motivated research in this area.

In line with Powell et al. (2004), we conclude that there is no dominant theory in virtual team research. Lee et al. (2004) identified 203 theories used in the IS discipline. Compared to that number, the number of theories (25) cited in multiple articles in virtual team research is relatively small. In addition, the most frequently used theory, AST, appeared in 16% of all the theoretical uses. The theoretical diversity (still) supports the claim that IS research reflects a “fragmented adhocracy” (Banville & Landry, 1989, p. 55). On the other hand, this diversity might be seen as a sign of health as much as a cause for regret (Jones, 2000). We conclude that theoretical diversity in virtual team research is at least for the short term a positive direction. A single theory cannot hope to address the large number of issues identified by previous research. Therefore, we encourage researchers to continue to theorize to develop original theories and to continue to embrace theories from reference disciplines such as organizational behavior, economics, and psychology. For the short term, it does not make sense to devote resources to identifying and creating a single unified theory.

Theory is generally used first for description and then for prediction (Barkhi & Sheetz, 2001). To become widely accepted, theory must present reasonable explanation and reliable prediction of phenomena (Barkhi & Sheetz, 2001; Swanson & Ramiller, 1993). However, the lack of theoretical foundations found in virtual team research demonstrates the limited resources available for theory building, falsifying, and testing. To accelerate theory application, to promote theoretical diversity, and to assist researchers in identifying and testing theories, the next section provides a framework for appropriating existing theories.

Each existing theory has some advantages and challenges. It is very important to consider the applicability of theories to address the specific elements used in virtual teams, such as technology used and structure of the virtual team. The appendix provides a summary of each of the 25 identified theories and provides an analysis of the advantages and disadvantages of applying these theories to virtual team research. The appendix is thus one important part of our theory tool kit and serves as a repository of theories available for virtual team research. Several of the theories in the appendix are the most commonly used theories, such as AST, MRT, and SIP theory. Other theories are less frequently used in current research but should still



be considered. The framework in the next section should prove helpful in identifying and selecting the most appropriate theories.

## **Virtual Team Theory Appropriation Framework**

The key to adopting a theory should be the consistency of the phenomena for which the theory is defined. Theories from other disciplines will apply in virtual team research only if the phenomena share common characteristics that can be explained in both areas. The adoption of theories also includes theory integration around shared theoretical constructs (Klein, 2002). Compared to traditional teams, the key elements of virtual teams, as defined in the introduction, are geographically dispersed team members and the substantial use of CMC. Although the framework presented in this section is designed to accelerate application of theory, when theories are selected from other areas, such as organizational behavior, it is important to avoid application problems, to critically evaluate the theory, and to identify the relationship between the possible common constructs from the borrowed theory and those in the virtual team context.

We present a framework for appropriating theories in virtual team research. It is suggested that theory selection presumes three components: first, a problem definition; then, the availability of more than one theory; and third, the criteria or categories for comparison. There are seven elements in our framework, each of which provides a distinct perspective to be considered when selecting theories. The purpose of this framework is not to evaluate the intrinsic quality and characteristics of theories but to provide a checklist that a researcher can use to appropriate theories based on a thorough analysis from different perspectives relevant to the unique needs of virtual team research. The literature already includes several important references that can assist researchers in generic theory evaluation (e.g., Bacharach, 1989; Weick, 1995). However, we believe that our framework is distinctive and can provide additional value in two aspects: (a) It focuses on how researchers can analyze and adopt existing theories, and (b) it is customized to the needs of virtual team researchers in particular.

### **Elements of the Framework**

*Objective.* What is the underlying objective of the theory? Lee et al. (2004) propose a classification scheme that distinguishes whether a theory

is descriptive, normative, prescriptive, and/or developmental. Understanding the basic objective of a theory will help researchers match their goals with the underlying goal of the theory. For example, it may not be useful to use a normative theory when the goal is to be able to develop a systematic structure. Analysis of the current state of the art in the development and application of theory in virtual team research suggests that the short-term focus should be on descriptive and normative theories, that is, on describing behavior in virtual teams and on identifying ideal behaviors (behaviors that can lead to positive outcomes). It may be too early to focus on prescriptive theories. We base this recommendation on the observation that (a) there are still several subcategories that are underrepresented in virtual team research and need richer description and (b) we do not seem to know enough about virtual teams yet to adopt a prescriptive focus, as discussed in the section on components of virtual team research. On the other hand, some researchers may question this recommendation as too conservative and may successfully argue that we do know enough about certain aspects of technology and behavior to successfully propose prescriptive theories. Moreover, the advantage of a prescriptive approach is that it can affect practice more obviously and move the field forward.

*Appropriateness.* Is the theory appropriate to the phenomena being studied? Appropriateness has two elements: (a) Does the theory easily map onto the phenomena of interest? This is measured subjectively by evaluating the *fit* or *empirical fidelity* between the phenomena of interest and constructs of the theory. (b) Is the theory strategic? That is, does it focus on an important phenomenon as defined by other researchers and/or the needs of industry? The basic focus here is on ensuring that both the theory and the phenomena under study converge on what Weber (1987) called the strategic hypothesis. Given the large number of potential phenomena in virtual teams, it seems important to focus on strategic questions.

*Robustness.* A theory that is based on a cumulative tradition is more likely to be robust and have sufficient explanatory power. In other words, a theory that is based on other theories and is currently being applied is more likely to be useful; this is a normal science view of the world (Kuhn, 1970). A researcher studying unusual phenomena or looking for a revolutionary finding, on the other hand, may choose to focus on untested theories. Given that we found no dominant theory for virtual team research, researchers looking to apply existing theory may also find it useful to look outside the inventory of social science theories listed in this article and apply our

framework to assess a new theory. Even in that instance, when the researcher is theory “shopping,” it is important to look for robust theories.

It is easy to call for a focus on robust theories but the reality in management information systems (MIS) research and in research on virtual teams in particular is that most theories have not been around long enough to have gone through a long developmental process and to claim wide application. The problem is further exacerbated by long publication lead times and rapidly shifting technological changes that may invalidate certain lines of inquiry. For example, group decision support systems is no longer considered an important area of study by many new researchers, and instead the focus seems to have shifted to Internet-enabled virtual teams. Yet group decision support systems was a major focus of attention in the previous two decades, and researchers have worked hard in that area to develop a cumulative tradition of theorizing and building on previous theories that are quite relevant to virtual teams. Perhaps researchers need to be more vigilant about building on related work while pursuing so-called new areas of inquiry. Another solution may be that, in fast-moving fields such as MIS, we may need to formally include conference proceedings in our evaluation of cumulative use of a theory. Obviously, conference proceedings have a much shorter publication cycle.

*Quality.* It is fine to consider the robustness of the theory; but the theory may still be technically inferior. Thagard (1978) suggested three criteria for theory choice: consilience (how much a theory explains), simplicity, and analogy. Whetten (1989) proposed four essential elements for theory development: what (factors to be considered), how (how the factors are related), why (why the factors are related), who, where, and when. Bacharach (1989) presented two criteria for theory evaluation: falsifiability (ability to be refuted) and utility (the usefulness of theoretical systems). Eisenhardt (1989) cited Pfeffer, who suggested that “good theory is parsimonious, testable, and logically coherent” (p. 548). Weick (1995) pointed out that data, lists of variables, diagrams, and hypotheses are not theories, whereas Sutton and Staw (1995) emphasized the process of theorizing. All of the above frameworks are useful in evaluating theories. However, even though there is considerable overlap between them; each framework emphasizes criteria using a slightly different perspective. For example, Bacharach (1989) focuses more on the fundamental technical quality of a theory, whereas Thagard (1978) has a more applied orientation. More recently, Shoemaker, Tankard, and Lasorsa (2004) summarized much of this literature and proposed a set of 10 generic criteria for evaluating social science

theories: testability, falsifiability, parsimony, explanatory power, predictive power, scope or generalizability, cumulative nature of science, degree of formal development, heuristic value, and aesthetics. Shoemaker et al.'s criteria encompass these different perspectives and provide a comprehensive set of elements to be considered. Note that *cumulative nature of science* refers to the refinement of the theory in question and could be measured by the number of times the theory has been revised. This concept is related to the robustness concept introduced above; however, we chose to keep them separate because robustness is related to the context in which the theory exists, whereas Shoemaker et al.'s conception of the cumulative nature of science is about the intrinsic quality (refinement) of the theory. It is also important to note that our framework goes beyond the quality scale by providing the foundation for analyzing and selecting theories from a more complete point of view: We not only consider the quality of theories but also reflect on the other six context-related aspects of theory using.

*Structure.* Whereas quality focuses on how well the theory is constructed, it is also important to consider the structure of the theory, that is, conceptions about the nature and direction of causality in the key constructs included in the theory. Markus and Robey (1988) define the causal structure of a theory to include causal agency (beliefs about the direction of causality reflected as the technological, organizational, or emergent perspectives and as the logical structure), whether a theory employs static invariant constructs (static variance theory) or a collection of temporal constructs (process theory) to explain phenomena, and finally level of analysis (whether a theory focuses on generic and organizational or societal macro issues or individualistic or group micro issues).

In the context of virtual teams, it seems that researchers who are trying to understand the impact of technical issues, such as how a videoconferencing system will affect virtual teamwork, will likely focus on theories that emphasize *technological imperative* (one of the three directions of causal agency proposed by Markus and Robey, 1988). On the other hand, if the focus is on specifying how organizations can use such technology and understand organizational needs, then the focus will likely be on the *organizational imperative* causal direction (Markus & Robey, 1988), in which human beings are the main actors. In addition, researchers trying to manage the large number of potential variables in virtual teams may prefer the *emergent* causal direction (Markus & Robey, 1988) so that the complex interplay between variables can be better understood. The recommendation to adopt an emergent causal direction may be even more important if turns

out that there is no one single “killer” (or small set of) variable(s) that is (are) part of a particular static variance theory that can explain the phenomena. The preceding would also indicate the need to use a process theory as opposed to a static variance theory. The nature of virtual teamwork also offers additional clues to selecting theory based on structure. Many researchers believe that teamwork is highly governed by aspects of group development and that behaviors and outcomes change dramatically with time as the team evolves. This view is more compatible with a process emergent theory. However, most virtual team research has typically followed the dominant perspective of IS research and focused on variant technological or organizational perspective theories.

The final aspect of theory structure as outlined by Markus and Robey (1988) is the level of analysis. As discussed earlier, it is not surprising given the topic that virtual team research has primarily focused on the micro level of analysis (52% on the individual level). However, we believe that if virtual team research is going to endure as a separate subcategory of IS, it would be useful to have more theories that are operationalized at the team unit of analysis.

*Perspective.* Structure is often but not always a reflection of the underlying value system adopted by the theory. Kling (1980) defines two major theoretical perspectives that can provide insights on the core beliefs or worldviews embedded in a particular theory. Kling’s characterization of theory incorporates basic philosophy, political views, and the role of technology in workplace and society. The two major perspectives are systems rationalization, which includes the rational, structural, and human relations perspectives, and segmented institutionalism, which includes the interactionist, organizational politics, and class politics perspectives. The perspectives are differentiated based on social setting, organizing concepts, dynamics of technical diffusion, technology, and workplace ideology.

Much early virtual team research has taken what Kling would call the rational perspective, in which the goal is to match technology to meeting explicit goals. More recent research has adopted socially more complex perspectives, such as the interactionist view, which seeks to explicitly acknowledge socially constructed realities and meanings. We believe that all of the perspectives, including the rational view, have a role in virtual team research, and we do not propose to assign a higher or lower score to specific theories based on which worldview they espouse. However, it is extremely valuable for researchers to explicitly identify their perspectives and the perspective of a selected theory because that can reveal new insights and better situate the findings.

*IT artifact.* The final element of our framework to appropriate theories is related to the word *virtual* in the phrase *virtual teams*. Researchers should use theories that allow the research to include what Benbasat and Zmud (2003) call the “IT artifact and its immediate nomological net” (p. 186). There are several reasons for taking the IT artifact into consideration:

1. Avoid duplication: There is a large body of research on small groups in social psychology and other disciplines, and it would be pointless to duplicate that work.
2. Identify a clear boundary: The framework proposed by Benbasat and Zmud provides a natural way to establish a clearly identifiable boundary for the research.
3. Increase relevance and impact: What appears interesting and unique to practitioners about virtual team research is found in the integration of teamwork with technology.

Applying the Benbasat and Zmud (2003) framework may, however, be a tricky exercise as the majority of the theories analyzed by this article are from other disciplines. The application would then likely be characterized by either the error of inclusion or the error of exclusion proposed by Benbasat and Zmud as concerns for the IS research community. However, Benbasat and Zmud do not necessarily propose that such theories should be avoided; they do propose that research conducted with these theories should directly include the IT artifact and its immediate nomological net. An intriguing and as yet unexplored question is whether some social science theories are more or less amenable to the IT artifact. One potential test is to consider whether the theory will (a) allow questions to be proposed that accommodate changes to the IT artifact (i.e., avoid the black box problem) and (b) specifically include one of the nomological net items. For example, AST takes technology into consideration; the IT artifact can be included together with its interaction and impact on organizational structure.

## **Application of the Framework**

The theory appropriation framework presented in this section was specifically derived for virtual team research. We have not considered application beyond this domain. Clearly some elements of the framework, such as quality, are applicable to any social science theory; others, such as IT artifact, are specific to MIS, but perhaps more subtly. Others may seem generic but were chosen because they are directly relevant to what we believe are important issues for virtual team research. For example, one could easily argue that the

appropriateness criterion is relevant to any social science theory. However, we chose to highlight appropriateness by using it as a separate criterion because it is an important issue in virtual teams. Virtual team research incorporates many diverse elements and phenomena; thus, making sure that the selected theory fits the phenomena of interest is quite important. In other, more developed areas of study, it is entirely possible that fit is obvious and that there is no need to have appropriateness as a separate criterion.

One way that virtual team researchers can directly influence quality and perhaps build a quicker cumulative tradition is to formally analyze each new theory using the above criteria and include those assessments in all our publications. This will certainly accelerate theorizing and tradition building, and it will help readers of the publication to adopt the relevant theory in their own work. For virtual team research, this may be particularly useful because the area represents the intersection of several different lines of inquiry, including but not limited to group development research from social psychology and group decision support systems research from MIS.

## **An Example of Application of the Framework**

In this section, we present a detailed example of application of our theory selection framework. The framework is applied to the problem space of delivering online help through text chat and other features. The theory analyzed in this section is called *media synchronicity theory* (MST) and was developed by Dennis and Valacich (1999).

Live online help is now a relatively common service on most e-commerce sites. It is usually delivered through a Web browser and consists of real-time help and on-demand assistance to online customers using text chat and advanced features such as cobrowsing windows. Some examples of live online help are eBay's Live Help, Lands' End Live, and QVC's LiveHelp. The online customer and the service representative collaborate virtually, forming a virtual team of two (a *dyad*), with the goal of addressing the online customer's inquiries.

The phenomenon of live online help can be studied from many different perspectives, and some might argue that it is outside the scope of virtual team research. However, there are some obvious similarities, such as task orientation and communication over distance, between virtual teams and live online help. Moreover, the phenomenon and the topic are new enough so that they may eventually disappear, become part of virtual team research, or be situated elsewhere. We believe that this scenario likely represents

what a future researcher will face when examining new phenomena and when applying our theory selection framework.

As suggested by this analysis, virtual team research covers the inputs, processes, and outputs of virtual teams. The input of live online help virtual teams includes the customer and the service representative. The context is the live help session in which the communication technologies (text chat and cobrowsing window) are used by the virtual team members on the Internet. The process of live online help involves communication between team members. Technologies (text chat and cobrowsing) are used as tools to facilitate the communication process. The virtual team members also influence each other from social perspectives such as language, feelings, and options revealed in the live help sessions. The outputs of live online help virtual teams are determined by the performance and effectiveness of the online help session, that is, whether customers' inquiries have been addressed or problems have been solved.

To study the phenomenon of live online help guided by the perspectives of inputs, processes, and outputs, the 25 theories identified in the previous section may all be applied in research. Among these theories, we believe that MST has the advantage of demonstrating interesting analysis with the application of our framework for the following reasons: MST is a newer theory developed based on MRT and TIP theory. It has just started to be adopted by IS researchers, and there have been some empirical studies testing and improving MST. Given its cumulative nature, using MST will demonstrate a rich application of our framework and reveal interesting results in the context of live online help.

*Media synchronicity* is defined as "the extent to which individuals work together on the same activity at the same time; i.e. have a shared focus" (Dennis & Valacich, 1999, p. 5). MST decomposes the usual communication task, normally studied as a single task, into conveyance and convergence processes (Dennis, Valacich, Speier, & Morris, 1998). According to Dennis et. al. (1998), *conveyance* represents the process of exchanging information, and *convergence* represents the process in which group members engage to seek understanding of how other individuals interpret or comprehend exchanged information and then come to a mutually agreed on meaning. MST proposes that (a) for conveyance communication, low media synchronicity will be more effective and (b) for convergence communication, high media synchronicity will be more effective. MST is fundamentally concerned with media-technology fit: Communication performance will be improved when media synchronicity matches the communication processes (conveyance or convergence).



To apply our framework, we analyze MST's fit into the phenomenon of live online help virtual teams in each of the elements of our framework: objective, appropriateness, robustness, quality, structure, perspective, and IT artifact.

## **Objective of MST**

MST proposes that media synchronicity (low or high) should match the communication process (conveyance or convergence) to achieve the best performance. Therefore, MST is a prescriptive theory because it adjusts the desired choice and use of medium or technology to the specific communication process. Specifically, MST implies that for live online help, text chat is suggested during the initial exchange of information in the beginning of the help session (conveyance communication), and both text chat and cobrowsing windows are suggested during the later processes that focus on collaboration and finding answers to the customers' inquires (convergence communication). Given our earlier analysis of the state of the art of virtual team research, selecting MST to study live online help virtual teams could be a risky strategy; it is possible that the prescriptive approach of MST may not be a good fit because live online help is a relatively new concept and has not been fully defined or explained in the literature.

## **Appropriateness of MST**

Live online help participants use advanced technologies (text chat and cobrowsing) as the media of communication for performing tasks. MST analyzes media in detail from five distinctive perspectives to determine level of media synchronicity. In addition, MST is designed with consideration of the characteristics of "new media," such as online chats, e-mail, and videoconferencing (Dennis et al., 1998). From an empirical fidelity perspective, MST has a good fit with issues and constructs that arise naturally from considering live online help, which is primarily a communicative task designed to quickly and effectively communicate desired information from one person to another. In that sense, the effectiveness of live online help is mostly governed by matching the task to the media. However, it is unclear whether MST is the correct strategic choice because live online help chat is so new that there is very little prior research that could guide what to study. Moreover, so far, the industry focuses more on how live online help can either reduce costs (where the text chat is a substitute for expensive customer-service calls) or increase sales (where the text chat is a way to

provide an instant answer to the customer while he or she is browsing on the Web site).

## **Robustness of MST**

MST was constructed on the basis of MRT (Daft & Lengel, 1986; Daft, Lengel, & Trevino, 1987) and TIP theory (McGrath, 1991). Both MRT and TIP theory have solid theoretical foundations, and both have been widely tested in a large amount of empirical research. However, MST is a new theory, and only a few empirical studies have formally applied MST. Its robustness is mainly based on the well-developed theoretical linkages and propositions between the factors under investigation. Whether MST would have explanatory power and the size of this power would have to be determined in future studies.

## **Quality of MST**

Shoemaker et al. (2004) proposed 10 generic criteria for evaluating theories: testability, falsifiability, parsimony, explanatory power, predictive power, scope or generalizability, cumulative nature of science, degree of formal development, heuristic value, and aesthetics. Aesthetics is a subjective measure and dependent on the scholars' background and interests. We apply the remaining measures to MST as follows:

*Testability.* Testability represents the ability of a theory "to be stated in terms of concepts and variables that can be measured" (Shoemaker et al., 2004, p. 171). MST scores high on this measure because it is based on specific constructs that can be operationalized into measurable variables and hypothesis.

*Falsifiability.* MST has a high level of falsifiability because it makes specific measurable claims about the two types of communication processes and the six specific factors defining media synchronicity. Therefore, it is possible to falsify MST by collecting empirical evidence.

*Parsimony.* There are only three major constructs in MST: communication process, media synchronicity, and effectiveness of communication. However, there are six factors defining the construct of media synchronicity. MST therefore ranks medium on parsimony.

*Explanatory power.* MST does not have a large number of constructs, and the theory itself is still in the process of development and empirical testing. MST thus has medium power to explain relations under investigation.

*Predictive power.* The purpose of MST is to suggest the choice and use of media with communication processes to improve the effectiveness of communication. When the match between the two constructs can be enforced, MST is able to predict the level of effectiveness. However, MST is a new theory, and its predictive power has to be widely tested in empirical studies in different situations.

*Scope or generalizability.* MST can be used in situations in which communication affects the choice and use of media, especially new media, in which information and communication technologies are used. MST can therefore be applied to a wide variety of situations not limited to virtual team research.

*Cumulative nature.* MST was constructed on the basis of MRT and TIP theory. However, it is also a new theory and is under additional testing and refinement. MST therefore ranks medium on cumulative nature.

*Degree of formal development.* Although MST is still under development and testing, a newer version of MST took the additional step of considering the process of group development (Dennis & Valacich, 1999). The theory distinguishes work groups into established groups, in which group members have worked together before and share established norms, and newly formed groups, in which group members are new to each other. MST proposed that media with high synchronicity will be suitable for established groups because members of established groups are more likely to “move directly to execution with less problem solving and conflict resolution” (Dennis & Valacich 1999, p. 8). In contrast, media with low synchronicity are more suitable for newly formed groups because members of newly formed groups will “focus on member support and group well-being activities” to better understand each other before they can effectively work together (Dennis & Valacich 1999, p. 8). This refinement shows a continued process of formal development. Other researchers, such as Maruping and Agarwal (2004) and Peffers and Tuunanen (2005), have started to work on additional applications and development of this theory. However, the theory is still relatively new and needs additional refinement and testing to increase its power of formal development.

*Heuristic value.* Heuristic value refers to the ability of a theory to help generate theoretical ideas for research. MST proposes three groups of constructs that are of interest to communication, media, and group performance and in which many interesting and valuable research ideas can be generated. MST therefore has a high heuristic value.

## Structure of MST

MST proposes a causal relation in which a better match of media synchronicity with communication process will lead to improved performance of team members. Communication processes, media capabilities, and communication performance are all constructs that explain the fit of media and technology in determining group performance. Therefore, MST follows what Markus and Robey (1988) call the organizational imperative perspective among their three categories of causal agency. In other words, in MST, assumptions about causality reflect the belief that technological options are unlimited and that technology can in fact be used and designed to meet organizational needs. This conclusion implies that MST is a good choice for explaining and predicting already identified behavior but may not be useful when the behavior is emergent and unspecified. Given that our goal is to explain and predict the relatively easily identified behaviors implied by live online help, MST seems a good fit in its assumptions about causal agency. In terms of logical structure, MST is a variant theory, and in terms of level of analysis, MST focuses on the individual level. This is consistent with our goal of understanding live online help, which occurs at the individual level, and with our goal of identifying constructs and outcomes that can improve and understand the phenomena of live help.

## Perspective of MST

MST does not easily fit Kling's (1980) theoretical perspectives. Clearly, MST has a rational perspective given the focus on task (communication effectiveness), and the orientation of the theory is clearly toward matching technology to the goals of communication. However, it would be unfair to simply dismiss MST as a rationalist theory, because it explicitly avoids labeling media as rich or lean, incorporates not only the task but also individual and social contexts, and focuses on processes that can lead to "mutually agreed on meanings" and "individual interpretation" (Dennis & Valacich, 1999, p. 4). The focus on individual needs and satisfaction and on the social world also bring in Kling's human relations and interactionist

perspectives. Perhaps this is not surprising; MST is a relatively new theory, and one would expect that many researchers now have a deeper understanding of the role and impact of technology than what is implied by the relatively simplistic rational perspective defined by Kling. The relatively broad theoretical perspective incorporated in MST, then, is a positive result and increases the chances that the theory will have broad scope and can in fact explain many interesting new phenomena, including live online help.

### **IT Artifact in MST**

The *media* in MST can refer to any type of technology for use in communication, such as text chat and the cobrowsing window for live online help. Because MST proposes the match of media and communication process, the IT artifact therefore plays an important role in MST.

### **Conclusions from Application of the Framework**

This analysis shows that MST is a suitable and powerful theory to be applied in the context of live online help. The major strength of MST is its ability to analyze communication processes on a more detailed level (i.e., conveyance and convergence) and its ability to suggest the right choice of media to improve effectiveness. MST also has weaknesses; it is a new theory, therefore its explanatory and predictive power will have to be tested in future studies.

## **Summary and Conclusion**

This article first analyzes 45 articles in virtual team research published between 1990 and the first quarter of 2005 and then identifies 25 theories currently used as research foundations. The results reveal the state of the art of theory-use patterns in virtual team research. There is no dominant theory in virtual team research, and AST is the most frequently used theory. In the 15 years covered by the analysis, there has been an increasing trend toward using theoretical foundations. Theories are more frequently used in studying some of the components of virtual teams, such as social interaction, and less frequently used in studying other areas. Ontological analysis shows that, in comparison to IS theories in general, virtual team theories are more behavior focused, with more emphasis on the individual and group level, and are less likely to be normative and developmental. The article then

presents a framework for appropriating theories based on seven criteria: objective, appropriateness, robustness, quality, structure, perspective, and IT artifact. The appendix provides a theory repository with detailed critiques of advantages and challenges in the context of virtual teams.

This work provides researchers with a tool kit that includes a descriptive database of available theories used in virtual team research, an analysis of the state of the art of theory use, and a framework that can accelerate and systemize the appropriation of theories. The results are expected to help researchers think broadly about the selection of appropriate theories as a foundation for developing research models, methods, and hypotheses. Researchers should continue to emphasize the importance of a theoretical foundation in virtual team research. Additionally, efforts should be made to explore how to successfully adopt theories from a broad range of disciplines to be integrated in the context of virtual teams or to create unique virtual team-based theories.

Our perspective and style of presentation follow the positivistic tradition in IS research. Theory appropriation and evaluation are clearly not limited to positivistic research. It is possible that interpretive or critical researchers may find alternative ways of analyzing, selecting, and appropriating virtual team theories. In the short run, we believe that our work will be directly useful to positivistic researchers. We also hope that the vocabulary and structure introduced by our theory appropriation framework will provide a basis to encourage more discussions between the different paradigms. If positivistic researchers start rigorously questioning the objective, appropriateness, structure, perspective, robustness, and IT artifact of their theories, then they are a step closer to understanding interpretative and critical approaches.

Overall, the direction of virtual team research is positive in that more work is theoretically motivated. However, there is too much reliance on broad, nonspecific theories and on individual measurement; and the specific theories applied seem to ignore some of the interesting areas of virtual team research. Therefore, we suggest that the time is right for researchers to broaden scope by bringing in theories from completely new areas, such as anthropology, and simultaneously narrow scope by creating meta or combinatory theories based on the existing virtual team literature.

The reason to look outside and broaden scope is that there are interesting virtual team topics that are not covered by existing theories. The reason to look in nontraditional (for IS) disciplines is that the literature has already identified the obvious candidates from disciplines such as social psychology. The theory appropriation framework presented in this article can be

used in a proactive manner to consider and select relevant theories. The reason to narrow the scope of work based on already identified theories is that we seem to have reached a plateau: Only so many behaviors can be analyzed with the existing crop of theories, and these behaviors are now reasonably well known through articles such as this one and through the previous review literature. Therefore, rather than continue forward in a fragmented manner, it may make sense to consolidate what we have learned in one or a few combinatory theories. Clearly, these suggestions are speculative and not easy to implement. However, our analysis does support these conclusions, at least on the level of selecting new theories, where we have tried to provide researchers with a useful tool kit.

## Appendix Analysis of 25 Theories in Virtual Team Research

Theory	Brief Description	Selected Publications	Advantages	Challenges
Adaptive structuration theory (AST)	AST is based on structuration theory as developed by Giddens (1989). AST explains how groups develop in a given situation, especially when technology is introduced. AST holds that a primary goal of group action is adaptation to the situation.	Archer (1990); Chidambaram and Bostrom (1993); Chidambaram, Bostrom, and Wynne (1990-1991); Dennis and Garfield (2003); Hinds and Bailey (2003); Krumpel (2000); Majchrzak, Rice, Malhotra, King, and Ba, (2000); Maznevski and Chudoba (2000); Qureshi and Vogel (2001)	AST emphasizes the impact of the use of technology, which is a key element of communication in virtual teams.	Social structure is defined as “rules and resources provided by technologies and institutions as the basis for human activity” (DeSanctis & Poole, 1994, p. 125). It is difficult to define or identify social structures of the context of virtual teams. As the team members work together in a changing environment, it is more difficult to define the appropriation of IT to be or being used.
“Big Five” personality model	The Big Five are bipolar dimensions of personality that have been found to form the taxonomic (and factorial) core of personality models and also capture a layperson’s description of personality as found in everyday language. These dimensions or factors	Balthazard, Potter, and Warren (2004)	The Big Five model provides a ground for the explanation of human or social interactions between virtual team members. Because these members are dispersed,	It is not yet clear how the extensive use of technology can affect the identification of personalities. Because face-to-face communication is sparsely used between virtual team members, it is difficult to identify the personality as a preassigned

*(continued)*



## Appendix (continued)

Theory	Brief Description	Selected Publications	Advantages	Challenges
	are extraversion, agreeableness, conscientiousness, openness, and neuroticism.		personality may contribute more to the effectiveness of communication, compared to traditional teams.	input to the virtual team; it is even more difficult to analyze the change of personalities as the team evolves.
Business action theory (BAT)	BAT divides business interaction between a customer and a supplier into six phases: establishing business prerequisites, exposure and contact search, proposal, contract, fulfillment, and assessment.	Axelsson (2003)	The six phases of BAT can be used to visualize and analyze business interactions performed by different business actors within a virtual organization and between the virtual organization in its entirety and its customer.	The BAT rationale is based on the relationship between buyers and suppliers. Therefore, it is too specific and may not be suitable to virtual teams as a general form of subunit of an organization.
Commitment theory	Originally developed from psychology, commitment theory states that members or employees who have a strong commitment to the organization can be trusted to use their discretion to carry out job tasks in ways that are consistent with organizational goals.	Schmidt, Montoya-Weiss, and Massey (2001)	In virtual teams, commitment theory can partially explain why some team members are trusted more than others, especially in consideration of the assigning of a particular task by team leaders.	The construct of commitment is very "fuzzy" and difficult to measure or manipulate. It is probably too vague to be used as a subjective measure of virtual team members.
Conflict management	Conflict management behavior theory uses five conflict-	Paul, Seetharaman, Samarath, and Mykytyn (2004)	The five conflict-handling modes would have different	In the process of virtual teamwork, it is very likely

behavior theory	B handling modes to describe conflict management in organizational work groups: avoidance, accommodation, competition, collaboration, and compromise.	effects on performance in virtual teams. The theory provides possible ways to resolve conflicting effects.	that these conflict-handling modes are interrelated. Thus, it would be difficult to distinguish between them, which will lead to difficulty of analysis.
Contingency theory of leadership effectiveness	The contingency theory of leadership effectiveness was developed by Fiedler (1964). This theory proposes that group performance is a result of interaction between two factors: leadership style and situational favorableness.	Contingency theory predicts that using computer-mediated communication to accomplish complex collaborative work will be difficult, especially for tasks that require interactive, expressive communication.	The challenge is how to assess situational favorableness in virtual teams. There are some factors, for example, characteristics of tasks, availability of time, and communication technologies, that may change the situation fundamentally. Therefore, it is not easy to separate and analyze the effect of these factors.
Control theory	Control is conceptualized as attempts to ensure that individuals working on organizational projects act in conformity with predefined strategies. Thus, control is exercised via mechanisms	In collocated teams, behavior-control mechanisms are used to stimulate team performance, foster cooperation, and improve individual psychosocial outcomes.	Some studies show that behavior control has negative effects on building trust in virtual teams. However, it is not clear whether this theory can be used to explain the variance of other factors in virtual teams.

(continued)

## Appendix (continued)

Theory	Brief Description	Selected Publications	Advantages	Challenges
	<p>implemented, lead to the regulation of behavior. Formal control mechanisms are classified into behavior controls and outcome controls.</p>			
Dialogue theory	<p>Dialogue theory provides some suggestions for how team members can discuss their tacit and explicit decision rules and come to an agreement. A dialogue is a sustained collective inquiry into everyday experience that people typically take for granted. Its objective is to create a setting in which people are more aware of the context surrounding their experience and more conscious of the thought processes that give rise to the experience.</p>	<p>Tan, Wei, Huang, and Ng (2000)</p>	<p>Dialogue theory is useful for analysis of communications on the individual level of virtual teams. It reveals how team members interact with each other to perform tasks and how knowledge is managed through language.</p>	<p>Use of dialogue theory may involve a large amount of data. For example, records of e-mails and discussions on whiteboard should be stored and processed for analysis. It is challenging to manage the data effectively and efficiently. In addition, researchers conducting research based on this theory may need to perform some interpretive analysis.</p>
Learning theory	<p>Learning theory proposes that learning is situated in work practice rather than on</p>	<p>Robey, Khoo, and Powers (2000)</p>	<p>Learning theory is applicable to the training of virtual team members. It shows that</p>	<p>In order to apply this theory, it is important to understand how learning is situated in</p>

<p>knowledge acquired outside the context of actual work. Participants in a community of practice learn work practices that satisfy their local needs, and they often ignore or neglect formally prescribed practices that are seen as less relevant to performance.</p>	<p>training is not confined to the process before the start of virtual teamwork and is also more likely to be effective if used during the process of work with other members.</p>	<p>the context of virtual practice. This becomes complicated when teams are multifunctional, because multifunctionality increases the communication and coordination requirements across functions.</p>
<p>Media richness theory (MRT)</p>	<p>MRT suggests that media vary in levels of richness according to the number of cues they are able to convey, the timeliness of feedback, and the capacity for natural expression. The commonly used media are face-to-face communication, phone, text, fax, e-mail, and videoconference.</p>	<p>MRT is widely accepted as a research foundation in virtual team studies, especially on the choice of communication technologies.</p>
<p>Media synchronicity theory (MST)</p>	<p>MST proposes that, for conveyance communication, low media synchronicity will be more effective and that, for convergence communication, high media synchronicity will</p>	<p>Because MST is constructed on the comparison of low and high media synchronicity, the virtual team phenomenon under investigation must involve two or more media.</p>

(continued)

## Appendix (continued)

Theory	Selected Publications	Advantages	Challenges
<p>be more effective. MST is fundamentally concerned with media-technology fit: Communication performance will be improved when media synchronicity matches the communication processes (conveyance or convergence).</p>	<p>therefore takes new media, such as e-mail and text chat, into consideration. MST also decomposes the usual communication task into a more detailed level: conveyance and convergence processes. It therefore distinguishes the requirements of media choice and use for different kinds of communication processes.</p>	<p>A single medium does not accommodate the difference between low and high synchronicity; the propositions therefore will not apply. Because MST focuses on the level of conveyance and convergence communication processes, the virtual team phenomenon under investigation needs to be detailed on such a level.</p>	<p>Virtual teams can be viewed as a subunit of an organization. Therefore, some constructs, for example, degree of hierarchy, are less suitable to virtual teams than to a virtual organization.</p>
<p>Network and organization form theory</p>	<p>Ahuja and Carley (1999)</p>	<p>The theory presents the dimensions of degree of hierarchy and centralization. It also concentrates on task characteristics, network structure, fit, and network performance.</p>	<p>The model of network performance in virtual organization was developed based on theories of network structures and emergent networks such as resource-dependence and related-exchange theories, contagion theories, cognitive theories, and theories of network and organizational forms.</p>

Punctuated equilibrium model	According to this model, groups experience relatively stable periods of activity punctuated by intense changes in behavior that occur at the halfway mark of a group's life. Thus, the halfway point is the critical juncture, where a group's equilibrium is shattered and a new level of activity and a different set of behaviors are established.	Chidambaram (1996)	This model provides a ground for analyzing behaviors of virtual team members on the change of team activities, such as the approaching of a deadline and the increasing complexity of tasks.	The challenge in using this theory is to identify the equilibrium and the halfway point where team members start to change some of their activities in the performance of particular tasks.
Role theory	Role theory states that the nature of organizations (and other social structures) is such that they can be understood in terms of the interactions and functional dependencies between individuals and groups.	Ahuja, Galletta, and Carley (2003)	The theory emphasizes interactions dependent on roles and therefore can be used in explaining and predicting some of the activities of leaders and team members.	The roles of virtual team members are likely to be dependent on the nature of tasks and the information technologies used. In some cases, the lack of face-to-face communications can change the occurrence of different roles, both positively and negatively.
Self-efficacy theory	Self-efficacy theory is an important component of social cognitive theory,	Staples, Hulland, and Higgins (1999)	Self-efficacy judgments can be used to determine how much effort team members will	Virtuality of team environment may increase the difficulty of judgments of self-efficacy. It

(continued)

## Appendix (continued)

Theory	Brief Description	Selected Publications	Advantages	Challenges
	<p>which suggests that an individual's behavior, environment, and cognitive factors (i.e., outcome expectations and self-efficacy) are all highly interrelated.</p>		<p>spend on a task and how long they will persist with it.</p>	<p>can also reduce the positive effect of self-efficacy on performance.</p>
<p>Social comparison theory (SCT)</p>	<p>SCT is a normative explanation for group polarization that has received empirical support. It argues that group polarization occurs because people are motivated to present themselves in a socially desirable light during discussion. People do this by continually comparing their opinions with those of others and adjusting their opinions in the direction valued by others.</p>	<p>Sia, Tan, and Wei (2002)</p>	<p>It is demonstrated that communication cues can alter social presence, which in turn can affect group communication.</p>	<p>Social presence is dependent on three types of communication cues: visual, verbal, and textual. However, communication among virtual team members is largely based on texts, for example, e-mails, rather than on visual images and verbal communications. It is a challenge to compare social presence change due to the unbalanced cues.</p>
<p>Social identity or deindividuation (SIDE) theory</p>	<p>SIDE theory argues that people categorize themselves as part of either</p>	<p>Cramton (2001), Jarvenpaa and Leidner (1999), Scott and Timmerman (1999)</p>	<p>In virtual teams, where individuating cues about others are limited,</p>	<p>It is not clear yet whether the self-categorizing of team members will have a positive</p>

<p>the in-group or the out-group based on the characteristics of others in the group.</p>	<p>individuals build stereotypical impressions of others based on limited information.</p>	<p>effect on team performance. The boundary of virtual teams is more intangible than the boundary of traditional teams. Therefore, it is more difficult to establish the social identity of virtual team members.</p>
<p>Social information processing (SIP) theory</p>	<p>SIP theory proposes that the rates of social information exchange differ between face-to-face and computer-supported groups.</p>	<p>The theory proposes that the restrictiveness of the computer medium initially hinders relational intimacy between unfamiliar participants and that recurrent use of a technology is likely to impede relational development in groups.</p>
<p>Social presence theory (SPT)</p>	<p>SPT suggests that the fewer channels are available within a medium the less attention is paid by the users to the presence of other social participants' interactions, it also suggests that social presence declines as messages become more impersonal.</p>	<p>It is still in question how much influence social presence would have on the performance of virtual teams. In addition, it is also not clear how to establish and maintain social presence during the life cycle of virtual teams.</p>
<p>Social information processing (SIP) theory</p>	<p>Chidambaram (1996), Chidambaram and Bostrom (1993), Walther (1995), Walther and Burgoon (1992), Warkentin and Beranek (1999)</p>	<p>The theory implies that computer-supported groups will take longer to exchange information than will face-to-face groups. These restrictions tend to slow the process of developing relational intimacy.</p>
<p>Social presence theory (SPT)</p>	<p>Lind (1999); Majchrzak, Rice, King, Malhotra, and Ba (2000); Pauleen (2003-2004); Walther and Burgoon (1992); Warkentin and Beranek (1999)</p>	<p>It was concluded that computer-mediated communication, because of its lack of sound and visual cues, will be perceived as impersonal and lacking in normative reinforcement, so there will be less socioemotional content exchanged.</p>

(continued)



## Appendix (continued)

Theory	Brief Description	Selected Publications	Advantages	Challenges
Swift trust theory	<p>The concern of swift trust theory is how to maintain trust in virtual teams. Traditional conceptualizations of trust are based strongly on interpersonal relationships; swift trust de-emphasizes the interpersonal dimensions and is based initially on broad categorical social structures and later on action.</p>	<p>Jarvenpää, Knoll, and Leidner (1998); Jarvenpää and Leidner (1999)</p>	<p>It is crucial to establish trust between virtual team members. The theory can be used to explain and explore interpersonal communications, especially between unfamiliar or global team members.</p>	<p>Trust will likely explain only a small amount of variance of virtual team effectiveness. When team members do not have other options to choose teammates and need to get the job done, the effect of trust on work performance probably will be largely suppressed.</p>
Task circumplex model	<p>McGrath (1984) generated the task circumplex model, which categorizes tasks under four activities: generating, choosing, negotiating, and executing.</p>	<p>Hollingshead, McGrath, and O'Connor (1993); Majchrzak, Rice, King, Malhotra, and Ba (2000)</p>	<p>Appropriate tools, processes, skills, and methods can be selected for virtual teams by identifying the types of tasks.</p>	<p>When simultaneous multiple tasks are the case, various requirements of these multitasks will add to the difficulty of categorizing tasks, which is the basis of this model.</p>
Task-media fit theory	<p>The task-media fit framework is developed based on MRT. It argues that for each type of communication task, a well-fitting medium should be selected.</p>	<p>Hollingshead, McGrath, and O'Connor (1993)</p>	<p>The theory emphasizes the fitting of task and media, which is usually the choice of information and communication technology in virtual teams.</p>	<p>The difficulty here is how to assess the best fit. There are no universal criteria so far for selecting the best medium for a communication task. These</p>

application obstacles will increase the challenge of use.

Team knowledge transfer model	The team knowledge transfer model is designed to apply to virtual teams where membership is relatively stable, but with members having interaction both within the focal team and with the collocated others.	Griffith, Sawyer, and Neale (2003)	Teams in more virtual settings will process their knowledge such that, eventually, they will focus on and be better able to transfer explicit rather than tacit knowledge.	The theory focuses on the relatively stable members in virtual teams. This focus may unfortunately reduce the team's ability to use much of the available knowledge (i.e., tacit knowledge). In addition, this is a very new model, which still needs to be applied, verified, and improved in future research.
Team performance model	The team performance model proposes seven stages of team performance: orientation, trust building, goal or role clarification, commitment, high implementation, high performance, and renewal.	Warkentin and Beranek (1999)	This model emphasizes changes in teams along the seven stages of team performance.	Not all virtual teams will follow the same seven-stage structure. According to this model, analysis of team activities will have to be performed on one stage at one time, which will restrict those activities from happening simultaneously.
Time, interaction, and performance (TIP) theory	TIP theory proposes that the development of relational links in groups involves performing activities related	Massey, Montoya-Weiss, and Hung (2003); Warkentin and Beranek (1999); Warkentin,	Analysis of the relational links in virtual teams can be performed using the three types of group functions.	Use of this theory will first require identifying three functions of activities making contributions to

(continued)

### Appendix (continued)

Theory	Brief Description	Selected Publications	Advantages	Challenges
	<p>to the member-support and group well-being functions. Groups make contributions to group discussions at three different levels: production function, member-support function, and group well-being function.</p>	<p>Sayeed, and Hightower (1997)</p>		<p>group discussions. A virtual team with no past history that is working on a challenging problem with much technological and environmental uncertainty will have to engage in all three functions to avoid detrimental effects on performance.</p>

## References

- Ahuja, M. K., & Carley, K. M. (1999). Network structure in virtual organizations. *Organization Science, 10*, 741-757.
- Ahuja, M. K., Galletta, D. F., & Carley, K. M. (2003). Individual centrality and performance in virtual R&D groups: An empirical study. *Management Science, 49*, 21-38.
- Anawati, D., & Craig, A. (2006). Behavioral adaptation within cross-cultural virtual teams. *IEEE Transactions on Professional Communication, 49*(1), 44-56.
- Archer, N. P. (1990). A comparison of computer conferences with face-to-face meetings for small group business decisions. *Behaviour & Information Technology, 9*, 307-317.
- Axelsson, K. (2003). Analysing business interaction in a virtual organisation—Using business action theory to study complex inter-organisational contexts. *Journal of Electronic Commerce in Organizations, 1*, 1-27.
- Bacharach, S. (1989). Organizational theories: Some criteria for evaluation. *Academy of Management Review, 14*(4), 496-515.
- Balthazard, P., Potter, R. E., & Warren, J. (2004). Expertise, extraversion and group interaction styles as performance indicators in virtual teams. *The DATA BASE for Advances in Information Systems, 35*, 41-64.
- Banville, C., & Landry, M. (1989). Can the field of MIS be disciplined? *Communications of the ACM, 32*, 48-60.
- Barkhi, R., & Sheetz, S. D. (2001). The state of theoretical diversity in information systems. *Communications of AIS, 7*, 1-19.
- Belanger, F., Collins, R. W., & Cheney, P. H. (2001). Technology requirements and work group communication for telecommuters. *Information Systems Research, 12*, 155-176.
- Benbasat, I., & Zmud, R. W. (2003). The identity crisis within the IS discipline: Defining and communicating the discipline's core properties. *MIS Quarterly, 27*(2), 183-194.
- Chidambaram, L. (1996). Relational development in computer-supported groups. *MIS Quarterly, 20*, 143-163.
- Chidambaram, L., & Bostrom, R. (1993). Evolution of group performance over time: A repeated measures study of GDSS effects. *Journal of Organization Computing, 3*, 443-469.
- Chidambaram, L., Bostrom, R., & Wynne, B. (1990-1991). A longitudinal study of the impact of group decision support systems on group development. *Journal of Management Information Systems, 7*, 7-25.
- Cohen, S. G., & Gibson, C. B. (2003). Chapter one: In the beginning—Introduction and framework. In C. B. Gibson & S. G. Cohen (Eds.), *Virtual teams that work: Creating conditions for virtual team effectiveness* (pp. 1-13). San Francisco: Jossey-Bass.
- Cramton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. *Organization Science, 12*, 346-371.
- Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science, 32*(5), 554-571.
- Daft, R. L., Lengel, R. H., & Trevino, L. K. (1987). Message equivocality, media selection and manager performance: Implications for information systems. *MIS Quarterly, 11*(3), 355-366.
- Dennis, A. R., & Garfield, M. J. (2003). The adoption and use of GSS in project teams: Toward more participative processes and outcomes. *MIS Quarterly, 27*, 289-323.
- Dennis, A. R., & Valacich, J. S. (1999, January). *Rethinking media richness: Toward a theory of media synchronicity*. Paper presented at the Hawaii International Conference on System Sciences, Maui.

- Dennis, A. R., Valacich, J. S., Speier, C., & Morris, M. G. (1998, January). *Beyond media richness: An empirical test of media synchronicity theory*. Paper presented at the Hawaii International Conference on System Sciences, Kohala Coast.
- DeSanctis, G., & Poole, M. S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science*, 5, 121-147.
- Eisenhardt, K. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532-550.
- Fiedler, F. E. (1964). A contingency model of leadership effectiveness. *Advances in Experimental Social Psychology*, 1, 149-190.
- Fiol, C., & O'Connor, E. (2005). Identification in face-to-face, hybrid, and pure virtual teams: Untangling the contradictions. *Organization Science*, 16(1), 19-32.
- Galegher, J., & Kraut, R. E. (1994). Computer-mediated communication for intellectual teamwork: An experiment in group writing. *Information Systems Research*, 5, 110-138.
- Giddens, A. (1989). *The constitution of society: Outline of the theory of structuration*. Berkeley, CA: University of California Press.
- Griffith, T. L., & Meader, D. (2004). Prelude to virtual groups: Leadership and technology in semi-virtual groups. In D. Pauleen (Ed.), *Virtual teams: Projects, protocols and processes* (pp. 231-254). Hershey, PA: Idea Group.
- Griffith, T. L., & Neale, M. (2001). Information processing in traditional, hybrid, and virtual teams: From nascent knowledge to transactive memory. *Research in Organizational Behavior*, 23, 379.
- Griffith, T. L., Sawyer, J. E., & Neale, M. A. (2003). Virtualness and knowledge in teams: Managing the love triangle of organizations, individuals, and information technology. *MIS Quarterly*, 27, 265-287.
- Hardgrave, B., & Walstrom, K. (1997). Forums for MIS scholars. *Communications of the ACM*, 40, 119-124.
- Hinds, P. J., & Bailey, D. E. (2003). Out of sight, out of sync: Understanding conflict in distributed teams. *Organization Science*, 14, 615-632.
- Hollingshead, A., McGrath, J., & O'Connor, K. (1993). Group task performance and communication technology: A longitudinal study of computer-mediated versus face-to-face groups. *Small Group Research*, 24, 307-333.
- Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is anybody out there? Antecedents of trust in global virtual teams. *Journal of Management Information Systems*, 14(4), 29-64.
- Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and trust in global virtual teams. *Organization Science*, 3, 791-815.
- Jones, M. (2000). The moving finger: The use of social theory in WG 8.2 conference papers (1975-1999). In R. Baskerville, J. Stage, & J. DeGross (Eds.), *IFIP TC8 WG8.2 International Working Conference on the Social and Organizational Perspective on Research and Practice in Information Technology* (pp. 15-31). Aalborg, Denmark: Kluwer Academic.
- Kayworth, T. R., & Leidner, D. E. (2001-2002). Leadership effectiveness in global virtual teams. *Journal of Management Information Systems*, 18, 7-40.
- Klein, H. K. (2002). On the theoretical foundations of current outsourcing research. In R. Hirschheim & A. Heinzl (Eds.), *Information systems outsourcing: Enduring themes, emergent patterns and future directions* (pp. 22-44). Berlin: Springer-Verlag.
- Kling, R. (1980). Social analyses of computing: Theoretical perspectives in recent empirical research. *Computing Surveys*, 12(1), 61-109.
- Krumpel, K. (2000). Making the right (interactive) moves for knowledge-producing tasks in computer-mediated groups. *IEEE Transactions on Professional Communication*, 43, 185-195.

- Kuhn, T. (1970). *The structure of scientific revolutions* (2nd ed.). Chicago: University of Chicago Press.
- Lee, O. (2000). The role of cultural protocol in media choice in a Confucian virtual workplace. *IEEE Transactions on Professional Communication*, 43, 196-200.
- Lee, Y., Lee, Z., & Gosain, S. (2004). The evolving intellectual diversity of the IS discipline: Evidence from referent theoretical frameworks. *Communications of the Association for Information Systems*, 1436, 546-579.
- Lind, M. R. (1999). The gender impact of temporary virtual work groups. *IEEE Transactions on Professional Communication*, 42, 276-285.
- Lipnack, J., & Stamps, J. (1997). *Virtual teams: Reaching across space, time, and organizations with technology*. New York: John Wiley & Sons.
- Lowry, P. B., & Nunamaker, J. F. (2003). Using Internet-based, distributed collaborative writing tools to improve coordination and group awareness in writing teams. *IEEE Transactions on Professional Communication*, 46(4), 277-297.
- Lowry, P. B., Romans, D., & Curtis, A. (2004). Global journal prestige and supporting disciplines: A scientometric study of information systems journals. *Journal of the Association for Information Systems*, 5, 29-77.
- Majchrzak, A., Rice, R., King, N., Malhotra, A., & Ba, S. (2000). Computer-mediated inter-organizational knowledge-sharing: Insights from a virtual team innovating using a collaborative tool. *Information Resources Management Journal*, 13, 44-53.
- Majchrzak, A., Rice, R., Malhotra, A., King, N., & Ba, S. (2000). Technology adaptation: The case of a computer-supported inter-organizational virtual team. *MIS Quarterly*, 24, 569-600.
- Markus, M. L., & Robey, D. (1988). Information technology and organizational change: Causal structure in theory and research. *Management Science*, 34(5), 583-598.
- Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual teams: What do we know and where do we go from here?. *Journal of Management*, 30(6), 805-835.
- Maruping, L. M., & Agarwal, R. (2004). Managing team interpersonal processes through technology: A task-technology fit perspective. *Journal of Applied Psychology*, 89(6), 975-990.
- Massey, A. P., Montoya-Weiss, M. M., & Hung, Y.-T. (2003). Because time matters: Temporal coordination in global virtual project teams. *Journal of Management Information Systems*, 19, 129-155.
- Maznevski, M., & Chudoba, K. (2000). Bridging space over time: Global virtual team dynamics and effectiveness. *Organization Science*, 11, 473-492.
- McGrath, J. E. (1984). *Groups: Interaction and performance*. Englewood Cliffs, N.J.: Prentice-Hall.
- McGrath, J. E. (1991). Time, interaction, and performance (TIP): A theory of groups. *Small Group Research*, 22(2), 147-174.
- Montoya-Weiss, M. M., Massey, A. P., & Song, M. (2001). Getting it together: Temporal coordination and conflict management in global virtual teams. *Academy of Management Journal*, 44, 1251-1262.
- Murthy, U., & Kerr, D. S. (2003). Decision making performance of interacting groups: An experimental investigation of the effects of task type and communication mode. *Information & Management*, 40, 351-360.
- Mylonopolous, N. A., & Theoharakis, V. (2001). On site: Global perceptions of IS journals. *Communications of the ACM*, 44, 29-33.
- Ocker, R. J. (2005). Influences on creativity in asynchronous virtual teams: A qualitative analysis of experimental teams. *IEEE Transactions on Professional Communication*, 48(1), 22-39.

- Orlikowski, W., & Iacono, C. S. (2001). Research commentary: Desperately seeking the "IT" in IT research: A call to theorizing the IT artifact. *Information Systems Research, 12*, 121-134.
- Paul, S., Seetharaman, P., Samarah, I., & Mykytyn, P. P. (2004). Impact of heterogeneity and collaborative conflict management style on the performance of synchronous global virtual teams. *Information & Management, 41*, 303-321.
- Pauleen, D. J. (2003-2004). An inductively derived model of leader-initiated relationship building with virtual team members. *Journal of Management Information Systems, 20*, 227-256.
- Peffer, K., & Tuunanen, T. (2005). Planning for IS applications: A practical, information theoretical method and case study in mobile financial services. *Information & Management, 42*, 483-501.
- Peffer, K., & Ya, T. (2003). Identifying and evaluating the universe of outlets for information systems research: Ranking the journals. *Journal of Information Technology Theory and Application, 5*, 63-84.
- Piccoli, G., & Ives, B. (2003). Trust and the unintended effects of behavior control in virtual teams. *MIS Quarterly, 27*, 365-395.
- Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A review of current literature and directions for future research. *The DATA BASE for Advances in Information Systems, 35*, 6-39.
- Qureshi, S., & Vogel, D. (2001). Adaptiveness in virtual teams: Organisational challenges and research directions. *Group Decision and Negotiation, 10*, 27-46.
- Robey, D., Khoo, H. M., & Powers, C. (2000). Situated learning in cross-functional virtual teams. *IEEE Transactions on Professional Communication, 43*, 51-66.
- Schmidt, J. B., Montoya-Weiss, M. M., & Massey, A. P. (2001). New product development decision-making effectiveness: Comparing individuals, face-to-face teams, and virtual teams. *Decision Sciences, 32*, 575-600.
- Scott, C. R., & Timmerman, C. E. (1999). Communication technology use and multiple workplace identifications among organizational teleworkers with varied degrees of virtuality. *IEEE Transactions on Professional Communication, 42*, 240-260.
- Shoemaker, P. J., Tankard, J. W., Jr., & Lasorsa, D. L. (2004). *How to build social science theories*. Thousand Oaks, CA: Sage.
- Short, J. A., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. New York: John Wiley & Sons.
- Sia, C. L., Tan, B. C. Y., & Wei, K.-K. (2002). Group polarization and computer-mediated communication: Effects of communication cues, social presence, and anonymity. *Information Systems Research, 13*, 70-90.
- Staples, D. S., Hulland, J. S., & Higgins, C.A. (1999). A self-efficacy theory explanation for the management of remote workers in virtual organizations. *Organization Science, 10*(6), 758-776.
- Sutton, R., & Staw, B. (1995). What theory is not. *Administrative Science Quarterly, 40*(3), 371-384.
- Swanson, E. B., & Ramiller, N. C. (1993). Information systems research thematics: Submissions to a new journal, 1987-1992. *Information Systems Research, 4*(4), 299-330.
- Tan, B., Wei, K., Huang, W., & Ng, G. (2000). A dialogue technique to enhance electronic communication in virtual teams. *IEEE Transactions on Professional Communication, 43*, 153.
- Thagard, P. R. (1978). The best explanation: Criteria for theory choice. *The Journal of Philosophy, 75*(2), 76-92.

- Walther, J. (1995). Relational aspects of computer-mediated communication: Experimental observations over time. *Organization Science*, 6, 186-203.
- Walther, J. B., & Burgoon, J. K. (1992). Relational communication in computer mediated interaction. *Human Communication Research*, 19(1), 50-88.
- Warkentin, M. E., & Beranek, P. M. (1999). Training to improve virtual team communication. *Information Systems Journal*, 9(4), 271-289.
- Warkentin, M. E., Sayeed, L., & Hightower, R. (1997). Virtual teams versus face-to-face teams: An exploratory study of a Web-based conference system. *Decision Sciences*, 28, 975-996.
- Weber, R. (1987). Toward a theory of artifacts: A paradigmatic base for information systems research. *Journal of Information Systems*, 1(1), 3-19.
- Weick, K. (1995). What theory is not, theorizing is. *Administrative Science Quarterly*, 40(3), 385-390.
- Whetten, D. (1989). What constitutes a theoretical contribution? *Academy of Management Review*, 14(4), 490-495.
- Zak, M. H. (1993). Interactivity and communication mode choice in ongoing management groups. *Information Systems Research*, 4, 207-239.

**Shu Z. Schiller** is an assistant professor in the College of Business at Wright State University. Her research interests include Internet services, computer mediated communication, virtual teams, and social and psychological impacts of information systems on individuals and groups.

**Munir Mandviwalla** is an associate professor and chair in the School of Business and Management at Temple University. He is also the executive director of the Irwin L. Gross eBusiness Institute. His research interests include collaborative systems and communication technologies, electronic commerce strategy, and the use of prototyping for theory development.