Virtual Teams Demystified:  
An Integrative Framework for Understanding Virtual Teams and a Synthesis of Research

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ABSTRACT

Virtual teams are essential to the functioning of an increasing number of organizations. They have been the subject of much research, resulting in a growing body of literature on the topic. Nevertheless, we still lack an integrated understanding of what drives virtual team dynamics and ultimately effectiveness. A key obstacle to achieving such understanding is the lack of an integrative theory-driven framework through which we can organize and make sense of prior, and guide future, research. We build on existing models of effectiveness and emergent processes and states that have been applied to traditional teams and use these to generate a framework for understanding virtual team dynamics. We then use this framework to structure a review and synthesis of ninety-seven empirical studies of virtual teams published between 1990 and 2008. Using vote-counting analysis, we assess and integrate these findings to provide insights into the direct and indirect antecedents of virtual team effectiveness. Based on this model, we highlight key gaps in both our knowledge of, and approach to studying, virtual teams. We outline areas for future research, provide managerial recommendations, and highlight implications for the study of both virtual and traditional teams.

KEYWORDS: Virtual teams, virtual team effectiveness, emergent team processes, emergent team states, team design, information technology.
INTRODUCTION

Technological advances, a globally distributed workforce, and a rapidly changing business context have created both the ability and need for organizations to operate across distance. Virtual teams, defined as interdependent individuals physically separated from one another and relying on information technologies to communicate, collaborate, and coordinate work to achieve a common goal (Cramton 2001; Maznevski and Chudoba 2000), are seen as a means to face these challenges. They allow firms to leverage dispersed intellectual capital as well as access local resources and markets, resulting in enhanced work unit performance, better responsiveness to changing customer demands, and ultimately competitive advantage in turbulent and competitive environments (Jarvenpaa and Leidner 1999; Malhotra et al. 2001; Sole and Edmondson 2002). Consequently, it is common to see organizations relying on virtual teams for core processes including knowledge management, R&D and product development, software development, customer service, and strategic analysis (Espinosa et al. 2007; Majchrzak et al. 2000; Malhotra and Majchrzak 2004; Maznevski and Chudoba 2000).

Particularly in recent years, virtual teams have also been the subject of considerable research attention, yielding numerous insights into their dynamics. Researchers have investigated a wide range of design factors (e.g. physical distance, temporal overlap, configuration), ongoing interpersonal, task, and IT dynamics (e.g. information sharing, conflict, trust, shared understanding, norms of IT-use, task-IT fit, use of computer-mediated-communication), and outcomes (e.g. quality of output, production efficiency, creativity and innovation, member satisfaction and learning). While this research has generated a substantial body of knowledge on virtual teams, our understanding of their dynamics, the drivers of their effectiveness, and how they relate to one another remains fragmented. A frequent occurrence as fields mature (King and He 2005), such fragmentation makes it difficult to fully understand the functioning of virtual teams and obtain an integrated and holistic view of the factors contributing to or inhibiting virtual

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1 The qualifiers “virtual”, “dispersed”, “distributed”, “far-flung”, and “global” have all been used to represent teams that span multiple geographical locations and rely on IT to perform their work. In this paper, we use the term “virtual teams” to represent this construct.
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team effectiveness. Furthermore, as argued by Hunter (1982) and Pillemer and Light (1980) the advancement of a domain of study requires the accumulation and refinement of a body of knowledge. However, as King and He note in their discussion of the role of meta-analyses in IS research, “knowledge accumulation increasingly relies on the integration of previous studies and findings” (2005 p. 666).

An important step in this process of knowledge accumulation is the establishment of a generalized conceptual framework that maps the relationships among antecedents and outcomes. Such a framework would help us to map the complex relationships among virtual team dynamics and their direct and indirect links to virtual team effectiveness. For example, while we do not have empirical evidence directly linking computer mediated communication (CMC) to output quality, such a framework might suggest indirect paths yielding a negative relationship. CMC hinders the sharing and communication of information among team members (e.g. Chidambaram and Jones 1993; Cramton 2001; Hightower and Sayeed 1996), which would otherwise positively impact output quality and satisfaction with team processes (e.g. Smith and Vanecek 1990; Warkentin et al. 1997). Such a framework would also help us to identify gaps in our current understanding of virtual teams. For example, while unique expertise and shared understanding have been found to be positively correlated with outcome quality and innovation (Balthazard et al. 2004; Majchrzak et al. 2000; Malhotra and Majchrzak 2004; Sole and Edmondson 2002; Yoo and Kanawattanachai 2001), the relationship between these predictors remains unclear. Thus, an integrative framework can be used both to organize and integrate prior findings as well as providing a means of identifying gaps in our current understanding and areas for future research. To this end, since the late 1990’s, and particularly since 2000, there have been numerous reviews of research relevant to virtual teams. Consistently, these reviews take a bottom-up approach to assessing our knowledge – they start with reviews of the empirical evidence and from those reviews build up models of virtual team dynamics (e.g. Martins et al. 2004; Maznevskii and Chudoba 2000; Powell et al. 2004). As such, these studies provide an excellent overview of what researchers have examined and how they have been linked to a set of outcomes.
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The goal of this paper is twofold. First, we seek to complement prior reviews by taking, a top-down approach, drawing on established theories of team processes to create a theoretically-grounded conceptual framework that is independent of prior virtual teams research. This framework is intended to help scholars understand the complex relationships among the people, tasks, and technology of virtual teams, to develop a better understanding of how they directly and indirectly affect effectiveness. Second, we seek to assess the current state of knowledge on virtual teams by using this framework to structure a systematic review of empirical research on virtual teams. In so doing, we both situate and integrate existing virtual teams research in a way that focuses our attention on gaps in the empirical evidence that can often remain hidden when reviews are driven by, and structured around, prior findings.

The paper is structured as follows. In the first section, we position our paper with respect to prior reviews and models of virtual team dynamics. In the second section, we draw on prior research to define the key categories of virtual team characteristics which we incorporate in our framework. In the third section, we use this framework to examine and synthesize prior research and build nomological nets for the antecedents of virtual team effectiveness. In the fourth section, we discuss the insights generated from the application of our framework to the current state of virtual teams research and their implications for future research and practice.

THEORETICAL FRAMEWORK

In creating our model of virtual team effectiveness we draw particularly on two bodies of prior scholarship. we draw on the work of Hackman et al. (1987) which highlights the importance of taking a differentiated view of workgroup effectiveness. We also build on work by Ilgen et al. (2005) and Marks et al. (2001) to specify key underlying categories of antecedent constructs. We discuss each in turn, and in the interest of increased integration, we organize our framework around effectiveness outcomes.

Outcome: Differentiated Virtual Team Effectiveness

Numerous scholars have stressed the importance of viewing team effectiveness as composed of three distinct dimensions: productivity, viability, and member development (Cohen and Bailey 1997; Guzzo and Dickson 1996; Hackman 1987; Sundstrom et al. 1990). Differentiating among these
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dimensions allows us to capture the interactions and interdependencies that exist among the antecedents of a specific dimension, providing us with a more nuanced and accurate understanding of its drivers. The first, productivity, is the extent to which a team’s output meets or exceeds the standards of those receiving it and includes measures like quantity, efficiency, output quality, timeliness, and creativity. The second, viability, is the extent to which carrying out its work permits or enhances a team’s ability to continue working together and includes factors like satisfaction and willingness to work together in the future2. Finally, member development is the extent to which a team’s experience fulfills the personal needs and contributes to the growth and personal well-being of its members and includes factors like learning.

Antecedents: Designed and Emergent Factors

Drawing on the work of Ilgen et al. (2005) and Marks et al. (2001) we group the relevant elements of virtual teams into three distinct categories: design factors, emergent team processes, and emergent team states. We further differentiate factors by domain, as relating to: interpersonal factors, task (which is also often referred to as action processes (e.g. Kirkman and Mathieu 2005)) or information technologies (IT). We suggest that team design factors affect virtual teams both directly and indirectly, through emergent team processes and states (Ilgen et al. 2005).

Team Design Factors

Team design provides the initial configuration of factors, setting the stage for the team to begin to work and providing the structural context within which it evolves. Team design affects interpersonal, task, and IT-related factors (Campion et al. 1993; Janz et al. 1997) and provides the situational opportunities and constraints that affect the occurrence and meaning of virtual teamwork (Johns 2006). Interpersonal factors (also referred to as membership factors) are the characteristics of individual team members as well as the resulting team-level structural properties shaped by those individuals attributes. They include personality traits (e.g. Balthazard et al. 2004), expertise (e.g. Malhotra et al. 2001), team

2 We consider other interpersonal factors closely related to viability (e.g., conflict, cohesion, inter-member coordination, mature communication & problem solving, and clear norms and roles (Sundstrom et al. 1990)) to be antecedents rather than aspects of viability.
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size (e.g. Majchrzak et al. 2005), geographical dispersion (e.g. Hinds and Bailey 2003), temporal dispersion (e.g. Cramton 2001), cultural diversity (e.g. Maznevski and Chudoba 2000), functional diversity (e.g. Jarvenpaa et al. 2004), indexes of team virtuality (e.g. O'Leary and Cummings 2007), and other properties of the team related to its membership. Task factors refer to the nature and characteristics of the task being performed. Examples include the required degree of interdependence (e.g. Lipnack and Stamps 1997), complexity (e.g. Maznevski and Chudoba 2000), and non-routineity (e.g. Malhotra and Majchrzak 2004), the task’s managerial structure – such as self or formally managed (e.g. Jarvenpaa and Leidner 1999; Jarvenpaa et al. 2004), and the task itself, for example software development (e.g. Malhotra and Majchrzak 2004), new product development (e.g. Malhotra et al. 2001), or research & development (e.g. Hinds and Mortensen 2005). IT factors involve the technologies used by a team to accomplish its work. They include the media itself such as computer-conferencing systems (e.g. Cass et al. 1992), electronic mail (e.g. Mortensen and Hinds 2001), and audio/videoconference systems (e.g. Andres 2002), as well as the respective attributes of a given technology like degree of feedback immediacy (e.g. Dennis and Kinney 1998) or synchronicity (e.g. Maruping and Agarwal 2004). Together, interpersonal, task, and IT-related elements of the team design form the given set of opportunities and constraints facing virtual team members and managers as they pursue their collaborative task, which can have both subtle and powerful effects on work unit/team performance (e.g. Johns 2006).

Emergent Team Processes

Emergent processes are the interdependent cognitive, verbal, and behavioral activities that convert inputs into outputs (Marks et al. 2001). Emergent processes capture how people act, do their job, interact with other members, and use IT. In the realm of actions, team processes are dynamic and typically transient. As team members interact, new emergent processes are created and existing ones are reinforced and/or changed. As with design factors, we distinguish among interpersonal, task, and IT-related emergent processes. Interpersonal emergent processes are the activities performed by members of virtual teams to manage relationships among them (Marks et al. 2001), including conflict management strategies (e.g. Montoya-Weiss et al. 2001), trust building (e.g. Jarvenpaa et al. 1998), and other
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cognitive, verbal, and behavioral activities used to manage teams’ socio-emotional and affective
dynamics (e.g. Kayworth and Leidner 2001). Task emergent processes are the activities performed by
members of virtual teams to structure, organize, control, and monitor work within virtual teams, including
exchanging task-related information and knowledge (e.g. Majchrzak et al. 2000; Maznevski and Chudoba
2000), relying on structured processes (e.g. Huang et al. 2002; Piccoli and Ives 2003), and using formal
team coordination mechanisms (e.g. Massey et al. 2003). IT emergent processes are the cognitive, verbal,
and behavioral activities related to IT use and capabilities, including using computer-mediated
communication (e.g. Maznevski and Chudoba 2000; Yoo and Kanawattanachai 2001) and adapting IT to
the context of the team (e.g. Majchrzak et al. 2000). Taken together, the three types of emergent processes
capture members’ interdependent actions aimed at converting inputs into outputs.

**Emergent Team States**

Emergent team states are the properties of virtual teams that are typically dynamic and vary as a
function of the team context, inputs, emergent processes, and outcomes (Marks et al. 2001). In contrast to
processes, emergent states do not denote interactions but reflect the characteristics of a team at a given
point in time (Ilgen et al. 2005; Marks et al. 2001; Mathieu et al. 2006). As with design factors and
processes, we differentiate between three types of states: interpersonal, task, and IT. Interpersonal
emergent states refer to the affective and socio-emotional properties of virtual teams, including shared
team identity (e.g. Mortensen and Hinds 2001), trust (e.g. Jarvenpaa and Leidner 1999), cohesion (e.g.
Chidambaram and Jones 1993), and conflict (e.g. Hinds and Mortensen 2005). Task-related emergent
states represent team members’ attitudes, values, cognitions, and motivations related to task activities,
including shared mental models and collective minds (e.g. Baba et al. 2004), transactive memory systems
(e.g. Yoo and Kanawattanachai 2001), and team awareness (Espinosa et al. 2007; Marks et al. 2001).
Finally, IT-related emergent states are a team’s attitudes, values, cognitions, and motivations about IT and
its roles in supporting the team’s activities, including shared IT knowledge (e.g. Bassellier et al. 2003),
media sensitivity (e.g. Trevino et al. 1990), computer self-efficacy (e.g. Compeau and Higgins 1995;
Staples and Hulland 1999), and perceived technology spirit (e.g. DeSanctis and Poole 1994).
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Virtual Team Framework

Incorporating a differentiated view of effectiveness and design factors, emergent processes, and emergent states allows us to develop a general framework for understanding virtual team effectiveness and its antecedents. As illustrated in Figure 1, team design provides the initial team context that shapes the future direction of teams and allows, facilitates, constrains, or prevents the subsequent emergence of processes and states. Team design factors can thus influence team effectiveness directly and indirectly, because they facilitate, stimulate, or hinder the emergence of some processes and states.

| Insert Figure 1 about here |

Beyond providing a structure for linking antecedents (either designed or emergent) to virtual team effectiveness, our framework also facilitates the exploration of the ongoing relationships among and within emergent factors. Take, for example, the relationships between emergent processes and states, which influence one another, sometimes reinforcing or modifying existing states or processes and at other times creating new ones (Ilgen et al. 2005; Marks et al. 2001). Emergent processes, through members’ repeated actions, contribute to emergent states by facilitating state formation, maintenance, and transformation. Emergent states, in return, affect emergent processes by influencing the selection, routinization, optimization, and structuration of processes. The framework also highlights the recursive relationship between outputs and team characteristics (Ilgen et al. 2005; Marks et al. 2001). The feedback loops, represented in the framework by dashed arrows, indicate that variables treated as output factors at time $t$ can become antecedents of contextual and/or emergent process and state variables at time $t+1$.

A REVIEW OF PRIOR RESEARCH

We use the virtual team effectiveness framework outlined above to structure a review of the current empirical research on virtual teams as it relates to effectiveness. In using the framework to organize prior findings, we illustrate how this framework helps us to both organize and link current findings as well as to highlight gaps in our knowledge and fruitful domains for further research.
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Method

We identified empirical articles on virtual teams\(^3\) by searching peer-reviewed journals published between 1990 and 2008 for papers with the following terms in their titles or abstracts: *virtual team(s)/group(s), distributed team(s)/group(s), and dispersed team(s)/group(s)*\(^4\). Based on the results, we generated a list of 13 relevant journals where research on virtual teams was being published. We then went to the journals themselves to generate the exhaustive list of all articles meeting the search criteria outlined above that were published between 1990 and 2008. This search process resulted in a total of 97 published empirical studies on virtual teams. A list of article counts by journal is provided in Table 1 and a complete table is provided as Appendix 1. To gain an overview of the current state of research on virtual team effectiveness, we classified all papers in the sample with respect to both methodology and content.

| Insert Table 1 about here |

Categorization of findings

As a key objective of this review was to identify the main direct and indirect drivers of virtual team effectiveness, we designed our analysis to connect concepts together in a nomological net based on Webster and Watson’s (2002) concept-centric approach. Our first step was to systematically identify and categorize the constructs and relationships found in the studies in our sample. To do so, we read each study, identifying all measured constructs and all tested relationships among them. Constructs were identified as either: metrics of effectiveness, design factors, emergent processes, or emergent states, and among the latter three, as primarily interpersonal, task, or IT-related. Each relationship was categorized as either “+” if a significant positive relationship was reported, “-” if a significant negative relationship was

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\(^3\) We included all studies reporting geographical dispersion, including members at the same site but in different rooms/workspaces and considered IT as any technology used by team members to perform their task.

\(^4\) We used ABI/INFORMS to perform our preliminary search.
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reported, or “o” if no relationship was found. It is important to note that unlike many previous reviews, we include quantitative, qualitative, and multi-method studies in our analysis and consider all published findings within the sample as having the same validity, irrespective of the methodology used. All findings reported in any study meeting the inclusion criteria outlined above were included in our analyses.

Not surprisingly, given the interdisciplinary nature of the topic, in many cases it was difficult to find multiple studies addressing any given construct or relationship. We therefore aggregated findings into broader constructs based on what we perceive to be the broader underlying themes or drivers of the particular effects. Many of these constructs were, in turn, aggregated into higher-level constructs, resulting in a hierarchy of nested constructs, allowing us to examine and compare findings at multiple levels when appropriate. The conceptual categorization was carried out independently by all three authors classification inconsistencies (less than 5%) were resolved through discussion.

Analyses

Numerous approaches exist for comparing findings across multiple studies, ranging along a continuum of increasing quantification: from narrative reviews to true statistical meta-analysis (Guzzo et al. 1987; King and He 2005). As noted by King et al., increasing quantification decreases subjectivity (2005), a key and often cited vulnerability of narrative analyses (Guzzo et al. 1987). Our decision to include qualitative research eliminates the possibility of conducting a “true” meta-analysis which requires the comparison of effect sizes. Thus, we conduct a vote-counting analysis, in which each finding is considered a vote in support of a positive, null, or negative relationship between two constructs. In his review of meta-analytic procedures, Rosenthal (1989) suggests a nonparametric sign test as a means to compare obtained versus expected frequencies of votes when the sample of findings describing a relationship between two variables is small. Thus, we use the formula:

\[ z = \frac{R - N/2}{\sqrt{N/4}} \]

5 Relationships reported in qualitative studies were considered as significant
6To control for varying precision across studies, we combined multiple instances of support for a given relationship provided by a single study into a single data point. Thus, a study that separately tested and found support for negative relationships between output quality and affect, task, and process conflict was considered a single instance, giving it the same weight as a study that only tested the link between overall conflict and quality.
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\[ z = \frac{x - np}{\sqrt{np(1-p)}} \]

As with z statistics, a 90% confidence interval is achieved when |z| > 1.65 and 98% when |z| > 2.326.

To produce meaningful results, however, this method requires a value of np greater than 5 (Keller et al. 1994). Given a p value of 1/3 (conservatively assuming equal probability of positive, negative, or null relationships) a sign-test requires any tested relationship to have at least 15 data points. Even aggregating to the highest meaningful level, only four of the 162 distinct relationships in the sample had been studied enough times for a sign test to yield meaningful results.

Nevertheless, our systematic categorization of studies allows us to conduct a non-statistical vote-counting in which we compare the relative number of positive, negative, or null relationships found in the literature and from them identify suggestive trends. To determine a reasonable threshold for considering a given path supported, we build on Light and colleagues’ (Light and Pillemer 1984; Light and Smith 1971), rule of thumb that reasonable evidence of a path exists if:

\[ \left( \frac{\text{number of supportive findings}}{\text{total number of findings}} \right) > \frac{1}{3} \]

This rule of thumb, however, has two relevant limitations. First, the 1/3 rule of thumb does not differentiate among our three categories of findings – positive, null, and negative – and the potential for contradictory results. Second, it does not set a threshold value for the minimum number of studies required before one can assess support. We modify Light and colleagues’ rule of thumb to find support if:

\[ \left( \frac{|\text{number of supportive findings} - \text{number of contradictory findings}|}{\text{total number of findings}} \right) > \frac{1}{3} \]

and

\[ \max(\text{number of supportive findings, number of contradictory findings}) \geq 3 \]

Starting from the assumption that supportive and contradictory findings have equivalent validity and importance, the first condition discounts the number of supportive findings (positive or negative) by the number of contradictory findings. Null findings increase the denominator, thereby diluting the strength of the evidence in support of a valenced relationship. The second condition sets the threshold
value for inclusion at three studies based on the number of directional findings thus avoiding artificially inflating counts by null findings. To assess the validity of our three-study threshold, we re-ran our analyses with thresholds of 2 and 4 studies. While the pattern of findings did not change, the overall trends were less clearly visible and more difficult to interpret in the case of 2 studies, and the data were too sparse the case of 4, therefore we maintained the threshold value of 3 studies.

In the following section we discuss the trends identified in our review of the literature. In the cases it is meaningful, we provide the results of a sign test analysis. In the remaining cases, we assess support using the metric outlined above. For all reported relationships we provide the number of positive, null, and negative findings as [+o,-] respectively (e.g. 3 positive, 2 null, and 4 negative would be reported as [3,2,4]. Given the large number of relationships covered in the sample, we report only supported relationships (meeting the criteria outlined above). We also discuss small number of interesting counterintuitive or “suggestive” relationships that do not meet the criteria above.

**Results**

We first turn to the broad trends regarding the state of research on virtual team performance (see Table 2 for article counts by classification). As indicated in Table 2, there has been a rapid increase in the number of published empirical studies of virtual teams. While 27 papers were published between 1990 and 1999, 26 articles were published between 2000 and 2004, and 44 between 2005 and 2008 alone – a trend suggesting that research on virtual teams is not only alive and well, but increasing rapidly.

| Insert Table 2 about here |

We find no difference in the number of studies conducted in a natural as opposed to an experimental setting (48 studies vs. 49 studies respectively). Interestingly, however, these proportions changed substantially over time, with experimental settings used more than natural settings in the 90’s (78% vs. 22% between 1991 and 2000), while after 2000, the reverse is true, as experimental studies decreased relative to those in natural settings (39% vs. 61% respectively between 2000 and 2008). This
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may reflect a large number of early laboratory studies aimed at understanding the effects of technology mediation on interpersonal interaction. With respect to their samples, the majority of studies relied on student subjects rather than employees within organizational contexts (64 studies vs. 34 studies respectively, with one using both). Though in the majority of cases, experimental studies used student subjects, and studies in natural settings used organizational employees, there were a number of field studies conducted using student subjects (ex Cramton 2001). We view this balance between field and experimental studies to be a great strength of research on virtual teams.

While the majority of analyses have been conducted at the level of the team (80), followed by individuals (38) and lastly the organization (5), three points are worth noting. First is the scarcity of research on organizational-level antecedents and consequences of virtual team use. Second, apart from a few exceptions (e.g. Munkvold and Zigurs 2007; Polzer et al. 2006), we also lack research on subgroup-level factors (e.g. as defined by location or demography). Third, while 21 studies have covered more than one level of analysis simultaneously, 19 of those studies have considered the levels independently and consequently have not integrated the effects of factors occurring at different levels. Thus, while such research has been multi-level, it has not performed cross-level analyses (exceptions are Caldwell et al. 2008; and Strijbos et al. 2004). Lastly, with respect to causal structure (Markus and Robey 1988), 71% of the studies have used variance models as compared to 29% that have used process models (69 studies vs. 28 studies respectively). We now turn to the specific relationships tested in these studies.

To make sense of the complex mapping of studies and relationships that exist, we organize our findings around the outcomes we have identified and the causal paths leading to them. First, we discuss findings identifying the antecedents of each of the dimensions of team effectiveness in terms of design factors and emergent properties and states. Second, we identify the constructs that have, been found to lead to those antecedents. A conceptual map of all identified relationships is provided in Figure 2.

| Insert Figure 2 about here |
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**Direct antecedents of effectiveness**

As noted, scholars stress the importance of recognizing three distinct, but equally important dimensions of effectiveness: productivity, viability, and member development (Hackman 1987).

*Antecedents of virtual team productivity*

Productivity captures how effectively a team converts inputs into outputs in terms of quality and quantity (Adler and Clark 1991). We also include output creativity as a sub-dimension of output quality. While distinct from quality of output, creativity has been well-studied and can be considered a criterion of output quality, as more creative solutions provide benefits above and beyond less creative ones.

*Antecedents of output quality*

Examining the direct antecedents of effectiveness in virtual teams, we look at the antecedents of six distinct constructs: output quality, creativity, productivity, satisfaction, learning, and viability. We find the largest body of existing research (46 unique studies) examines the antecedents of output quality. Team design is linked to output quality through a positive relationship between levels of expertise and quality of output [3,0,0]. We also find a positive relationship between media richness and quality [4,3,0]. Breaking down the construct of media richness, yields suggestive support for a positive link between the use of multiple media and quality [2,0,0] than for feedback immediacy and quality [1,1,0] or multiplicity of cues [1,3,0].

More research has examined the effects of emergent processes on output quality. We find evidence of a positive link between collaborative orientation (e.g. collaborative behaviors, collaborative conflict management, accommodating behaviors) and output quality [3,1,0]. Similarly, effective coordination, and communication quality both related to higher quality output ([6,1,0] and [4,1,0] respectively). We also find positive interpersonal climate (in the form of trust, cohesion, and low conflict) is positively related to output quality [3,3,0]. Interestingly, though by far the most plentiful, research on the link between mediated communication and output quality remains ambiguous [2,11,7] ($z = 0.16$). Thus, across 20 findings, unique studies on the topic, the majority of findings indicate no relationship between the use of CMC and quality of output.
With respect to emergent states, we find a strong link between output quality and shared team mental models of both task and IT [6,0,0]. We also find positive links between output quality and both efficacy beliefs [3,1,0] and positive interpersonal climate [3,3,0] – as evidenced by low conflict and high trust. Two additional relationships are suggestive, having only two congruent points of support each. We find suggestive positive links between output quality and both active leadership and the adaptation of technology to fit the team’s needs (both [2,0,0]). With only a single point of corroboration, we do not consider these to be well-supported findings, but they are certainly suggestive and worth noting.

Finally, we view creativity – particularly as enacted in real teams – as one dimension along which the quality of a given virtual team output can be, and often is, judged. Evidence of the antecedents of creativity in virtual teams is minimal. We find only five studies examining antecedents of virtual team creativity all but one of which focus on the effects of IT. We find mixed evidence of the link between media richness and creativity [2,1,0] and only suggestive evidence on the links between creativity and both mediated communication [1,1,0] and IT adaptation [2,0,0].

**Antecedents of output quantity**

The second aspect of productivity, output quantity, includes studies predicting both volume of output and speed of output. Closely intertwined, these two constructs assess the conversion of inputs into outputs over a fixed period of time. Surprisingly, we find little consistent evidence of predictors of virtual team productivity. Coming from eleven distinct studies, with the exception of negative links between more demanding tasks and virtual team productivity [0,3,3] and between mediated communication and productivity [0,1,5], we find no other relationships supported by more than 2 findings. Of the remainder, while scholars have studied the links between output quantity and structural diversity, team size, resource availability, communication quality, and coordination effectiveness, only the suggestive positive relationship between media richness and output quantity [2,0,0] has multiple points of support.

**Antecedents of virtual team viability**

Though many factors may be considered as contributing to virtual team viability (e.g. satisfaction, intent to remain, willingness to collaborate in the future), satisfaction is the construct that has been most
frequently studied in virtual teams. Nevertheless, we lack clear evidence of a link between virtual team design and satisfaction. Of the seven findings addressing this relationship, five find no direct relationship, breaking down into the relationships between satisfaction and media richness [1,2,0] and structural diversity [0,2,1]. The latter finding is especially surprising given the large amount of existing theory arguing that working in dispersed and cross-cultural teams yields unpleasant dynamics.

The most studied emergent process-satisfaction link is that between mediated communication and satisfaction which again finds mixed results [3,8,8] (z=0.81), with similar patterns for emergent team process and outcome satisfaction. Results are slightly stronger for the relationship between mediated communication and communication satisfaction [0,3,5], suggesting that the negative impact of technology mediation may be limited to the act of communication itself. A smaller number of findings connect satisfaction to the use of multiple media [2,2,2], but these findings are ambiguous irrespective of the object of the satisfaction. We also have some suggestive evidence of links between satisfaction and both effective coordination and collaborative orientation ([2,0,0] for both). Also contributing to viability is research on predictors of intention to remain in the team, though to date we have only one study on this construct, which finds a positive relationship with perceived self-efficacy, thus we need further evidence before reaching conclusions about predictors of intention to remain in the team. In all, studies examining the link between satisfaction and interpersonal or task-related factors appear surprisingly rare.

**Antecedents of virtual team member development**

The final dimension of effectiveness is the extent to which team members develop. A number of potential constructs can be placed under this category, including learning and personal growth (Majchrzak, et al. 2005). We find, however, only one study that examines antecedents of team member development – measured as learning – and that study finds a positive link between information and knowledge sharing and learning within virtual teams.

**Indirect antecedents of effectiveness**

While these findings illustrate a number of direct predictors of effectiveness, by examining the antecedents of those team design elements, emergent processes, and emergent states, we are also able to
identify causal chains affecting dynamics through intermediate steps. As we found no strong evidence of predictors of either virtual team viability or member development, we cannot draw causal chains to either of those dimensions of effectiveness. Thus, in the remainder of this section, we focus on causal chains leading to virtual team productivity. Though we will discuss them as mediators, in some cases, these intermediate factors may operate more as moderators of these relationships.

Turning first to output quality, although we identified eight antecedents of virtual team output quality, we lacked evidence of predictors of expertise, leaving us with seven testable paths to virtual team output quality: efficacy beliefs, collaborative orientation, shared mental models, communication quality, positive interpersonal climate, media richness, and effective coordination.

While some research exists on the antecedents of collaborative orientation in virtual teams - another predictor of output quality – those studies provide no consistent trends in their results. Individual studies have found negative relationships between high levels of individualism and collaborative conflict management, a lack of a relationship between diversity and collaborative conflict management, and mixed results for the link between mediated communication and collaborative conflict management. Research on efficacy beliefs is similarly inconsistent in its findings, with individual studies linking such beliefs to individualism, communication effectiveness, role assignments, and level of feedback. Due to the lack of corroboration of these findings, we do not include predictors of either collaborative orientation or efficacy beliefs in our final model.

We do, however find evidence of antecedents of positive interpersonal climate (in the form of cohesion, trust, and lack of conflict) in virtual teams, from 36 studies yielding 87 distinct findings. We find a sizeable number of studies finding a negative relationship between such dynamics and structural diversity (in the form of geographic dispersion, the existence of subgroups, and diversity with respect to culture, function, and age) [0,0,10]. Covering a wide range of types of diversity and forms of positive interpersonal climates, the most consistently found relationships are the negative relationship between subgroups and trust [0,0,3], and the positive relationship between conflict and both cultural diversity [4,0,0] and subgroups [3,0,0] (both reverse scored to match positive interpersonal climate). We also find
positive relationships between positive interpersonal climate and media richness \([3,1,0]\), interpersonal as opposed to task-based communication \([4,0,1]\), and communication quality \([3,1,0]\). The largest amount of research exists for the link between positive dynamics and mediated communication \([3,7,10]\) \((z = 1.58)\) which suggests a negative relationship.

We also find consistent evidence of antecedents of the effective coordination of work and expertise, also a predictor of virtual team output quality. Turning first to research linking virtual team design to effective coordination, we find that having structures in place that support coordination – such as temporal coordination mechanisms or knowledge brokering mechanisms – increases the likelihood of effective coordination in virtual teams \([3,0,0]\). Moving on to emergent states and processes, effective coordination is positively related to shared mental models \([4,1,0]\) – particularly those relating to the task \([3,0,0]\) and negatively to mediated communication \([0,2,3]\). We find a suggestive negative relationship to structural diversity (temporal and functional) \([0,0,2]\) and findings are mixed for the link between effective coordination and the use of multiple media \([2,0,1]\).

Distinct from the effective coordination, we find evidence of a negative relationship between quality of communication and structural diversity (primarily with respect to geographic dispersion) \([1,3,6]\). Shared mental models also appear to be positively linked to communication quality \([3,0,1]\) while mediated communication again reduces it \([2,3,7]\). Related, though not directly measuring the quality of communication, a large number of studies have examined the antecedents of sharing particular types of information, such as interpersonal or task-based. Though examining a wide range of antecedents including structural diversity, active leadership, media richness, and mediated communication, these findings have, to date, yielded conflicting results.

Also contributing to the quality of virtual teams’ output is the existence of a shared team-level mental model. Research has found structural diversity to be negatively related to shared team-level mental models in virtual teams \([0,0,3]\) this is attributable to a range of factors including unshared experience and reduced information about the distant location. We find a positive relationship between communication quality and shared mental models \([4,1,0]\) and suggestive evidence for a positive relationship between
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cognitive sensemaking processes and shared mental models [2,0,0]. Surprisingly, only two studies explored the link between IT factors and shared mental models in virtual teams, with ambiguous results.

Last, while many factors can be indirectly linked to virtual team productivity through output quality, we the lack corroborated evidence needed to draw causal chains leading to creativity or output quantity through their antecedents of adapted technology, media richness, mediated communication, or demanding tasks. Similarly regarding viability, we identified a number of predictors of shared mental models, but we lack consistent evidence of the antecedents of collaborative orientation.

DISCUSSION

Over the past twenty years, scholars have generated a substantial body of knowledge on virtual teams. This knowledge, however, has remained fragmented, in need of a conceptual framework to organize and guide our research and theory. Such a framework facilitates the comparison and assimilation of findings across studies to yield an integrated body of knowledge. We seek to provide researchers with a theoretically-driven comprehensive framework that helps them grasp the complexity of virtual teamwork, while succinct enough to guide new virtual teams research in a manageable way.

In the proposed framework of virtual teams, we differentiate constructs with respect to three key dimensions of virtual teams: team effectiveness (productivity, viability, personal development); team features (design, emergent processes, emergent states); and team components (interpersonal, task, IT). This approach yields three important benefits. First, it provides a more precise understanding of the synergistic, complementary, and sometimes opposing effects of different types of factors on different aspects of effectiveness that may or may not themselves be complementary. Second, analyzing virtual teams by grouping individual constructs into categories of design factors, emergent processes and states, and different dimensions of effectiveness allows us to capture the dynamic nature of virtual teams and assess the relationships among intra- and inter-category factors. Third, this approach also allows us to map the nomological net linking different virtual team design, emergent process, and emergent state factors to effectiveness and provides insights into what we know about virtual team effectiveness and what we have yet to learn. The empirical evidence reviewed provides support for these distinctions, as
they were found to differently influence virtual team effectiveness. Insights obtained from each dimension of virtual teams are detailed below.

**Insights gained from taking a differentiated view of effectiveness**

We build on Hackman (1987) and others who identify three dimensions of team effectiveness – productivity, viability, and member development – and stress the importance of all three in determining the ultimate success of a virtual team. Research on virtual teams, however, focuses solely on virtual team productivity. While we have some suggestive evidence that effective coordination and a collaborative orientation contribute to the long-term viability of the team (in the form of team member satisfaction), further research is needed. Even more striking, we find only one study in our sample that predicts member development (in this case learning) in virtual teams, and two that look at learning-related antecedents of other effectiveness outcomes. Within the extant research on virtual team productivity, the evidence focuses heavily on antecedents of output quality, with less evidence for antecedents of output quantity.

This focus on virtual team productivity in many ways reflects similar trends in the traditional team literature, which also initially focused on productivity. This focus is not surprising, given that productivity is the most obvious managerial metric for assessing the success or failure of a team. However, the absence of research on virtual team learning and viability limits scholars’ ability to theorize about virtual teams, and practitioners’ ability to manage them. For both scholars and practitioners, a model of virtual teams that focuses solely on productivity may not capture many of the factors that motivate individual team members like satisfaction or personal growth. It also risks focusing on short-term gains (in the form of more or better output) at the cost of long-term benefits in terms of stability or the development of members as future resources. For this reason, future research in the domains of virtual team member development and viability is needed.

**Insights gained from differentiating among design factors, emergent processes, and emergent states**

We also build on Marks, Mathieu, and Zaccaro (2001), who argue that a key impediment to the team literature is the lack of distinction between emergent team processes and states. In this review, we
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differentiate among three types of constructs: design factors, emergent processes, and emergent states. Evidence supports the importance of all three, as research is evenly balanced across them. We find that design factors play an important role in virtual team effectiveness, but that their impact on team effectiveness occurs primarily through their effects on emergent processes and states. Those emergent processes and states, in turn, are closely interconnected, supporting the model of Marks et al. (2001). As they note, states “are products of team experiences (including emergent team processes) and become new inputs to subsequent processes and outcomes” (Marks et al. 2001 p 378). Our review shows the importance of distinguishing state and process factors because the nature of these factors and their relationships to team effectiveness are different. Further, the distinction has important methodological implications as states can easily be studied by a cross-sectional approach, while processes are best studied using a longitudinal approach where relations evolving over time are captured.

**Insights gained from differentiating among interpersonal, task, and IT-based factors**

Finally, in addition to differentiating among features of virtual teams, we also differentiate among components of virtual teams. Looking at existing research, we find much on interpersonal constructs and some (inconclusive) research on IT-related factors, but comparatively little research on virtual team tasks. Given the direct links between task-related constructs and both output quality and quantity, it is clear that more research is needed on this dimension. For instance, we need a better understanding of how the design of virtual team tasks affects team processes, states, and effectiveness as well as how those emergent task-related processes and outcomes affect each other. We therefore believe the role of tasks, and their relationships to interpersonal and IT-related factors within virtual teams, remains an important and understudied domain for virtual teams research.

**Contributions and Future Research**

In this review and synthesis of existing research on virtual teams, we combine Hackman’s (1987) model of the antecedents of team effectiveness with Marks et al.’s (2001) Input-Mediator-Output-Input model to provide a framework for assessing the current state of knowledge with respect to virtual team effectiveness. Not surprising, given the recency of the frameworks we draw upon, we are not aware of
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existing examinations of research in the larger teams literature that draws on this approach. Given the clear trends evidenced by this approach, highlighting theoretical and methodological gaps as well as suggestions for future research, we believe this approach may prove beneficial in other domains as well. In particular, we believe the approach used in this review can be used as a template or starting point for a much larger review of research on traditional teams.

This work has specific contributions to research and practice. First, as noted, for scholars, the paper provides an integrative framework designed to highlight key differences among constructs and capture their relationships. It thereby allows us to identify the key elements of virtual team effectiveness and understand how they relate to design, processes, and states as well as to components of virtual teams (task, interpersonal, IT). Our framework allows us examine the complex nomological network connecting these disparate factors and to more accurately situate and integrate extant virtual teams research. Second, beyond improving understanding of our extant knowledge, this framework helps us recognize and identify key gaps in our understanding, and thus serves as a roadmap for future research opportunities. Third, the recognition of theoretical and methodological similarities within, and differences across, categories further helps us to better design (both theoretically and methodologically) future studies. Fourth, and more generally, this work highlights the importance of recognizing interconnections among constructs and helps reinforce the prevalence and importance of mediation and moderation roles of emergent team processes and states. It further helps explain the differences between, and the interrelationships among different types of virtual team effectiveness.

This paper has three implications for practice. First, by differentiating among effectiveness outcomes and highlighting the unique antecedents of each, this framework opens the black box and allows managers of virtual teams to prioritize their actions and decisions in such a way as to focus on the outcomes that are most important to them. Second, our framework also provides managers with a model of virtual team effectiveness that can help them make sense of the complex interrelationships and interdependencies among design factors (some of which they might control) and factors arising over the life of the team (which they can influence with appropriate actions).
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For example, our review shows how the initial design and set up of virtual teams can trigger the emergence of particular processes and states, which in turn affect effectiveness. Managers need to consider the implications of design decisions not only immediately (such as higher-quality output produced by expert teams), but also as they continue to affect subsequent emergent dynamics (such as the negative effects of structural diversity on communication quality, shared mental models, and a positive interpersonal climate – all of which in turn affect quality). Our model also reinforces the importance of managers recognizing the interconnections among their efforts to manage ongoing team dynamics throughout teams’ lifecycles (such as the negative effects of increased reliance of mediated communication on communication quality) and the potential to use these dynamics to offset one another (such establishing team-wide shared mental models in an effort to reduce those negative effects).

Third, our framework identifies certain factors as having more wide-ranging effects than others, suggesting they might be the most effective managerial levers. These include structural diversity, with its negative effects on climate, communication quality, and shared mental models; communication quality, with its effects on climate and shared team mental models; shared mental models, with their effects on communication quality and effective coordination; and mediated communication with its effects on communication quality and climate. Efforts to mitigate the negative - and enhance the positive – effects of these factors are likely to have further-reaching ripple effects than will efforts to address other factors.

**Future Research**

Despite having accumulated a large body of knowledge on virtual team effectiveness over the past twenty years, we are far from having exhausted all the interesting questions. There are a number of broad questions and macro-level topics that are likely to yield important insights.

**Dimensions of effectiveness:** We find that research has been unbalanced across these dimensions of effectiveness (productivity, viability, and member development), being heavily weighted toward one dimension of productivity (output quality). There have been comparatively few studies of other aspects of productivity such as creativity and innovation or production efficiency, which suggests the need for further research on other measures of team productivity. In addition, there is limited research on team
virtual teams. More research is needed on this topic. For instance, interpersonal states like conflict or cohesion are likely to affect team viability through the creation of mutual antagonism or bonding respectively. Also, more research is needed to study whether increased reliance on mediating technologies creates persistent tensions, thereby inhibiting members’ ability to work together in the future.

On member development, one key understudied area involves the links between interpersonal, task, or IT-related factors and individual learning within virtual teams. More research is needed to determine whether members of virtual team learn as do those in collocated teams; what forms of learning occurs (incidental versus intentional learning); and how learning is distributed among members. Beyond individual learning, future work might also examine the ability of the virtual teams to fulfill other personal needs like those for safety, control, relatedness, autonomy, and affiliation. There is also a need for research on the impacts of IT (either emergent processes or states) on member development outcomes (e.g., how IT affects social processes and individual achievement of personal needs).

Although obviously related, there have been no studies explicitly examining the relationships and tradeoffs within and between different dimensions of virtual team effectiveness. It is, however, easy to see how teams may sacrifice high productivity for individual growth or team viability. A better understanding of these relationships would allow us to better predict ultimate effectiveness, as a combination of multiple dimensions. Taken together, this suggests a need for further research on as yet understudied dimensions of effectiveness as well as the relationships within and between effectiveness dimensions. More research is therefore needed to further unpack these effectiveness dimensions.

**Role of IT:** While extensively studied, the relationship between IT and effectiveness in virtual teams remains unclear. Though scholars have studied the effects of mediated communication and media richness on effectiveness (e.g. output quality, satisfaction, innovation) and of other IT-related factors on a wide range of emergent processes and states (status, task-related information exchange, interpersonal communication), findings are in general inconclusive and sometimes contradictory.
To make sense of inconsistent findings, we looked at how authors operationalized the IT artifact across studies and found that in general, the IT artifact has been conceptualized broadly by dichotomizing usage (i.e., usage of IT in virtual teams vs. no use of IT in face-to-face teams). For instance, 19 out of 20 findings about the effect of computer mediated communications on output quality have been obtained through comparisons between face-to-face teams (no use of IT) and computer-mediated dispersed teams. Similarly, all 19 studies focusing on the effect of computer mediated communication on satisfaction used such a dichotomous approach. Adopting more precise and detailed conceptualizations of the IT artifact might lead to a better understanding of the effect of IT on virtual team effectiveness. For example, Jarvenpaa et al. (2005) assessed the IT artifact by measuring the number of emails exchanged between members of virtual teams over the course of their project, thus conceptualizing continuously rather than dichotomously as use vs. non-use. Interestingly, both studies found clear effects of IT on the effectiveness of virtual teams. Better conceptualizations of the IT artifact is needed and might provide important insights into how IT affects virtual team processes, states, and effectiveness.

**Exploring structural diversity:** Our analysis highlights the effects of structural diversity on virtual team effectiveness. By pooling evidence from across studies, the review suggests that structural diversity is detrimental for the effectiveness of virtual teams because of its negative effects on communication quality, the development of positive interpersonal climate, and the establishment of shared team mental models. However, Johns (2006) suggests that structural elements that shape the overall context in which work is performed are likely to present both situational constraints and opportunities for organizational members. In the context of virtual teams, this means that the context shaped by structurally-diverse virtual teams would not only raise collaboration constraints, but are also likely to present some opportunities. To date, however, we have minimal research on the potential benefits of structural diversity in virtual teams, either directly or indirectly. One rare exception can be found in the work of Haas (2006), who found that structurally-diverse teams in which a balance exists between cosmopolitans and local members have higher quality output because these members provide different types and quantities of applicable knowledge to the team. Again, this finding remains fairly
isolated from the wider body of empirical evidence on the effects of structural diversity, which leads us to suggest more research on the potential opportunities raised by structural diversity within virtual teams.

**Approaches to conducting research on virtual team effectiveness:** There are notable gaps in our approaches to studying virtual teams that we believe can and should be addressed in future research. Though it is not surprising that the majority of studies have focused on team as opposed to individual, subgroup, or organizational factors when assessing virtual team effectiveness, the relative lack of organizational and subgroup level analyses suggests a need for future research at these levels. Organizational level factors like culture, structure, and infrastructure (as well as higher level factors like industry) are the context within which virtual teams function and as such they might have important influence. At the same time, understanding the effect of virtual teams on organizational outcomes is equally important as it will allow us to better assess the cost-benefit tradeoffs inherent in the use of virtual teams. Similarly, more research is needed on the role of subgroups in determining virtual team effectiveness and their interaction with other virtual team dynamics. Recent research indicates that subgroups have wide-reaching effects (e.g. O'Leary and Mortensen 2010). Strong subgroups also raise the possibility of team members focusing primarily at the level of the subgroup over that of the team, raising larger questions about the validity of the overall virtual team as a construct in certain situations. Given the powerful effects of organizational and subgroup-level factors on team dynamics, more research is needed.

Bringing these together, along with extant research at the level of the team and individual, we need more cross- and multi-level research in order to better understand how factors at the individual, subgroup, team, and organizational levels interact and either reinforce or counteract one another. Individual member traits and actions have obvious repercussions on team dynamics and team-level factors, be they designed or emergent, interpersonal, task, or IT-related, will likewise affect outcomes for both the organizations in which they are embedded and the individuals they contain. Thus, research is needed to further understand the relationships between these factors at different levels.

Also, our emphasis on cross-sectional studies and variance analyses has two key consequences. First, in cross-sectional field studies, and variance analyses, causality is impossible to empirically...
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validate. This poses a significant impediment to correctly mapping how the constructs and processes interrelate. Second, the lack of longitudinal analyses makes it difficult to assess the evolution of team dynamics over time and the study of team process factors. The frameworks of both Marks et al. (2001) and Ilgen et al. (2005) highlight the importance of recursive feedback loops that necessitate understanding how dynamics unfold and interrelate over time. Thus, we consider these important shortfalls in our existing knowledge and strongly suggest a need for more longitudinal and process-oriented studies in order to definitively identify causal structures and evolving dynamics (Markus and Robey 1988).

CONCLUSION

In this paper, we present an integrative framework through which to approach and understand virtual teams. We use this framework to synthesize the extant literature and identify key domains for future research. By taking a differentiated approach to effectiveness, we provide scholars and practitioners with a means of disentangling what are otherwise often confusing and seemingly contradictory findings. By clarifying the roles of design factors as well as emergent processes and states, we help scholars and managers understand the importance of, and distinctions between, initial team configuration decisions and the continuing management of on-going dynamics. At the same time, through this analysis, we have expanded our theoretical understanding of distributed teamwork, complementing prior frameworks of virtual team effectiveness (Martins et al. 2004; Maznevski and Chudoba 2000; Powell et al. 2004) and highlighting understudied areas that warrant more research.

As is often the case as domains of scholarship mature, over the past twenty years, we have rapidly accumulated a large body of knowledge on virtual team dynamics and effectiveness. This increasingly complex body of knowledge has remained largely unstructured, making it hard for scholars and practitioners to grasp. As a result, it is becoming increasingly difficult to effectively use or build upon that knowledge. By providing an integrative framework for understanding virtual team dynamics and effectiveness, we to provide academics and managers with the tools required to do so.
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REFERENCES


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Johns, G. 2006. The Essential Impact of Context on Organizational Behavior. Acad. of Management Rev. 31(2) 386-408.


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### Table 1. Article counts by journal

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7 One study used both employees and students

8 The numbers in this table represent the frequency at which a given factor has been analyzed in the studies surveyed. A single study can address multiple factors and categories are not necessarily mutually exclusive.
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**Figure 1. Virtual Team Effectiveness Framework**

VIRTUAL TEAM DESIGN

- **Interpersonal factors** (e.g. expertise, diversity, geographical dispersion...)
- **IT factors** (e.g. media richness, available technologies...)
- **Task factors** (e.g. interdependencies, coordination structure...)

INTERPERSONAL PROCESSES

- **Interpersonal Processes** (e.g. sensemaking, communication quality...)

IT PROCESSES

- **IT Processes** (e.g. mediated communication, patterns of IT use...)

EMERGENT PROCESSES

- **Task Processes** (e.g. effective coordination, structured processes...)

VIRTUAL TEAM EFFECTIVENESS

- **Productivity** (e.g. quality/quantity of output...)
- **Viability** (e.g. ability to work together in future...)
- **Personal development** (e.g. learning...)

INTERPERSONAL STATES

- **Interpersonal States** (e.g. shared mental models, positive interpers. climate...)

IT STATES

- **IT States** (e.g. shared context of IT use, IT awareness, IT literacy...)

EMERGENT STATES

- **Task States** (e.g. shared task understanding...)

State formation/maintenance/transformation

Process routinization/optimization/structuration
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Figure 2. Map of Antecedents of Virtual Team Effectiveness
## Appendix 1: List of Studies

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Virtual Teams Demystified: An integrative framework

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Key:
- Natural setting: N
- Experiment: E
- Surveys: S
- Interviews: I
- Observations: O
- Communication logs (content and/or frequency): L
- Objective evaluations (grades, amount of time, lines of codes): E
- Case analyses: C
- Documentation: D
- Individual analyses: I
- Dyad analyses: D
- Team analyses: T
- Organization analyses: O
- Multilevel analyses: M
- Employees: E
- Students: S
- Unspecified: U
- Process: P
- Variance: V