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SHARING LEADERSHIP AND TEAM PROCESS IN VIRTUAL TEAMS

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ABSTRACT

This study examined the idea that virtual team leaders may be able to reduce their repertoire of behaviors by focusing on those behaviors that allow them to create the most impact and distributing the remaining leadership roles to their teams. This research investigated the impact of both leadership roles from Quinn's (1988) model of leadership and team processes from Marks, Mathieu, and Zaccaro's (2001) taxonomy of team behavior on team emergent states (i.e., empowerment, psychological safety, potency, and shared understanding) and effectiveness. Specifically, it examined whether external leadership roles (i.e., innovator, broker, director, and producer) have a stronger positive impact on team processes and outcomes than internal leadership roles (i.e., monitor, coordinator, mentor, and facilitator) and whether action processes and interpersonal processes account for more variance than internal leadership in emergent states and team effectiveness.

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Team Process as a Substitute for Leadership in Virtual Teams

Virtual teams have become so common that more than half of all professional workers in almost all industries work in virtual teams (Wakefield, Leidner, & Garrison, 2008). The growth of virtual teams may be attributed to the potential benefits they provide to rapidly expanding organizations that must collaborate across organizational, geographic, and temporal boundaries in order to remain competitive (Kahai, Huang, & Jestice, 2012). In this context, virtual teams can help reduce travel, save time, overcome coordination difficulties, and reduce the cost of replicating functions or working collaboratively across geographic and temporal boundaries (Martins, Gilson & Maynard, 2004). However, because members of virtual teams primarily communicate via communication technologies such as email, chat, and telephone, members of these teams are likely to encounter difficulties resulting from their limited ability to share social cues and contextual information from their environment. Furthermore, leaders of virtual teams may encounter challenges exerting influence and building trust if they are geographically separated from members of their virtual teams and, to compensate, team members may have to take on more responsibility for leadership (Zigurs, 2003). This suggests that leadership may become distributed in virtual teams with leadership roles shared amongst the formal team leader and different members of the team (Zigurs, 2003). However, in situations where roles and responsibilities are not clearly understood or defined, the activities of virtual team members may overpower the efforts of a formal virtual team leader and potentially limit the effectiveness of leadership behaviors within a virtual team.

To help understand what virtual team leaders can do to make virtual teams more effective, it is also useful to understand what virtual team leaders do not need to do. A review of the current literature suggests that most studies of virtual team leadership tend to ignore the role of virtual team members and what they can do to enhance the efficiency and effectiveness of virtual team functioning. However, studies specifically focusing on the behaviors of virtual teams, and not virtual team leadership, provide evidence for the role of virtual team members in enhancing team effectiveness by performing activities that could duplicate or even overpower formal leadership (Bell & Kozlowski, 2002). There is even some evidence suggesting that team process can be more important than leadership in virtual teams (Lurey & Raisinghani, 2001). Specific examples where team member actions could overpower leadership include functions relevant to monitoring and development (Bell & Kozlowski, 2002; Hovarth & Tobin, 2001), daily strategy formation and planning (Suchan & Hayzak, 2001), conflict management (Montoya-Weiss, Massey & Song, 2001), and the ability of team members to contribute to the development of trust, identity, and cohesion (Timmerman & Scott, 2006).

To improve understanding of leader roles in virtual team environments, the purpose of this study was to identify the roles that virtual team leaders play and the roles that virtual team members play in influencing emergent states and team effectiveness. Understanding how leadership roles impact virtual team effectiveness and where team processes may overpower leadership efforts may help leaders limit their repertoire of role requirements when working with virtual teams, while simultaneously resulting in improved team effectiveness.

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Quinn's (1988) competing values framework and Marks et al.'s (2001) taxonomy of team processes provide the conceptual frameworks to compare the behaviors of virtual team leaders and virtual team members. Quinn's competing values framework of managerial leadership (1988) captures a number of suggested actions that virtual team leaders might take to improve the effectiveness of virtual teams. Marks et al.'s (2001) taxonomy of team processes, although still in its earlier stages of validation, captures several of the processes discussed by researchers who are interested in learning about the team member actions that make virtual teams effective. Furthermore, both Quinn's framework and Marks et al.'s taxonomy are structured in a manner that allows them to be compared and provides the opportunity to examine where the actions of virtual team members may have more influence on team effectiveness than formal virtual team leadership.

The following sections provide an outline for the present study. In the first section I provide an overview of virtual teams and the characteristics that differentiate them from face-to-face teams. In the next section I describe the state of virtual team leadership and how characteristics of virtual teams can impact how leadership is understood and might manifest differently in the virtual team environment. This is followed by a discussion of Quinn's (1988) competing values framework, Marks et al.'s (2001) taxonomy of team processes, and a discussion of the emergent states and team effectiveness outcomes included in this study. Finally, an Input- Mediator-Outcome (IMO) model (Ilgen, Hollenbeck, Johnson, & Jundt, 2005) of virtual team effectiveness based on Marks et al. (2001) is presented and tested.

Virtual Teams

Virtual teams by definition are "groups of geographically and/ or organizationally dispersed coworkers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task." (Townsend, DeMarie, & Hendrickson, 1998, p.17). These teams are often disbursed across temporal boundaries and have the option to work both synchronously and asynchronously via technologies such as email or instant messaging. They may have fluid memberships and shorter lifecycles relative to face-to-face teams. And, whereas early definitions contrasted virtual teams to face-to-face teams, more recent definitions suggest that virtual teams may include some face-to-face interaction, although the extent of this interaction is not yet clear (Martins et al., 2004). Virtual teams provide the added benefit of affording organizations with the ability to source experts from remote locations (Bhappu, Zellmer-Bruhn, & Anand, 2001). In many cases these experts are professionals with previous experience working in virtual teams and already have the technical knowledge and abilities to make the team effective (Bell & Kozlowski, 2002). With sufficient direction, these team members are also able to monitor their own performance and gather their own feedback.

Virtual teams can come together and get reassigned relatively rapidly. This means that members must be selected appropriately, and that member roles, tasks, and processes should be clarified and communicated efficiently for these teams to be effective (Zigurs, 2003). However, carrying out these activities can be become challenging because members of virtual teams are often disbursed from one another and communicate via information technologies (e.g., email, chat, telephone, and video conferencing), which

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can make it more likely that they will encounter communication difficulties that do not exist in face-to-face teams. For example, socio-emotional cues reflected in voice inflections, gestures, facial expressions, and verbal cues are lost, as well as other cues related to the social context, which may reflect social or expert status. The constraints on sharing contextual information may make it difficult to exert influence, clarify roles and expectations, and build trust as a result (Kayworth & Leidner, 2002).

Other impacts of interacting via communication media may include information overload. The asynchronous communication environment that virtual teams operate in can lead to multiple threads of information being shared in a non-linear fashion, making it difficult to identify how individual messages fit into the broader communication context. Managing the volume of messages from multiple senders and acting on them can also add to the information load. In global and cross-cultural virtual teams these communication issues can become even more complex because of language and cultural differences, time differences, and differences in the quality of technological infrastructure. The technological proficiency of individual users can also impact communication patterns in virtual teams (Kayworth & Leidner, 2002).

Formal leaders of virtual teams are likely to be less present and have less access to the daily activities of their team members because virtual team members are often dispersed across geographies and time zones and use information technology to communicate. As a result, some leadership roles may need to be transferred to members of the virtual team (Bell & Kozlowski, 2002), leaving leaders and virtual team members to take on role profiles that are broader or more specialized than in face-to-face teams. For example, because of the difficulties conveying contextual information, virtual team

leaders may be required to spend more time clarifying goals, roles, and team norms to ensure a common contextual understanding. Additionally, differing communication patterns across cultures and contextual differences, such as the capabilities of communication media, may mean that virtual team members will need to take on a facilitator type role to ensure contributions from their team members and to help resolve disagreements while accounting for local constraints. Members of virtual teams may also need to take on additional roles, such as coordinating logistics to manage different time zones, and to ensure that information is conveyed in a manner that does not impede workflows. Even though, as others have suggested (Kayworth & Liedner, 2002), more complex and diversified roles are required in virtual teams, only some of these roles would be the domain of the leader, whereas responsibility for other roles may go to members of the virtual team.

Taking this one step further, virtual team members are often experts who are disbursed from their leaders and have high levels of responsibility, flexibility, motivation, and empowerment. As such, they also tend to require high levels of trust, cooperation, and self-management skills (Hertel, Greester, & Konradt, 2005), which are characteristics similar to those of self-managed teams. However, virtual team members are just as likely to be working remotely from one another, as they are to be working remotely from a formal leader. Furthermore, virtual teams, unlike self-managed teams, are not likely to exist as permanent teams within the organization (Yang & Shao, 1996). As a result, virtual teams will frequently need to establish clarity and take on roles in short time frames and not have the same opportunity that self-managed teams have to grow and refine their role profiles overtime. Thus, in virtual teams the responsibility to set

direction and ensure performance will likely fall on the team leader because of the limited time available for team members to discuss and come to agreement on roles, responsibilities, and the team's direction, while operational activities will become the domain of team members (Carte, Chidambaram, & Becker, 2006).

Leadership in Virtual Teams

Given the value that virtual teams can provide to organizations when performing at their level of potential, it is interesting that research on virtual team leadership is still relatively new. The majority of work on virtual team leadership remains conceptual. Very few studies have been conducted and the majority of these studies are laboratory based with students as participants (Balthazard, Waldman, & Warren, 2009; Chen, Wu, Ma, & Knight, 2011; Kahai, Fjermestad, Zhang, & Avolio, 2007; Horvath & Tobin, 2001). The researchers conducting the studies have investigated the relationship between leadership and team effectiveness in varied controlled circumstances, such as the presence or absence of a leader, the anonymity versus identifiability of team members, or different technological contexts such as email, audio-conferencing, and group support systems (Hertel et al., 2005; Kahai et al., 2007; Kahai et al., 2012). However, very few studies have investigated e-leadership in the field (c.f. Al-Ani, Horspool, & Bligh, 2011; Allen, 2005; Horvath & Tobin, 2001; Konradt & Hoch, 2007; Lawrence, Lenk, & Quinn, 2009; Wakefield et al., 2008).

Rather than focusing on the role of leaders in virtual teams, most of the articles investigating e-leadership in the field focus more generally on the attributes leaders possess, the tasks they need to accomplish, and the outcomes they need to achieve to be perceived as effective and to help team members interact effectively to reach their highest

potential (Avolio & Kahai, 2003; Hertel et al. 2005; Kayworth & Leidner, 2002; Zaccaro & Bader, 2003; Zigurs, 2003). An exception to this has been Al-Ani et al. (2011) who interviewed sixteen employees from a Fortune 500 corporation, who had or were currently working in a virtual team, to identify important aspects of the virtual team leader's role. Their qualitative research identified the importance of goals, planning, being a project champion, strong communication, and project management skills. More recently, some research on virtual team leadership (cf., Chen et al., 2011) has started to incorporate theory from the behavioral complexity approach (Denison, Hooijberg, & Quinn, 1995), self-leadership (Manz, 1986), and shared leadership (Pearce & Conger, 2003). This study borrows from each of these approaches and primarily focuses on shared leadership to determine if virtual team effectiveness results primarily from vertical leadership roles, shared team process behaviors, or a combination of the two.

Many commonly referenced examples of leadership, such as transactional or transformational leadership (Burns, 1978), initiating structure or consideration, directive or participative, and task-oriented or relationship-oriented (Denison et al., 1995), suggest that leaders can be classified as tending towards one leadership style or behavior over another. However, behavior complexity theory describes effective leaders in terms of their ability to recognize multiple and contradictory dynamics within an organizational unit and to respond with multiple and potentially contradictory roles (Denison et al., 1995). This situational need to address contradictions in values, roles, and needs can sometimes be balanced by the roles and attributes of others when leadership is shared (Yukl & Van Fleet, 1992). Individuals working in virtual teams may engage in self-leadership by integrating leadership roles or integrating team process related activities to

manage their own behaviors as well. Thus, virtual team members may share a number of

activities through self-leadership and shared leadership to complement formal leadership

and may even overpower some formal leadership roles.

Manz (1986) describes a view of self-leadership suggesting that individuals can

lead themselves to perform naturally motivating tasks or manage themselves to perform

tasks with lower levels of intrinsic motivation. Furthermore, there are strategies that can

be put in place to support individual self-control. Some of these include being able to

choose or impact the physical work context so that it enhances performance by

communicating norms and values that can enhance the psychological work context,

altering the task so that it becomes more intrinsically rewarding, and creating a strong

vision so that employees can have flexibility in achieving work outcomes. Virtual team

leaders can help to create these circumstances by communicating a strong vision and

establishing clear norms and values during the early days of team formation. With some

creativity virtual team leaders can also take advantage of the virtual environment to allow

team members to impact their physical work environment and address issues related to

their physical work context. Follow-up research from Manz and Sims (1987) supports

this view of leadership, suggesting that there are roles that leaders can engage in that will

help team members lead themselves. Specifically, leader behaviors that can help team

members set their own goals, and evaluate and reward their own performance, such as

clarifying expectations for performance and communicating and encouraging progress

towards task completion, were seen as helpful. Although these results do provide some

support for how leaders may work with remote teams, this research was not conducted in

the virtual team environment. The current study further investigates how leader roles might support virtual team functioning without conflicting with team process behaviors.

Shared leadership has also been presented as a theoretical perspective relevant to virtual teams. According to Pearce and Conger (2003), shared leadership is, "a dynamic, interactive influence process among individuals in groups for which the objective is to lead one another to the achievement of group or organizational goals or both. This influence process often involves peer, or lateral, influence and at other times involves upward or downward hierarchical influence" (p. 1). In the case of virtual teams, where formal leaders may not be as available to team members as their peers, some roles and responsibilities for leadership may be shared or rotated amongst team members (Pearce, Conger, & Locke, 2008; Zigurs, 2003). As team member influence moves both laterally and vertically throughout the virtual team to achieve outcomes, the leadership that is shared amongst team members may account for variance over and above that accounted for by the behaviors of the formal vertical team leader (Ensley, Hmeileski, & Pearce, 2006).

Leaders can support self-leadership and shared leadership in virtual teams by creating formalization through a strong vision, plans and goals; creating a motivational context by develop cohesion amongst team members; and creating opportunities for team members to receive feedback from their task. Having these conditions in place increases the likelihood that team members will be able lead themselves and share roles with their team members to create opportunities where team members take on roles that may have more influence on team outcomes than formal leadership.

Team Process and Emergent States

Models of teamwork tend to be based on the input-process-output (IPO) framework developed by McGrath (1964); however, this method tends to limit the focus of teams' research to process-oriented variables (Ilgen et al., 2005). The IPO framework (McGrath, 1964), according to Ilgen et al. (2005), should be expanded to include a greater variety of mediator variables, such as emergent states like cohesion (Marks et al., 2001), that focus on more than just team processes. Emergent states are qualities that represent team member attitudes, values, cognitions, and motivations and are defined as, "constructs … that are typically dynamic in nature and vary as a function of team context, inputs, processes, and outcomes" (Marks et al. 2001). Emergent states include such constructs as trust (Avolio, Kahai, Dumdum, & Sivasubramaniam, 2001; Hoyt & Blascovich, 2003), shared understanding (Avolio et al. 2001), and group identity or cohesion (George & Sleeth, 2000; Zaccaro & Bader, 2003), which tend to be associated with the most successful virtual teams. In contrast, team processes are, "members' interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward taskwork to achieve collective goals," (Marks et al., 2001). Team processes require some form of interaction like those that take place when planning, coordinating, and managing conflict to achieve task outcomes.

In the virtual team environment, the differentiation between emergent states and team process may be especially important to virtual team leaders who may affect emergent states directly or indirectly via empowerment and team processes. Team leader behaviors can also create a sense of empowerment amongst team members, which can subsequently enhance the likelihood that team members will engage in team processes

that can positively impact emergent states (Kirkman & Rosen, 2000). If leaders

understand how and where to direct their energy, they may be able to better focus their

efforts and enhance their impact on team effectiveness. Interestingly, in the scholarly

literature on virtual teams there are only a handful of (generally untested) models, which

depict the relationship between virtual team inputs, processes, and outcomes (Avolio,

Kahai & Dodge, 2000; Martin et al., 2004; Powell, Piccoli & Ives, 2004). Kahai et al.

(2012) are an exception and have tested a model, which looks at leadership style and

communication medium as inputs; feedback positivity as process; and member

experience, capability (including the emergent states of cohesion, consensus, and

efficacy), and production as outcomes. Their findings suggest that transformational

leadership is more effective at encouraging feedback positivity in media with lower social

presence, such as chat, and that feedback positivity enhances team outcomes such as

group efficacy and cohesion. This study will add to the literature that has incorporated an

Input-Mediator-Outcome (IMO) model, where mediators include emergent states and

team processes, as shown in Figure 1.
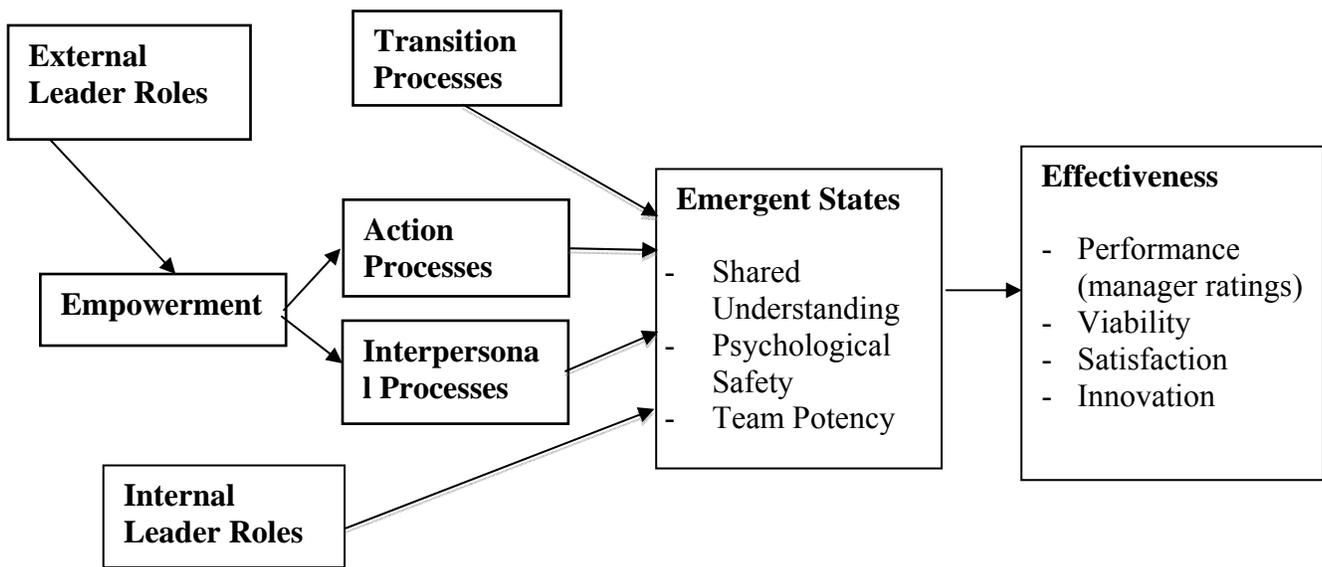
Figure 1: Hypothesized Model of Leadership Impact in Virtual Teams

In the next sections I review leadership roles, team processes, and the impacts of

leader and team behaviors on emergent states and team effectiveness in the virtual team

environment. Finally, I describe a partially mediated model of virtual team leadership

that will be tested against the fully mediated model of virtual team leadership shown in

Figure 1 to help improve understanding of the relationships between leadership roles,

team processes, emergent states, and team outcomes.

The leadership roles to be studied come from Quinn's framework of managerial

leadership (1988) and are categorized according to four models of performance: the open

systems, rational goal, internal process, and human relations model (Ostroff & Schmitt,

1993). The open systems model (Yuchtman & Seashore, 1967) places a priority on

remaining flexible to facilitate adaptation to the organization's external environment. The

rational goal model (Etzioni, 1961) emphasizes setting and pursuing goals to attain

efficiency and effectiveness. The internal process model (Likert, 1967) prioritizes communication to maintain internal control and stability. Finally, the human relations model (Keeley, 1978) emphasizes internal focus and the importance of morale, cohesion, and the development of team members to improve satisfaction.

Within Quinn's framework, these four models are arranged along two axes. The vertical axis represents stability on the lower end and flexibility toward the top of the axis. The horizontal axis represents internal focus on the left versus external focus on the right. Each model is also associated with two leadership roles. The external leadership roles are captured on the right hand side of the Quinn's framework. In the upper right hand quadrant is the open systems model, which is associated with broker and innovator roles. In the lower right quadrant are director and producer roles, which are associated with the rational goal model. Internal leadership roles are captured on the left hand side of the framework. Coordinator and monitor roles are found in the bottom left hand quadrant and are associated with the internal process model. Finally, in the top left quadrant is the human relations model, which is associated with mentor and facilitator roles. Each of the models and their related roles are described in greater detail in the section describing Quinn's framework of managerial leadership.

Team processes based on Marks et al.'s (2001) taxonomy are organized into transition processes, action processes, and interpersonal processes. The processes categorized under transition processes include mission analysis, goal specification, and strategy formulation and planning. Under the action phase are monitoring progress towards goals, resources and systems monitoring, team monitoring and backup, and coordination. Interpersonal processes include conflict management, motivating and

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confidence building, and affect management. These processes are described in greater

detail in the section on team process behaviors.

The emergent states to be measured in this study include empowerment,

psychological safety, team potency, and shared understanding. Finally, team

effectiveness is measured in terms of the performance, innovation, and the quality of

team interaction (Salas, Sims, & Burke, 2005). Because teams that have more effective

team interactions are likely to have more satisfied members who see the team as viable

for future projects, quality of team interaction will be captured by measures of viability

and satisfaction.

Quinn's Model of Leadership Roles

Although little research has utilized Quinn's competing values framework to test

leadership in the virtual environment (Konradt & Hoch, 2007; Wakefield et al., 2008),

many of the findings and suggestions for effective e-leadership summarized in existing

articles, reviews, and case studies (e.g., Bell & Kozlowski, 2002; Hertel, et al., 2005;

Kahai et al., 2007; Malhotra, Majchrzak & Rosen, 2007; Zaccaro & Bader, 2003) tend to

map closely onto Quinn's role-based model of leadership (see Table 1).

A key premise underlying Quinn's model (1988) is that leaders need to develop a

complex and dynamic theory of behavior that requires continuous change and the ability

to balance oppositional or competing values. The best leaders, "master managers"

according to Quinn, are able to balance the tensions between internal process and external

factors, as well as the tensions between flexibility and control within organization.

Quinn's model is specifically developed to avoid either/ or models of understanding

managerial leadership. And, according to Quinn, at some point in the life of any given

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organization, every dimension of the competing values framework is equally important as any other dimension in the competing values framework. As such, each managerial leadership role is measured independently of every other managerial leadership role and scores on each role can be used to create an overall profile of managerial leadership, with some profiles associated with higher levels of effectiveness than others.

Table 1: Mapping of existing research to Quinn's role based model of leadership

Quinn's Leadership Role	Similar behaviors from previous research	Representative Research Studies
Innovator: creative and envisions, encourages, and facilitates adaptation and change.	- Facilitates adaptive and appropriate changes in line with external conditions - Facilitates transfer of best practices via communities of practice	Kozlowski & Bell, 2001 Cordery, Soo, Kirkman, Rosen & Mathieu, 2009
Broker: acquires resources and maintains the unit's external legitimacy by developing, marketing to, negotiating with, and maintaining a network of external contacts.	- Acts as a team liaison - Manages external boundaries - Monitors changes in environmental conditions - Provides meaning about events in the environment - Demonstrates sensitivity to external stakeholders including project sponsors, executives, and customers - Spans boundaries to link team members to information and resources - Buffers from shocks that can disrupt work - Ensures access to company knowledge, technology, and external supports	Zaccaro & Bader, 2002 Rapp et al., 2010 Malhotra et al., 2007 Bell & Kozlowski, 2002 Rosen et al., 2006 Zivick, 2012
Director: conducts planning, and goals setting, clarifies roles and objectives, generates rules and policies, defines problems, selects alternatives, establishes clear expectations, and evaluates performance.	- Communicates a shared vision, mission statement, and objectives - Sets direction and mutual goals - Creates a shared purpose, identity, and understanding - Creates task interdependence - Clarifies goals, roles, norms, expectations, rules, and guidelines - Assigns tasks - Explicitly defines team culture - Structures processes and	Hertel et al., 2005 Kayworth & Leidner, 2002 Avolio & Kahai, 2003 Zaccaro & Bader, 2003 Rapp et al., 2010 Zigurs, 2003 Malhotra et al., 2007 George and Sleeth, 2000 Avolio et al., 2001 Bell & Kozlwoski, 2002 Kasper-Fuehere et al., 2001 Rosen et al., 2006 Thatcher & De la Coeur,

	develops standard operating procedures - Anticipates and solves problems, and creates back-up plans - Evaluates data to set a course of action and reach logical decisions - Enforces norms - Evaluates behavior - Provides focus	2003 Berry, 2011 Zivick, 2012 Zander, Zetting, & Makela, 2013
Producer: focuses on work and the task, encourages team members to accept responsibility, and seeks closure by motivating those behaviors that will lead to completions of the group's task.	- Enthusiastically conveys purpose and mission - Actively influences discussions, originates action, and acts on opportunities - Transformational - Encourages meeting team objectives by transcending self interest - Motivates and empowers employees to devote more energy to the task - Encourages task completion through communication and feedback - Provides motivational incentives to comply with routines - Demonstrates achievement orientation - Increases team commitment and participation - Builds confidence in collective ability	Hertel et al., 2005 Kayworth & Leidner, 2002 Zaccaro & Bader, 2002 Zigurs, 2003 Kahai et al., 2007 Malhotra et al., 2007 George and Sleeth, 2000 Avolio et al., 2001 Bell & Kozlowski, 2002 Tatcher & De la Cour, 2003 Al-Ani et al., 2011

Coordinator: maintains structure by scheduling, coordinating plans and proposals, problem solving, minimizing disruptions, reviewing, evaluating reports, and writing budgets.	- Coordinates - Elaborates - Structures processes - Structures meetings with electronic discussion threads, summaries, time allocations, and progress updates	Zaccaro & Bader, 2002 Zigurs, 2003 Malhotra et al., 2007 Al-Ani et al., 2011
Monitor: provides a sense of continuity and stability by collecting and distributing information, checking on performance to ensure that rules and standards are met, and to see if a unit is meeting production quotas by conducting technical analysis, dealing with routine information, and partaking in logical problem solving.	- Monitor systems, the team, information about task progress, and actions - Monitor the environment and informs members of changes - Shares performance feedback - Checks for procedures, keeps agendas, records, and provides feedback - Demonstrates instrumental leadership	Hertel et al., 2005 Zaccaro & Bader, 2002 Rapp et al., 2010 Zigurs, 2003 Kahai et al., 2007 Malhotra et al., 2007 Bell & Kozlowski, 2002 Rosen et al., 2006 Berry, 2011
Facilitator: encourages the expression of opinions and participation, seeks consensus, builds cohesion and morale, manages interpersonal conflict, and negotiates compromise.	- Facilitates - Encourages participation and input - Facilitates communication - Establishes effective interaction dynamics - Has team members frequently share information about own tasks, decisions, progress and social information - Encourages supportive interactions to repair broken trust and build cohesion - Mediates - Ensures full utilization of unique knowledge. Especially with culturally diverse subteam pairs, asynchronous discussion threads, and	Hertel et al., 2005 Kayworth & Liedner, 2002 Zaccaro & Bader, 2002 Zigurs, 2003 Kahai, Sosik & Avolio, 2003 Tarmizi et al., 2007 Malhotra et al., 2007 Hart & McLeod, 2003 George & Sleeth, 2000 Avolio et al., 2001 Kozlowski & Bell, 2002 Thatcher and De la Couer, 2003 Al-Ani et al., 2011 Berry, 2011 Zander et al., 2013

	sharing of personal information - Facilitates consensus development and enacts a participative leadership style - Considers all input and encourages understanding - Appreciates the need to build effective relationships with other group members, a spirit of cooperation, and consensus	
Mentor: focuses on individual needs by actively listening, acting in a fair manner, conveying appreciation, supporting legitimate requests, and facilitating individual development.	- Mentors - Demonstrates empathy/ understanding - Identifies or develops members - Demonstrates individualized consideration - Coaches for appropriate technology usage - Identifies shared development opportunities - Demonstrates supportive leadership behaviors from path-goal theory - Focuses on individual needs - Recognizes and rewards contributions and goal achievement - Acknowledges and agrees to what others have to say and shows recognition for the needs of others - Motivates non-participative members and builds confidence	Kayworth & Leidner, 2002 Zaccaro & Bader, 2002 Zigurs, 2003 Kahai et al., 2007 Malhotra et al., 2007 Hart & McLeod, 2003 George & Sleeth, 2000 Avolio et al., 2001 Rosen et al., 2006 Thatcher & De la Cour, 2003 Cordery et al., 2009
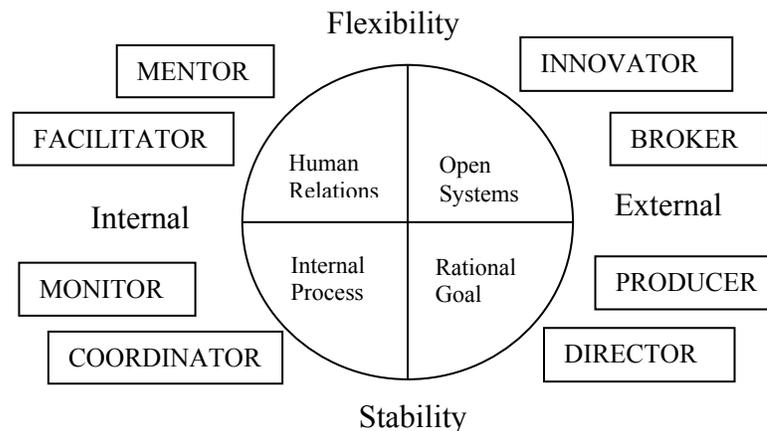
Figure 2: Quinn's Model of Leadership

Quinn's (1988) model is organized into a circumplex with two underlying dimensions: stability versus flexibility and internal versus external focus. These dimensions divide the circumplex into four quadrants with two of eight leadership roles in each quadrant (Denison et al., 1995; Quinn, 1988). Quadrants 1 and 2 on the right hand side of the model include external leadership behaviors and Quadrants 3 and 4 on the left hand side of the model include internal leadership behaviors.

Quadrant 1 is associated with the open system model (Yuchtman & Seashore, 1967), which emphasizes adapting to the organization's external environment and flexibility. It also emphasizes using readiness and flexibility to acquire external resources, garner support, and achieve growth. The leadership roles of innovator and broker are related to this quadrant. The *innovator* is creative and envisions, encourages, and facilitates adaptation and change. The *broker* acquires resources and maintains the unit's external legitimacy by developing, marketing to, negotiating with, and maintaining a network of external contacts.

Quadrant 2 is associated with the rational goal model (Etzioni, 1961). The

rational goal model emphasizes the pursuit of goals external to the group and control.

The rational goal model emphasizes goal setting and planning to achieve efficiency and

effectiveness, as well as the leader's role in clarifying these goals and encouraging their

attainment in the roles of director and producer respectively. The *director* conducts

planning and goal setting, clarifies roles and objectives, generates rules and policies,

defines problems, selects alternatives, establishes clear expectations, and evaluates

performance. The p*roducer* focuses on work and the task, encourages team members to

accept responsibility, and seeks closure by motivating those behaviors that will lead to

completion of the group's task (Denison et al., 1995; Quinn, 1988).

Quadrant 3 is associated with the internal process model (Likert, 1967) and

emphasizes internal control and stability by placing importance on communication to

maintain stability, control, and a sense of continuity. Quadrant 3 is associated with the

leadership roles of coordinator and monitor. The c*oordinator* maintains structure by

scheduling, coordinating plans and proposals, problem solving, minimizing disruptions,

reviewing and evaluating reports and writing budgets. The *monitor* provides a sense of

continuity and stability by collecting and distributing information, checking on

performance to ensure that rules and standards are met, conducting technical analyses to

see if a unit is meeting production quotas, dealing with routine information, and partaking

in logical problem solving (Denison et al., 1995; Quinn, 1988)

Quadrant 4 is linked to the human relations model (Keeley, 1978) and emphasizes

flexibility and internal focus, as well as cohesion and morale, to help develop team

members and improve satisfaction. This model is based on relationships, collaborative

decision making, and supportive leadership. Human interactions and process are

encouraged via the leadership roles of facilitator and mentor. The *facilitator* encourages

the expression of opinions and participation, seeks consensus, builds cohesion and

morale, manages interpersonal conflict, and negotiates compromise. The *mentor* focuses

on individual needs by actively listening, acting in a fair manner, conveying appreciation,

supporting legitimate requests, and facilitating individual development (Denison et al.,

1995; Quinn, 1988)

An example of e-leadership advice mapping onto Quinn's model comes from

Hertel et al.'s (2005) review of virtual team management research. They present five

general principles for managers of virtual teams that map onto Quinn's model: a)

clarifying team goals and team roles [director]; b) implementing efficient communication

and collaboration processes [coordinator, monitor]; c) supporting team awareness through

informal communication, sharing of socio-emotional cues, and providing feedback

regarding individual performance and working situations [mentor, facilitator]; d) creating

a sense of interdependence within the team [director, producer, coordinator]; and e)

preparing workshops and training to address team specific challenges [mentor,

facilitator]. As can be seen in this example, some leadership objectives map onto a single

leadership role, whereas others result from a combination of leadership roles. For

example, creating a sense of interdependence would result from developing shared goals

and objectives (director), working collectively towards meeting shared objectives

(producer), and structuring tasks in an interdependent manner (coordinator).   Other

authors (Avolio & Kahai, 2003) have referred to effective leadership functions in terms

of participatory behaviors, which are similar to the facilitator role, and inspirational functions, which are similar to the role of producer.

For purposes of this study the leadership roles outlined above were grouped into external leadership roles (i.e., broker, innovator, director, and producer) and internal leadership roles (i.e., monitor, coordinator, mentor, and facilitator). This helped to simplify comparisons with team transition processes that are similar to external leadership roles and with team action and interpersonal processes that are more similar to internal leadership roles. These team process behaviors described by Marks et al. (2001) are outlined in the next section and, where applicable, are compared to the leadership behaviors outlined by Quinn (1988).

Team Process Behaviors

As mentioned previously, the team process behaviors outlined by Marks et al. (2001) are categorized into the superordinate dimensions of transition processes, action processes, and interpersonal processes. Categorized underneath the three superordinate dimensions are the ten sub-processes. Mission analysis, goal specification, and strategy formulation are categorized under transition processes; monitoring progress towards goals, systems monitoring, team monitoring and backup behavior, and coordination are categorized under action processes; and conflict management, motivation and confidence building, and affect management are categorized under interpersonal processes.

Mission analysis involves the interpretation and evaluation of a team's mission, identification of main tasks, and an understanding of the environmental conditions and resources available for the execution of a mission (Marks et al., 2001). This process combines the director and broker leader behaviors, which involve planning, goal setting,

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and clarifying objectives in the director role and developing and scanning external contacts in the broker role.

Goal specification involves identifying and prioritizing goals and sub-goals needed to achieve desired outcomes (Marks et al., 2001). Goal specification occurs as part of the director role, which involves planning and goal setting.

The final process categorized under the dimension of transition processes is s*trategy formulation*. Strategy formulation involves developing alternative courses of action to achieve desired outcomes (Marks et al., 2001). This process will likely be similar to a combination of both the innovator role and the director role. The innovator role involves encouraging adaptation to change and defining alternative courses of action and the director role involves the planning process, clarification of objectives, and development of alternative courses of action.

The Action dimension includes monitoring progress toward goals, systems monitoring, team monitoring and backup, and coordination. *Monitoring progress towards goals* involves tracking task progress, taking in information to identify gaps toward goal accomplishment, and transmitting progress and possible impediments to team members (Marks et al., 2001). Monitoring progress towards goals is similar to the monitor role for leaders that involves collecting and distributing information, and checking on performance for progress towards goals and compliance with rules.

The second process, *systems monitoring*, involves tracking team resources, such as personnel, equipment, and other information within the team as well as environmental conditions relevant to the team by being alert to changing conditions within and external to the team that may affect timely accomplishment of goals (Marks et al., 2001). This

second process is similar to the leader roles of monitoring and brokering. The monitoring

component involves collecting information on internal team processes, whereas the

brokering component involves acquiring resources and scanning the external

environment.

Team monitoring and backup behavior is the process of assisting team members

to perform their tasks. This may involve verbal feedback or coaching, helping a

teammate carry out an action, fully assuming a task and completing it for a teammate, or

delegating it to another teammate (Marks et al., 2001). Team monitoring and backup

behaviors can involve a combination of facilitator and mentor roles from the leader. The

facilitator role involves building cohesion, encouraging participation and negotiating

compromise, whereas the mentor role involves listening to the needs of teammates,

supporting legitimate requests, and facilitating development.

Finally, the fourth process under the action dimension is *coordination*.

Coordination involves integrating and ordering the timing of integrated actions or tasks

(Marks et al., 2001). In the leadership role coordination is quite similar in that it refers to

structuring, scheduling, problem solving, and coordinating plans and proposals (Quinn,

1988).

The remaining dimension of task processes is the Interpersonal dimension.

Categorized under this heading are the processes of conflict management, motivation and

confidence building, and affect management. *Conflict management* can be preemptive or

reactive. Preemptive conflict management emphasizes creating conditions that may

prevent, control, or guide team conflict. Reactive conflict management involves

mediating disagreements with team members. Reactive conflict management is similar to

the leadership role of facilitation, which encourages the expression of opinions, seeking of consensus, and negotiation. Preemptive conflict management, on the other hand, may result from effective behaviors in the director role including setting clear goals, roles, and expectations and the coordinator role that involves the prioritization and scheduling of tasks and activities to support smooth execution.

Motivating and confidence building involves building confidence, motivation, and task based cohesion with respect to effective task completion (Marks et al., 2001). This process is similar to the leadership behaviors involved in the producer role which involves motivating those behaviors that lead to task completion, the mentor role which involves supporting and developing individuals, and the facilitator role which involves building cohesion and morale amongst team members.

Finally, *affect management* involves regulating the emotions of team members and managing such aspects of team functioning as social cohesion, frustration, and excitement. This process will most likely be similar to the leadership roles of facilitator and mentor, where the facilitator role is involved with seeking consensus and negotiating and the mentor role is involved with addressing individual needs and providing support.

The activities categorized under transition processes overlap with leader roles associated with the rational goal model (producer/ director) and open systems theory (innovator/ broker). These leadership roles help to build support and define alternative courses of action that will help to achieve *externally* defined goals. Action processes and interpersonal processes include activities that overlap with the leadership roles associated with the internal process model (coordinator/ monitor) and the human relations model

(mentor/ facilitator). These leadership roles emphasize smooth *internal* team process and relationships amongst team members.

Because the majority of activities represented by external leadership roles are associated with setting direction based on external sources of information, it is likely that virtual teams with leaders who perform external leadership roles will be more effective. Although transition processes are likely to serve a similar purpose, formal team leaders will likely have better access to information outside the team, thus allowing the formal team leaders to perform the role of acquiring resources and setting team direction more effectively.

Alternatively, in the virtual team environment, teams with virtual team members who demonstrate action processes and interpersonal processes are likely to be more effective than teams that rely on the formal team leader to manage internal team process. This is especially true in the virtual team environment where the formal team leader is less likely to have immediate access to the activities of their team members. Members of virtual teams will likely do a better job of performing action processes and interpersonal processes because they will have greater access to team members and have awareness of the day-to-day activities and conflicts impacting team effectiveness.

As can be seen by the above comparisons, there are significant opportunities where team processes will account for more variance in team outcomes than some leadership behaviors in virtual teams. This will be especially true when leaders are acting remotely from many of their virtual team members and will be less able to monitor and address issues associated with team interactions. From this we could expect that virtual team leaders will most likely need to take on external leadership roles (i.e., innovator,

broker, director, and producer). On the other hand, team process behaviors encompassed under action processes and interpersonal processes will likely account for more variance in team performance than internal leadership roles (i.e., coordinator, monitor, facilitator, mentor). Thus, the first intention of this study is to determine a) whether team processes in virtual teams can have a greater impact on team effectiveness than formal virtual team leadership; and b) what team processes in virtual teams have more impact on team performance than virtual team leadership. The four hypotheses that address this general question are listed below:

> H1: Virtual teams with virtual team leaders who emphasize external leadership roles (i.e., broker, innovator, director, & producer) will be more effective (i.e., receive higher overall ratings on viability, satisfaction, productivity, and innovation) than virtual teams with leaders who emphasize internal leadership roles.
>
> H2: External leadership roles will account for more variance in emergent states and team outcomes that team transition processes.
>
> H3: Action processes will account for more variance in emergent states and team outcomes than internal leadership roles (i.e., monitor, coordinator, mentor, and facilitator) in virtual teams.
>
> H4: Interpersonal processes will account for more variance in emergent states and team outcomes than internal leadership roles (i.e., monitor, coordinator, mentor, & facilitator) in virtual teams.

External Leader Roles and Empowerment

Research on leadership and empowerment suggests that leaders empower teams by increasing team members' sense of control, removing conditions that create a sense of powerlessness, and allowing team members the flexibility to handle circumstances that arise (Arnold, Arad, Rhoades, & Drasgow, 2000). Empowerment refers to, "team members' collective beliefs that they have the authority to control their proximal work environment and are responsible for their team's functioning" (Mathieu, Gilson, & Ruddy, 2006). Empowerment is important in the virtual team context because it has been shown to have greater impact on process improvement and customer satisfaction in instances of decreased face-to-face contact (Kirkman, Rosen, Tesluk & Gibson, 2004). Furthermore, because leaders have less face-to-face interaction with their team members, it may be important for leaders to empower their teams to manage control and coordination mechanisms and to manage internal conflicts via action processes and interpersonal processes. Where leaders are less involved in the day-to-day activities of their team members and are less able to work with them face-to-face, as with virtual teams, the key functions of leaders are likely to change so that they spend more time acquiring resources and creating an environment that enables team members to develop their own solutions, control their own activities, and manage their own problems (Burpitt & Bigoness, 1997; Druskat & Wheeler, 2003; Kirkman & Rosen, 1999). Behaviors that are likely to create these outcomes are similar to those associated with external leader roles such as setting direction, encouraging innovation, motivating performance, and managing external relationships. Thus, it is expected that external leadership behaviors

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will encourage team empowerment and subsequently enhance the likelihood that team members engage in action and interpersonal processes within the team.

H5a: Empowerment will mediate the positive relationship between external leader roles and team action processes in virtual teams.

H5b: Empowerment will mediate the positive relationship between external leader roles and team interpersonal processes in virtual teams.

Internal Leader Roles, Team Process, and Emergent States

Team Potency and Psychological Safety

According to Ilgen et al. (2005), team members trust on the basis of a) competence, expressed within the literature as potency, efficacy, and confidence in team member abilities, and b) a belief that their team members will not harm their interests, also known as psychological safety (Edmondson, 1999). Although the literature on virtual teams frequently refers to these ideas as trust (Avolio & Kahai, 2003; Hertel et al., 2005; Zigurs, 2003), trust is generally an individual level construct focusing on whether the actions of others will have one's own best interests at heart (Edmondson, 1999). At a team level, there is still no clear definition of trust in relation to virtual teams. However key themes have been identified and include belief, expectation, honesty, confidence, and vulnerability (Mitchell & Zigurs, 2009). The two ideas described by Ilgen et al. (2005), potency and psychological safety, capture elements of trust but are not entirely similar to trust. Potency is similar with respect to the ideas of belief, expectation, and confidence, whereas psychological safety is similar to trust in terms of vulnerability and, to a lesser extent, honesty. Following the relationships just described, I first provide an overview of trust as it is referenced in the literature on virtual teams. Then I focus more specifically

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on potency and psychological safety because the construct domains for psychological safety and potency are more clearly defined than the construct domain for trust in virtual teams.

The physical disconnectedness and communication limitations of virtual teams make it difficult to build trust (Hertel et al., 2005). However, according to Avolio and Kahai (2003), trusting relationships are paramount if virtual team leadership is going to be effective. Trust includes both competence and a belief that team members will not harm one's own interests (Ilgen et al., 2005) and is frequently addressed as a key driver of motivation in the literature on virtual teams (Zaccaro & Bader, 2003; Zigurs, 2003). In the virtual team environment, team members must know that others on their team will live up to commitments and act out of positive intentions towards their team (Zaccaro & Bader, 2003). Team members must quickly trust one another after very brief interactions frequently forming trust on the basis of broad expectations introduced from other environments (Avolio et al., 2001). Leaders and virtual team members also need to rely on trust as a result of the difficulties associated with direct monitoring and supervision in virtual teams (Avolio et al., 2001). For these reasons, leaders or team members need to surface hidden assumptions, especially when virtual team members come from different cultures and environments that operate under different beliefs and ideas (Zigurs, 2003). Leaders can achieve this in the facilitator role by encouraging team members to express opinions and seek consensus to help develop shared understanding and subsequent trust (Avolio et al., 2001). However, team members can also create conditions that will prevent or guide potential conflicts and take steps to build cohesion and reduce frustration to subsequently build trust as well.

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In the virtual team environment it is important for team members to have a belief or confidence that their expectations will be met. The form of trust based on met expectations or a broader belief that the team can be effective is *conditional* trust or knowledge-based trust (Jones & George, 1998; Zaccaro & Bader, 2003). This type of trust develops after team members have had some time to interact and have developed a better sense of the skills and resources that their team members can offer. In virtual teams, it is important for team members to trust each other to be effective in a number of areas including the team task, capability with technology, and interpersonal skills. When team members focus on the team's ability to be effective in a number of areas, this form of trust is known as potency (Guzzo, Yost, Campbell & Shea, 1993). Team potency has been associated with a number of team performance outcomes, including self-ratings of effectiveness and managerial ratings of performance (Campion, Papper, & Medsker, 1996; Gully, Incalcaterra, Joshi, & Beaubian, 2002; Lee, Tinsley & Bobko, 2002). Group norm strength has been shown to predict potency (Lee et al., 2002), which suggests that leaders can help to create potency in the role of director by setting goals and objectives and creating norms. Communication norms can be especially important in virtual teams because technology can limit the ability to convey socioemotional cues and this can subsequently lead to conflict. Leaders can also help to build potency in the role of *producer* by motivating behaviors that can encourage team members to complete tasks to ensure that objectives are met.

Leaders who set common goals and objectives for team members and encourage them to work towards these common goals in the roles of *director* and *producer* are, in essence, repeatedly setting expectations and then meeting or exceeding them, which can

further enhance trust in virtual teams (Avolio & Kahai, 2003) because it offers virtual team members an opportunity to develop a better understanding of the skills and motivations of their team members. Once team leaders have set goals in the role of director and continue to encourage team members to work towards these goals, then team members can work towards goals, help to build motivation towards goal accomplishment, and provide team backup. According to Shamir, House, and Arthur (1993), as team members work towards a common purpose, mission, and goals, they come to identify with one another at a greater level and form a deeper level of trust called *unconditional trust*. Thus, leaders are more likely to develop potency in virtual teams if they are perceived to build a common understanding, set goals and objectives, motivate progress, and encourage team members to work towards common goals by performing the roles of director and producer, respectively.

Within the context created by the leader, leaders can also help to build team potency by encouraging appropriate levels of innovation and brokering external relationships to increase access to resources and reduce barriers to progress. Teams that implement team action processes by monitoring progress towards goals and providing backup can also help to create positive perceptions of team potency in virtual teams. Furthermore, as discussed in the section on empowerment, virtual team leaders will likely have to take on the external leadership roles of director, producer, broker, and innovator to help empower their teams to engage in team action processes. Thus, it could be expected that virtual teams with leaders who perform external leadership roles would have higher levels of potency than virtual teams with leaders who do not perform external leadership roles. Additionally, even though a virtual team leader could take on internal

leadership roles, such as mentoring and facilitation, because of the virtual environment it could be expected that team members would do a better job of enacting action processes, understanding team dynamics, and managing monitoring and back-up behaviors on their own. Therefore:

H6a: Virtual teams with leaders who enact external leadership roles are likely to have higher levels of team potency than virtual teams with leaders who do not enact external leadership roles.

H6b: Action processes carried out by virtual team members will account for more variance than internal leadership behaviors to enhance team potency.

H6c: Interpersonal processes carried out by virtual team members will account for more variance than internal leadership behaviors to enhance team potency.

The forms of trust discussed so far tend to be associated with competence and a common understanding of the work environment. The other form of trust involves trusting the intentions of other team members (Ilgen et al., 2005), as well as risking one's own perceived competence. Edmondson (1999) defined this form of trust, psychological safety, as, "a shared belief that the team is safe for interpersonal risk taking" (p. 354). Psychological safety is associated with team effectiveness and is encouraged by the coaching behaviors of team leaders. This form of trust is especially important in the virtual team environment because virtual team members are not co-located with others on their team and often must make assumptions about the work loads, competence levels of their team members, and environmental conditions and supports existing in the physical work environments of their team members. Leaders who encourage meetings to discuss progress, provide coaching, and are readily available are more likely to develop

psychological safety within the team. Thus, leaders who enact the producer, mentor, and facilitator roles are more likely to encourage psychological safety within the team. Furthermore, leaders can also enhance psychological safety by promoting their team members to key stakeholders external to the team via brokering behaviors and ensuring a clear direction, so that virtual team members have a clear idea of what is expected of them. Team members who emphasize interpersonal processes, such as building confidence and cohesion and reducing frustration, are also likely to contribute to the development of team psychological safety. If team members coordinate smoothly, provide backup when needed, and are able to see progress towards goals via action processes, then psychological safety is likely to be further enhanced. However, because virtual team leaders are dispersed from virtual team members, it is likely that they will have to rely on the impressions of others and have more difficulty assessing team issues when acting in the role of team mentor or facilitator. Thus, we would expect the interpersonal processes and action processes carried out by virtual team members will account for more variance in psychological safety than internal leadership roles in virtual teams.

> H7a: Virtual teams with leaders who enact external leadership roles are likely to have higher levels of psychological safety than virtual teams with leaders who do not enact external leadership roles.

> H7b: Action processes carried out by virtual team members will account for more variance than internal leadership behaviors to enhance psychological safety.

> H7c: Interpersonal processes carried out by virtual team members will account for more variance than internal leadership behaviors to enhance psychological safety.

Work on leadership in virtual teams, and in teams more generally, suggests that leaders of virtual teams can have the greatest impact on trust by setting expectations and ensuring that they have been exceeded or met through a combination of director and producer roles associated with external leadership. Leaders may also be able to build trust by enacting the internal leadership roles of facilitator and mentor to surface hidden assumptions and create a climate where team members feel safe taking risks and asking for support. However, in the virtual team environment, it is likely that team members will be able to engage in many of the roles related to creating a context to guide conflict and manage affect, as well as building confidence and providing backup support to ensure success. Thus, even though internal leadership roles may have an impact, it is more likely that interpersonal processes and action processes carried out by virtual team members will have more influence than internal leadership roles and that external leadership roles will positively influence team outcomes by providing virtual team members with the tools and direction to manage their own performance and build trust within the team as a result.

Shared understanding

Virtual team members can often come from different cultural backgrounds, organizations, and nations, making it especially important that they develop a common understanding of how they will work together. Sharing information separates effective teams from less effective teams because it helps team members interpret the environment in similar ways and make decisions that are aligned with others on their team. Shared understanding also helps team members improve coordination, and adjust behaviors based on similar information to meet the demands of the task and other team members

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(Cannon-Bowers & Salas, 2001; Levesque, Wilson, and Wholey, 2001; Moller &
Tollestrup, 2013). However, the domain of shared understanding is broad with multiple
approaches for assessing content, sharedness, and measurement.

Sharing of information and common understanding of information have been
conceptualized in a number of different ways including transactive memory, cognitive
consensus, group learning, and team mental models among others (Cannon-Bowers &
Salas, 2001; Mohammed & Dumville, 2001). There are different interpretations of what it
means to share, such as whether information between two or more team members
overlaps, if the information shared is identical, or whether it is complementary or
compatible so that team members can all contribute to and have similar expectations for
performance even without exactly the same knowledge (Cannon-Bowers & Salas, 2001).
Furthermore, information that is shared can refer to multiple sets or levels of shared
knowledge, or even to an aggregation of individual mental models without requiring
synergy, overlap, and complementarity across the entire team (Langan-Fox, Anglim, &
Wilson, 2004).

In addition to the different interpretations of sharing, there are a number of ways
in which the content to be shared can be categorized, including descriptions of true states
in terms of declarative, procedural, and strategic knowledge, and, some scholars have
argued, desired states or belief structures representing preferred or expected outcomes
(Mohammed, Ferzandi, & Hamilton, 2010). For purposes of this study, shared
understanding will be measured following the approach used by Kang, Hee-Dong and
Rowley (2006), who followed a phenomenological approach emphasizing the beliefs of
team members and how team members interpret events within the team. According to

Klimoski and Mohammed (1994), beliefs matter because there can only be shared understanding if team members believe this is the case and act accordingly. Thus, shared understanding will be measured by the similarity and agreement of ratings within teams regarding key contextual factors, such as team strategy, goals, roles, and responsibilities.

Shared understanding has been shown to lead to competitive advantages and improved customer service. For example, Ray, Muhanna and Barney (2007) found that overall competitive advantage was an outcome of the extent to which information technology (IT) managers and line managers were able to develop shared understanding related to the capabilities of IT specific processes, as well as how these processes could improve procedures and performance of specific business functions. In virtual teams, shared understanding has been shown to have positive associations with team processes, such as creativity, communication and coordination, and team performance (Avolio et al., 2005; Maznevski & Chudoba, 2000; Ocker, 2005). Shared understanding has also been associated with improved business outcomes in situations where clear goals helped to create shared understanding around team process (McComb, Green, & Compton, 1999).

According to Cramton (2001), failures to develop shared understanding in globally dispersed teams generally results from failures to communicate and retain information about context, information that is unevenly distributed, failure to communicate and recognize the importance of various pieces of information, differences in how quickly information is accessible, and difficulties interpreting the meaning of silence. Furthermore, when there are difficulties creating shared understanding, this can lead to personal rather than situational attributions. Thus, she suggests that leaders and

team members should ensure that goals and incentives are as aligned as possible, and that any areas where alignment is lacking should be communicated to the entire team. In addition a) information should be communicated to team members about availability and constraints on availability; b) the specific objectives or outcomes that are desired from the collaboration; c) local requirements, customs, and practices; d) means of communication, norms and back-up procedures; as well as e) reports on the pace of overall group activity as well as subgroup activity. Furthermore, because local culture and context can influence how information is understood, it is vital to gather feedback to know how information that has been communicated has been understood and if there are any differences in understanding (Brake, 2006). This information can help teams assess risks and opportunities, and prioritize actions that can further help build shared understanding.

This suggests that leaders who perform broker and director roles by scanning the external environment and use this information to plan, prioritize, and set clear expectations are likely to enhance shared understanding. Leaders can also encourage the development of shared understanding by communicating and encouraging progress towards goals. Team members facilitate the development of shared understanding by engaging in mission analysis, strategy formulation, and systems monitoring. Following Crampton's (2001) suggestions, goal-setting, performance monitoring, and feedback can help to develop shared understanding, providing further evidence for the value of the director role as well as monitoring and mentoring to help develop shared understanding. However, due to distance in the virtual team, we would expect virtual teams with leaders who perform the external roles of director, producer, and broker (providing knowledge of

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risks and opportunities) and leave team members to take on the internal roles of monitor and mentor to have more success in developing shared understanding.

H8a: Virtual teams with leaders who enact external leadership roles will be more likely to develop shared understanding than teams with leaders who do not enact external leadership roles.

H8b: Action processes carried out by virtual team members will account for more variance in the development of shared understanding than internal leadership behaviors.

H8c: Interpersonal processes carried out by virtual team members will account for more variance in the development of shared understanding than internal leadership behaviors.

Team Effectiveness and Emergent States

In addition to the relationships between leadership, team processes, and team effectiveness outlined previously as part of hypotheses one to eight, this study also examines the relationship between emergent states and measures of effectiveness. Team effectiveness can be measured using internal criteria, such as team member satisfaction and viability, as well as external criteria, such as team productivity, performance, and innovation (Hackman, 1987, as cited in Kozlowski & Bell, 2001; Gressard, 2011). For purposes of this study, team effectiveness is captured with external measures of team performance and innovation, as well as internal measures of team viability and satisfaction. Because this study will involve work teams performing different activities, a subjective measure of performance is used in addition to an objective measure of percent of performance achieved. Hackman (1987) has noted that valid and reliable criteria that

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are measured objectively are only available for very few work teams in organizations, which can strongly restrict the domain of study. Furthermore, work team performance and its impacts usually result from the judgments of others, so it is reasonable to use a subjective measure of performance (Hackman, 1987). Using subjective ratings of performance from managers and team members as a measure of team effectiveness will also remove the effects of external economic conditions, location, and other factors that can influence performance outcomes but are not under the control of team members (Beal, Cohen, Burke, & McLendon, 2003).

Team viability will capture "members' satisfaction, participation, and willingness to continue working together in the future" (Kozlowski & Bell, 2001, p. 57) especially with respect to maintaining performance levels over a period of time. As noted by Hackman (1987), team effectiveness should incorporate current effectiveness and the ability of teams to work together, at the same level or with improvement, in the future. Teams that do not see themselves as viable are likely to experience burnout, conflict, and less desire to work cooperatively (Barrick, Stewart, Neubert, & Mount, 1998), resulting in lower levels of satisfaction and performance for their members as well. Because low scores on viability can be associated with low levels of satisfaction, a measure of satisfaction is included to measure team members' sense of gratification with team processes.

Finally, organizations are able to achieve competitive advantages through innovation and the development of products and services that are superior to competitors. However, the use of different technologies to mediate communications in the virtual team settings can place constraints on communications that can impact innovation and

creativity (Gressgard, 2011). For this reason, innovation will also be included as a measure of team performance.

Emergent States and Team Effectiveness

There is evidence to suggest that higher scores on each of the emergent states in this study (i.e., empowerment, potency, psychological safety, and shared understanding) will improve team effectiveness measure in terms of performance, viability, satisfaction, and innovation. The following sections review some of the relationships between each of the emergent states measured in this study and the measures of team effectiveness.

Empowerment and Team Effectiveness

Team empowerment is likely to have positive relationships with team performance, viability, satisfaction, and innovation in virtual teams. Evidence for performance can be found in research demonstrating that empowerment has greater impacts on process improvement and customer satisfaction in teams with less face-to-face contact (Kirkman et al., 2004). Mathieu et al. (2006) found that team empowerment was associated with team effectiveness as demonstrated by customer satisfaction and performance on quantitative metrics, such as response time and machine reliability. Although there is limited direct evidence of the impact of empowerment on viability in virtual teams, there has been some evidence supporting team satisfaction. Kirkman and Rosen (1999) suggest that empowered teams have higher levels of productivity, job satisfaction, organizational commitment, team commitment, and effectiveness (Kirkman & Rosen, 2000). Though the relationship is indirect we could expect that empowerment, via its impacts on team commitment, would be associated with higher ratings of team viability. Zhou, Wang, Chen, and Shi (2012) provide additional support for the

relationship between empowerment and satisfaction. They found that empowerment mediated the positive relationship between leader-leader exchange (i.e., exchange relationships between leaders and their own supervisors) and job satisfaction.

Finally, there is some evidence connecting empowerment to innovation as well. Harborne and Johne (2001) operationalize empowerment as power sharing and found that power sharing lead to more successful outcomes in major innovation projects. Along the same lines, Doll and Deng (2010) found that engineers empowered by software capabilities and peer support were more likely to develop work process innovations. Thus, although consistent evidence was not available connecting empowerment to team outcomes in virtual team environments, there is some evidence available to connect empowerment to team outcomes in face-to-face environments. This study provides an opportunity to test all these relationships in the virtual team context.

Potency and Team Effectiveness

Higher scores on team potency have been associated with enhanced team performance, higher ratings on viability and satisfaction, and improved innovation. Research has demonstrated that potency improves virtual team performance. For example, Turel and Zhang (2011), taking the perspective that teams with high levels of potency will work harder to tackle more challenging problems, found that team potency improved virtual team performance in management information system student teams. Fuller, Hardin, and Davison (2007), taking a more focused approach, argued that broad group potency would influence more specific efficacy beliefs related to virtual team efficacy and computer efficacy, which would subsequently have a positive association with virtual team performance. Consistent with their hypotheses, they found that team

potency was positively associated with perceptual and objective measures of team performance in virtual information systems project teams.

Potency has also been positively associated with team viability in meta-analytic research by Gully et al. (2002). However, it does not appear that the relationship between potency and viability has been studied in virtual teams, so this study will provide one opportunity to test the existence of this relationship in the virtual team context.

The relationship between potency and satisfaction has been investigated in virtual teams through meta-analytic research and via longitudinal research. Cox (2005) found that potency and satisfaction were associated with higher levels of performance in virtual teams settings. Though not specifically in virtual environments, meta-analytic research by LePine, Piccolo, Jackson, Mathieu, and Saul (2008) found positive relationships between the team processes outlined by Marks et al. (2001) and potency and satisfaction. Furthermore, potency has been related to subsequent group satisfaction in longitudinal research examining the consequences of group potency in newly initiated work groups (Lester, Meglino & Korsaard, 2002)

Finally, there is some minimal research connecting potency to innovation in teams, but this relationship is yet to be examined in the virtual environment. Potency has been found to have a positive moderating effect on innovation climate in face-to-face environments (Gil, Rico, Alcover, & Barrasa, 2005).   In two separate studies, potency was found to mediate the positive relationship between team cohesiveness and team innovation (McDowell & Zhang, 2009), as well as between cognitive styles, including attentive-to-detail, creative, and conformist, with radical innovation in teams (Miron-

Spektor, Erez, & Naveh, 2011). These studies provide support for the positive impact of potency on innovation that is tested as part of this study.

Psychological Safety and Team Effectiveness

Teams that experience high levels of psychological safety, a sense of safety with respect to interpersonal risk taking, are also likely to have higher performance, innovation, satisfaction, and improved viability because they will be more likely to try things that will improve team performance and enhance team member relationships. For example, building on Edmondson's (1999) work, Kostopoulos and Bozionelos (2011) found that psychological safety positively influences team performance measured in terms of innovativeness, quality, efficiency, and work excellence, via the generation of new knowledge and exploitation of existing knowledge in face-to-face teams. Gibson and Gibbs (2006) found evidence to suggest that psychological safety has positive relationships with innovation in virtual teams. Ortega, Sanchez-Manzanares, Gil, and Rico (2010) found that psychological safety was positively related to both team performance and viability in virtual teams via increased learning behaviors. It appears that minimal research connecting psychological safety to job satisfaction has been done thus far. However, psychological safety climate has also been found to have positive relationships with job satisfaction in safety critical organizations (Nielsen, Mearns, Matthiesen & Eid, 2011). Thus, we can expect psychological safety to have positive relationships with team outcomes.

Shared Understanding and Team Effectiveness

Similar to potency and psychological safety, shared understanding can also be expected to enhance virtual team performance, innovation, satisfaction and viability. Shared understanding has been associated with improved coordination amongst team members and increased team effectiveness (Cannon-Bowers & Salas, 2001). It has also been suggested that shared understanding can help team members develop collective expectations, exchange information in the most efficient way, agree on how to evaluate results, develop team members, and create a sense of how to effectively work together (Avolio et al., 2001). If virtual team members have a common understand of strategy, goals, and outcomes, this will increase the likelihood that they will work together efficiently to achieve a common purpose. Having a common purpose is likely to enhance collaboration and reduce conflict to improve team viability (Resick, Dickson, Mitchelson, Allison, & Clark, 2010). Shared understanding can also influence relationships, decision quality, and productivity (Crampton, 2001). Thus, it would not be surprising that shared knowledge would contribute to perceived ratings of improved team performance, satisfaction, and viability in virtual teams. Finally, Moller and Tollestrup (2013) have pointed out that shared understanding around a problem space, desired outcomes, and opportunities can support innovation, especially with diverse stakeholders during the early stages of an innovation project.

Given that each of the emergent states, including empowerment, potency, psychological safety, and shared understanding, would all be expected to independently increase team performance, satisfaction, viability, and innovation, we could also expect

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that higher average ratings on all the emergent states would also be associated with higher ratings of team performance, satisfaction, viability, and innovation.

H9a: Virtual teams with higher average overall ratings of emergent states will have higher ratings on team performance.

H9b: Virtual teams with higher average overall ratings of emergent states will have higher ratings on team viability.

H9c: Virtual teams with higher average overall ratings of emergent states will have higher ratings on team satisfaction.

H9d: Virtual teams with higher average overall ratings of emergent states will have higher ratings on team innovation.

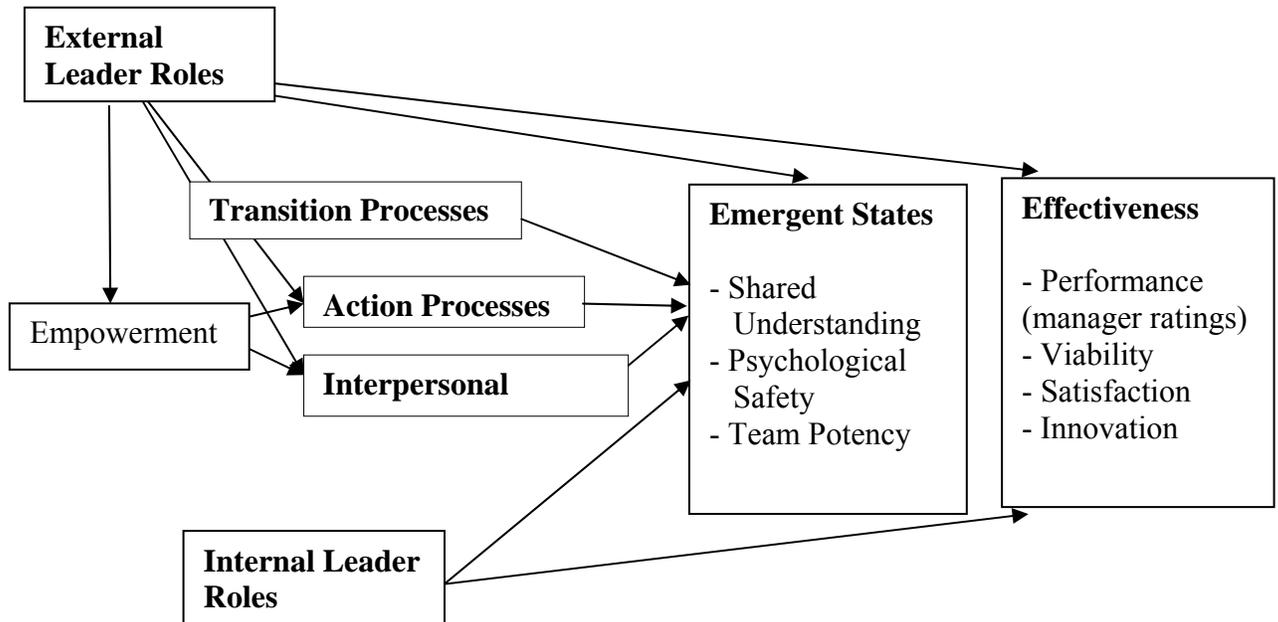Model of Leadership in the Virtual Environment

Figure 3: Hypothesized Partially Mediated Model

Because of the distributed nature of virtual teams and the likelihood that several leadership behaviors will be distributed to team members and enacted via team processes, it is possible that external leadership will be fully mediated by empowerment and have no direct impact on team action processes, interpersonal processes, emergent states, or outcomes. However, the relationship between external leadership roles and team action processes and interpersonal processes, emergent states, and outcomes could also be partially mediated by empowerment. At the same time the direct relationship between internal leadership on team outcomes could be partially mediated by emergent states. As such, this study will test the fully mediated model of virtual team leadership shown in Figure 1 against the partially mediated model of virtual team leadership shown in Figure 3 to better understand the relationship between leadership roles, team processes, emergent states, and team outcomes. In the fully mediated model (Figure 1), I hypothesize that external leadership roles will account for more variance in team emergent states and subsequent team outcomes than team transition processes. Higher scores on a measure of external leadership roles would be related to higher scores on a measure of empowerment. Higher scores on the measure of empowerment are expected to be positively related to higher scores on measures of team action processes and interpersonal processes. Higher scores on team action processes and interpersonal processes are expected to be associated with higher scores on emergent states (i.e., shared understanding, psychological safety, and team potency). Higher scores on measures of emergent states are hypothesized to relate to higher scores on team outcome measures (i.e., performance, viability, satisfaction and innovation). Simultaneously, team action

process and interpersonal processes are expected to account for more variance in team emergent states and subsequent team outcomes than internal leadership roles.

The partially mediated model will include positive paths from external leadership roles to team empowerment, team action processes and interpersonal processes, emergent states, and team outcomes. There will only be paths from internal leadership to emergent states and team outcomes. Team action processes and interpersonal processes are expected to account for more variance in emergent states and team outcomes than internal leadership roles. Paths from internal leadership roles to team empowerment and team processes will not be specified. All paths shown in the model are expected to be positive according to the hypotheses outlined previously. Finally, although not explicitly shown in the model, it is also recognized that emergent states can be products of team experiences or become new inputs to subsequent processes and outcomes (Marks et al, 2001).

Method

Participants

To identify potential survey participants 356 survey requests were sent via typed letter to SIOP members who had previously provided SIOP with information to suggest that they led or would have access to managers of virtual teams. Only three teams from three different organizations agreed to participate in response to this mailing. In addition, I contacted 75 individuals over Linked-In and 5 agreed to participate. I also used a networking strategy by contacting organizations and individuals, directly, which yielded responses from 6 additional organizations. I received responses from 50 managers from the 14 organizations that agreed to participate in this survey. The organizational

response rate to this survey was only 4%. Out of the 291 surveys that were distributed to the organizations that did agree to participate, I received a total of 195 surveys, which included 50 responses from managers who represented potential teams. The overall response rate was 67%. The majority of teams were from global companies in manufacturing and consulting industries. Teams ranged in size from 2 to 8 team members including managers (Median = 4; Mode = 4). However, after removing teams with fewer than two surveys, response rates less than 25%, as well as more than 20% missing values, I was left with 159 individual responses and 32 teams. This is equivalent to a 54% response rate from individuals and a 64% response rate at the team level. To ensure confidentiality participants were not asked to provide any demographic information.

A sub-sample of one or two respondents was randomly selected from the majority of teams. The sub-sample was used to calculate scale reliabilities. To maintain sample size, no respondents were selected for the sub-sample from teams with two team members, one respondent was randomly selected from teams with three to five team members, and two respondents were randomly selected from teams with six or more team members. Scale reliabilities using Cronbach's alpha were calculated at the individual level due to the small team sample size. After following this procedure, the sub-sample consisted of 45 respondents and the primary sample consisted of 114 respondents in 32 teams.

No teams indicated that they spent between 61% to 100% of their time communicating face-to-face, 16% of teams described themselves as communicating face-to-face between 41% to 60% of the time, 41% of teams described themselves as

communicating face-to-face 21% to 40% of the time, 47% of the 32 teams described themselves as communicating face-to face less than 20% of the time. In other words, all teams spent more than 40% of their time communicating virtually via email, telephone, video conferencing or other means and 84% of teams spent more than 60% of their time communicating virtually.

The majority of team members did not demonstrate full agreement regarding the type of team. Because type of team was measured on a nominal scale, the modal value was used to identify type of team rather than the mean. Based on this approach, 44% of the 32 teams within the sample described themselves as Service Teams, 6% described themselves as Management Teams, and 28% described themselves as Project Teams. In 16% of the cases or teams respondents did not agree regarding type of team and more than one modal value appeared. Teams where all team members did not agree had between two and four team members and described their teams as various combinations of Production Teams, Service Teams, Management Teams, Project Teams, and Action and Performing Teams. Additional specifics describing type of team as it was presented to survey participants can be found in the Appendix.

Table 2 provides the percentages of respondents using various types of collaboration technologies. The types of technology used most frequently by teams in this sample included email (98.2%), web conferencing tools (79.8%), survey software (55.3%), and enterprise collaboration platforms (52.6%).

Table 2: Use of Collaborative Technologies

Type of technology	Percent Usage
Email (Gmail, Outlook)	98.2%
Web conferencing tools (Adobe Connect, Blackboard Collaborate, WebEx)	79.8%
Survey Software (Survey Monkey)	55.3%
Enterprise collaboration platforms (Sharepoint, Google Apps, Buddypress)	52.6%
File synchronization/ cloud storage (Dropbox, Windows Skydrive)	28.1%
Public Social Networks (Twitter, Facebook, Google+/ Hangouts, LinkedIn	27.2%
Live communication/ feedback tools (Skype, Poll, Everywhere)	26.3%
Video tools – viewing, creating, sharing (YouTube, TED Talks/ Ed, Khan Academy, Movie Maker, Vimeo, iMovie)	21.9%
Wiki/ Website tools (Wikispaces, Googles Sites, PBWorks)	15.8%
Note taking tools (Evernote, OneNote)	10.5%
Private social networking platforms (yammers, Edmodo, Ning, Buddypress)	8.8%
Audio Tools (Audacity, iTunes and iTunesU)	5.3%
Blogging/ website tools (WordPress, Blogger/ Blogspot, Edublogs, Tumblr)	5.3%
Digital organizers (Livebinders, Symbaloo, MetorMob)	3.5%
Mindmapping tools (Minmeister, Mindjet)	2.6%

Pinboarding tools (Pintrest, Learnist)	.9%
Social bookmarking tools (Diigo, Delicious, Popplet)	.9%
Content curation tools/ social magazine/ newspapers (Scoopit, Flipboard, Zite, Paper.li)	0%

Nineteen percent of teams relied primarily on 1 to 5 different types of collaborative technologies, 72% of teams relied on using between 5 to 10 different types of collaborative technologies, and 9% of teams collectively used more than 10 different types of collaborative technologies.

Procedure

Data for this study were collected using an online survey. Emails and typed letters providing a brief description of this study, its purpose, and benefits were sent to 370 small, medium and large size organizations that rely on virtual teams to accomplish at least a portion of their work. In some cases, person-to-person networking was used as well. If companies agreed to participate, key stakeholders were asked to share an email with managers informing them that the company had agreed to participate in the survey. Managers of virtual teams were then approached with a brief email describing the survey research and requesting participation via a Qualtrics link to the survey. In a few cases, managers were approached to participate directly. Consent to participate in the survey was implicit and based on the decision to complete the survey. Managers who agreed to complete the survey were asked to provide email addresses for members of their virtual team. Members of the virtual team were then provided with a unique Qualtrics link that was associated with their team. This approach made it possible to associate the unique

survey link with team member responses via a common identification code. Managers were asked to complete the survey along with team members. In addition to responses that team members provided, managers also provided ratings of team performance using a measure of "percent of target achieved" and a subjective measure of performance adapted from Denison et al. (1995). Information about additional measures is provided in detail below.

Relationships were investigated at the team level using structural equation modeling. Typically structural equation modeling requires a minimum of 200 observations or $5 - 10$ observations per parameter (Klem, 2001). If all 71 potential parameters were estimated in the measurement model a minimum of 355 teams to 710 teams would be required to achieve adequate levels of power in this study. Unfortunately I only received responses from 32 teams, which is less than 10% of the minimum required sample size for this study. In addition, a number of variables demonstrated a significant amount of skewness and kurtosis. However, Maximum Likelihood solutions, which were used for this study, are robust to violations of multivariate normality even with small N's (Hau & Marsh, 2004) and are further attenuated when item parcels are used.

I originally intended to analyze results at the individual level if enough teams did not respond to the study. However, calculation of ICC(1)'s suggested there were fairly strong effect sizes in the range of .20 and above due to team membership which could cause issues of multicollinearity if data was analyzed at the individual level. Therefore, even though there were only 32 teams who responded to this study, I analyzed results at

the team level. However, because of small sample sizes, results for this study should be interpreted with caution.

<div align="center">*Measures*</div>

Control Variables

Previous research has identified a number of variables that could potentially influence team effectiveness. These control variables include workflow interdependence, percentage of face-to-face communication, team size, type of team, perceived usefulness of e-collaboration tools, and experience with collaborative technologies. Workflow interdependence may interact with team processes, leadership, and technology to influence the quality of team outcomes and the time it takes to complete a task (Bell & Kozlowski, 2002; Martins et al., 2004). Face-to-face communications have been associated with improved information exchange and team interaction (Powell et al., 2004) and can consequently reduce some of the process losses resulting from virtual communication (Bell & Kozlowski, 2002). Face-to-face communication also reduces a team's reliance on technology for communications. Thus, teams with more face-to-face interaction could be thought of as having a lower degree of virtuality than teams with more face-to-face communication.

Team size may improve or reduce team performance depending on the type of technology used and type of task (Martins et al., 2004). Factors influencing team outcomes can vary as a result of the type of team (Kozlowski & Bell, 2001). For example, a service team may have to use resources and technology differently and align work processes differently than a production team to achieve effective team performance.

The technological proficiency of individual users can also impact communication patterns in virtual teams (Kayworth & Leidner, 2002), including how team members perceive the usefulness of various e-collaboration technologies ranging from email to more sophisticated enterprise collaboration platforms such as Sharepoint (Centre for Learning and Performance Technologies [C4LPT], 2000-2012). Perceived usefulness, an individual's belief that use of a particular e-collaboration tool will enhance job performance, has been shown to be a strong determinant of behavioral intentions to use a particular systems (Venkatesh & Davis, 2000), in this case e-collaboration tools. If members of a virtual team do not find e-collaboration tools useful, it will reduce the likelihood that the tools will be used by all team members limiting the potential effectiveness that the virtual team can achieve.

Respondents were asked to identify the e-collaboration tools used by their virtual team to help increase understanding around the opportunities for enhancing productivity within a particular virtual team. We could expect that the greater the breadth of knowledge virtual team members have of available collaboration technologies, the greater will be their ability to select from the most useful tools to enhance task performance and team collaboration.

Leadership Behaviors

The eight roles captured in the categories of external leadership roles (i.e., innovator, broker, director, and producer) and internal leadership roles (i.e., monitor, coordinator, mentor, and facilitator) and described in Quinn's model of leadership were measured using the extended form of Quinn's (1988) leadership complexity measure. As the short form of their measure only has two items per scale, Quinn has recommended

that researchers may wish to use the more fully developed version of the leadership complexity measure. The extended form designates four items for each leadership role outlined in Quinn's leadership model. Quinn's previous research demonstrates scale reliabilities ranging from .72 to .90 when examining each of the roles independently. For this study the individual scales for the innovator, broker, director, and producer scales were used as indicators of external leadership and the individual scales for the monitor, coordinator, mentor, and facilitator roles were used as indicators of internal leadership. All items on Quinn's leadership complexity measure were measured on a scale of 1 to 5. (1 = "Never"; 5 = "To a Great Extent").

Empowerment

Empowerment is the sense of control and autonomy that teams have over outcomes. Thus, following the approach of Mathieu et al. (2006) empowerment was measured along the dimensions of authority and responsibility. The scale for authority included the following three items: (1) my team is empowered to change our work processes in order to improve performance; (2) my team is empowered to allocate our own resources in order to improve performance; and (3) my team is empowered to allocate our budget in the best way to improve performance. The scale for responsibility included the following three items: (1) members of my team are responsible for identifying the best way to satisfy customer needs; (2) members of my team are responsible for monitoring our own progress; and (3) members of my team are responsible for developing our own strategy to achieve goals. All team empowerment items were measured on a scale of 1 to 5 (1 = "Strongly Disagree"; 5 = "Strongly Agree").

Team Process

Team process was measured using the items in Mathieu et al.'s (2001) team process taxonomy. To limit respondent fatigue the 30-item short form of their measure was used. This short form provided three items for each of the ten dimensions discussed in their article. All team process items were measured on a scale of 1 to 5 (1 = "Never"; 5 = "To a Great Extent").

Potency

Potency was assessed using an eight-item measure by Guzzo et al. (1993). Items included, to what extent does your team: (1) have confidence in itself, (2) expect to be known as a high-performing team, (3) feel it can solve any problem it encounters, (4) believe it can be very productive, (5) believe it can get a lot done when it works hard, (6) believe no task is too tough for this team, (7) expect to have a lot of influence around here, and (8) believe it can become unusually good at producing high quality work (1 = "Never"; 5 = "To a Great Extent"). Although, team-efficacy could have also been used to assess team member beliefs that the team could successfully perform a given task, this study assessed teams with members who were required to demonstrate skill in a number of domains. Thus, whereas team-efficacy is task specific (Bandura, 1997, p. 477), potency captured a more generalized performance domain (Gully et al., 2002), which was more relevant to the cross-functional skills (e.g., presentation skills, project management, influence, and technical skills) required of these teams working in a virtual environment.

Psychological Safety

Psychological safety was assessed using Edmondson's (1999) seven item measure. Items included: (1) if you make a mistake on this team, it is often held against you; (2) members of this team are able to bring up problems and tough issues; (3) people

on this team sometimes reject others for being different; (4) it is safe to take a risk on this team; (5) it is difficult to ask members of this team for help; (6) no one on this team would deliberately act in a way that undermines my efforts; and (7) working with members of this team, my unique skills and talents are valued and utilized (1 = "Very Inaccurate"; 7 = "Very Accurate").

Shared Understanding

Shared understanding can help team members interpret information in the same way, make decisions that are aligned, and take actions that are aligned as a result, which is expected to lead to better team performance, team process, and team motivation (Cannon-Bowers & Salas, 2001). Shared cognition or shared understanding can be conceptualized in a number of different ways, including overlapping knowledge, similar or identical knowledge, complementary or compatible knowledge, and distributed or apportioned knowledge that may differ across team members but will contribute to an overall team understanding of the full task domain. This study focused on overlapping or shared knowledge related to team strategy, goals, roles, and technological capability. According to Kang et al. (2006), shared understanding can be measured by asking team members to report the degree to which they perceive information to be shared. The rationale being the team members who have shared expectations or beliefs with respect to goals, roles, strategy, or specific technological capabilities will act in accordance with these beliefs or expectations making the anticipated goals, roles, strategies, or technological limitations and capabilities a reality (Klimoski & Mohammed, 1994).

Perceptions of shared understanding were measured using a set of five questions specifically derived for this study and focusing on three of the four categories outlined by

Cannon-Bowers et al. (1993). Technology/ equipment is the first category and refers to team members sharing information about the functions, usage, limitations, and failures possible with respect to technology and equipment. The second category refers to procedural elements of the task such as instructions, strategy, and task constraints. The third category refers to interactional concerns and how team members are involved in this task. This is related to roles and responsibilities, information flows, communication channels, and mutual dependencies amongst team members. The fourth and final category is related to the sharing of information about teammates' knowledge, skills, attitudes, and preferences.

The six questions in this study captured content related to technology and equipment, procedural elements of the task, and interactions, and assessed perceived shared understanding of goals, strategies, roles, and the technological environment within the virtual team. Items included (1) most of my team members have a clear sense of the roles on this team; (2) most of my team members have a clear sense of the goals on this team; (3) most of my team members have a clear sense of the strategy on this team; (4) most of my team members have a clear sense of the speed of the technology (phone, email etc.) used on this team; (5) most of my team members have a clear sense of the effectiveness of the technology (phone, email etc.) used on this team; and (6) most of my team members have a similar understanding of how close we are to achieving our goals. All items measuring perceptions of shared understanding were measured on a scale of 1 to 5 (1 = "Strongly Disagree"; 5 = "Strongly Agree"). This scale was developed specifically for this study and was pilot tested for reliability and agreement on nine student project teams.

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Team Effectiveness

Team effectiveness measures captured the dimensions of performance, viability, satisfaction, and innovation. Performance was measured with the following three items, which are adapted from Denison et al. (1995): (1) my team outperforms most other teams in my organization; (2) my team continuously meets or exceeds expectations; and (3) my team does excellent work. Managers were also asked to provide an estimate of "the percent of target achieved" when providing ratings on team performance.

Team viability was measured with items derived from Busche and Coetzer (2007). Items include: (1) I believe this team would perform successfully on similar task in the future; (2) I believe this team could continue to work together successfully in the future; (3) I would choose to work with this team on similar tasks in the future; and (4) being a member of this team is a positive experience.

Five team satisfaction items were adapted from Smith and Barclay (1997). These items included: (1) some aspects of my team's work processes could be improved (reverse scored); (2) overall I am satisfied with the working relationships on my team; (3) when compared to other teams I have worked with in the past, I would prefer to work on my current team; (4) I am happy with the contributions that my team members make; and (5) I believe my team members enjoy working with me.

Finally, innovation was measured using four items adapted from De Dreu and West (2001).   Items included: (1) team members often implement new ideas to improve the quality of our products and services; (2) this team gives little consideration to new and alternative methods and procedures for doing their work (reverse scored); (3) team members often produce new services, methods, or procedures; and (4) this is an

innovative team. All team effectiveness items were measured on a scale of 1 to 5 (1 =

"Strongly Disagree"; 5 = "Strongly Agree").

<div align="center">Results</div>

Pilot Test for Shared Understanding

I used James, Demaree, and Wolf's (1984) R_{wg} agreement index with a minimum

value of R_{wg} = .70 to warrant aggregation, as this value is acceptable for newly developed

measures (LeBreton & Senter, 2008). I tested the rectangular response distribution and

an additional response distribution with a slight negative skew, given that the distribution

appeared to be consistent with the data gathered for this study. However, the response

distribution with a slight negative skew led to R_{wg} values exceeding unity, suggesting that

this distribution was inaccurately specified (LeBreton & Senter, 2008). Thus, analyses

were only reported for the uniform rectangular distribution.

I also report intraclass correlations to justify aggregation by demonstrating

reliability of ratings across respondents (Bliese, 2000). To ensure that shared

understanding was influenced by group membership, an ICC(1) was calculated based on

a one-way random-effects analysis of variance model. The ICC(1) is typically used to

identify non-independence resulting from group membership and can also be interpreted

as an effect size (Bliese, 2000; Bryk & Raudenbush, 1992, LeBreton & Senter, 2008).

The ICC(K) provides an estimate of the stability of a mean rating provided by K judges

(α = .92; ICC(1) = .39; ICC(K) = .72; meanR_{wg} = .80; SD = .21). An ICC(1) = .39 can

be viewed a strong effect size, and the mean ICC(K) = .72 and the mean R_{wg} = .80

suggests that shared understanding demonstrates sufficient agreement to justify

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aggregation to the team level and the scale for shared understanding was appropriate to include in the primary analyses for this study.

Scale Reliabilities

Prior to determining if results could be aggregated to the team level, I calculated Cronbach's alphas on each of the scales using the individual level subsample. Where scales did not achieve acceptable levels of reliability ($\alpha > .70$), I first removed items whose corrected item-total correlations were below .30 (Cortina, 1993). If scales still did not achieve acceptable levels of reliability, I did not include them in further analyses. I have identified excluded scales as appropriate in the remainder of this section.

Eight separate subscales were used to measure aspects of external leadership and internal leadership. The sub-scales comprising external leadership included innovator ($\alpha = .87$, $r_{min} = .57$, $r_{max} = .70$), broker ($\alpha = .87$, $r_{min} = .51$, $r_{max} = .72$), producer ($\alpha = .92$, $r_{min} = .67$, $r_{max} = .82$), and director ($\alpha = .93$, $r_{min} = .64$, $r_{max} = .92$). The subscales comprising internal leadership included coordinator ($\alpha = .85$, $r_{min} = .58$, $r_{max} = .80$), monitor ($\alpha = .82$, $r_{min} = .53$, $r_{max} = .65$), facilitator ($\alpha = .90$, $r_{min} = .63$, $r_{max} = .80$), and mentor ($\alpha = .91$, $r_{min} = .57$, $r_{max} = .82$).

Team processes were measured using 10 subscales that fell into the superordinate categories of transition processes, action processes, and interpersonal processes. Transition processes consisted of mission analysis ($\alpha = .92$, $r_{min} = .71$, $r_{max} = .87$), goal specification ($\alpha = .85$, $r_{min} = .74$, $r_{max} = .74$), and strategy formulation and planning ($\alpha = .85$, $r_{min} = .59$, $r_{max} = .73$). Action processes included monitoring progress towards goals ($\alpha = .81$, $r_{min} = .46$, $r_{max} = .72$), resource and systems monitoring ($\alpha = .85$, $r_{min} = .57$, $r_{max} = .76$), team monitoring and back-up ($\alpha = .81$, $r_{min} = .50$, $r_{max} = .73$), and coordination ($\alpha =$

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.86, r_{min} =.63, r_{max} = .73). Finally, interpersonal processes included conflict management (α = .83, r_{min} =.71, r_{max} = .71), motivating and confidence building (α = .88, r_{min} =.69, r_{max} = .77), and affect management (α = .85, r_{min} =.66, r_{max} = .69).

Emergent states included empowerment, which was not used in further analysis due to low scale reliability and bivariate correlations (α = .62, r_{min} =.11, r_{max} = .52), potency (α = .90, r_{min} =.35, r_{max} = .72), psychological safety (α = .70, r_{min} =.05, r_{max} = .67), and shared understanding (α = .78, r_{min} =.42, r_{max} = .72).

Outcomes included performance (α = .71, r_{min} =.29, r_{max} = .66), viability (α = .82, r_{min} =.42, r_{max} = .73), satisfaction (α = .82, r_{min} =.42, r_{max} = .70), and innovation (α = .87, r_{min} =.66, r_{max} = .71). Scales for the team level analysis are shown in Table 3.

Scale Aggregation

To determine if scales could be aggregated to the team level, I followed the same approach that I used to pilot the scale measuring perceptions of shared understanding. Because scale means were to be used for follow-up analysis, the mean from each team was used as the input for agreement and reliability analysis (Chen, Mathieu, & Bliese, 2004; Mathieu, Gilson & Ruddy, 2006). I tested the rectangular response distribution and an additional response distribution with a slight skew. The response distribution with a slight skew led to R_{wg} values exceeding unity suggesting that this distribution was inaccurately specified (LeBreton & Senter, 2008). Thus analyses were only reported for the uniform rectangular distribution.

The same scales used in the reliability analysis were tested for aggregation with James et al.'s (1984) R_{wg} as well as ICC(1) and ICC(k) reported for each scale to be included in the analysis.

Table 3: Scales for Team Level Analysis

External Leadership	Transition Processes	Emergent States	Outcomes
• Innovator • Broker • Producer • Direction	• Mission Analysis • Goal Specification • Strategy Formulation and Planning	• Potency • Shared Understanding • Psychological Safety	• Objective Performance Measure • Team Viability • Team Satisfaction • Team Innovation
Internal Leadership • Coordinator • Monitor • Facilitator • Mentor	**Action Processes** • Monitoring Progress Towards Goals • Resource and Systems Monitoring • Team Monitoring and Back-Up • Coordination		
	Interpersonal Processes • Conflict Management • Motivating and Confidence Building • Affect Management		

Agreement indices for the external leadership scales were as follows: innovator (r_{wg} = .87, ICC(1) = .27, ICC(k) = .75), broker (r_{wg} = .86, ICC(1) = .24, ICC(k) = .75), producer (r_{wg} = .81, ICC(1) = .03, ICC(k) = .21), and director (r_{wg} = .81, ICC(1) = -.01, ICC(k) = -.05). Agreement indices for the internal leadership subscales included coordinator (r_{wg} = .84, ICC(1) = .30, ICC(k) = .77), monitor (r_{wg} = .66, ICC(1) = .06, ICC(k) = .35), facilitator (r_{wg} = .85, ICC(1) = .08, ICC(k) = .40), and mentor (r_{wg} = .79, ICC(1) = .07, ICC(k) = .38).

Team processes were measured using 10 subscales that fell into the superordinate categories of transition processes, action processes, and interpersonal processes. Agreement indices were calculated for each of the subscales. Transition processes consisted of mission analysis (r_{wg} = .65, ICC(1) = .12, ICC(k) = .52), goal specification (r_{wg} = .64, ICC(1) = .36, ICC(k) = .82), and strategy formulation and planning (r_{wg} = .59, ICC(1) = .29, ICC(k) = .77). Action processes included monitoring progress towards goals (r_{wg} = .71, ICC(1) = .41, ICC(k) = .85), resource and systems monitoring (r_{wg} = .45, ICC(1) = .20, ICC(k) = .67), team monitoring and back-up (r_{wg} = .73, ICC(1) = .48, ICC(k) = .88), and coordination (r_{wg} = .77, ICC(1) = .30, ICC(k) = .77). Finally, interpersonal processes included conflict management (r_{wg} = .85, ICC(1) = .17, ICC(k) = .62), motivating and confidence building (r_{wg} = .78, ICC(1) = .20, ICC(k) = .67), and affect management (r_{wg} = .75, ICC(1) = .21, ICC(k) = .68.

Agreement indices for emergent states were calculated for empowerment (r_{wg} = .85, ICC(1) = .20, ICC(k) = .66), potency (r_{wg} = .87, ICC(1) = .19, ICC(k) = .66), psychological safety (r_{wg} = .87, ICC(1) = .32, ICC(k) = .79), and shared understanding (r_{wg} = .84, ICC(1) = .15, ICC(k) = .59).

Finally, agreement indices for outcomes were calculated for performance (r_{wg} = .88, ICC(1) = .20, ICC(k) = .67), viability (r_{wg} = .88, ICC(1) = .08, ICC(k) = .40), satisfaction (r_{wg} = .87, ICC(1) = .36, ICC(k) = .82), and innovation (r_{wg} = .77, ICC(1) = .17, ICC(k) = .61).

In most cases the ICC(1) for scales represented effects that could be considered small to medium (.06 to .12) and in many cases there were also large effect sizes above .20 (LeBreton & Senter, 2008). Only producer (ICC(1) = .03) and director (ICC(1) = -

.01) had ICC(1)'s below .05. However, both these scales had R_{wg}'s of.81. Furthermore,

because all subscales are used as indicators of latent constructs, rather than using

individual items, it is less worrisome that some of the scales do not meet the .70 cutoff

(Landis, Beal & Tesluk, 2000). Thus scales were aggregated to the team level for further

analyses.

Confirmatory Factor Analysis

To test the structural equation model I followed the model testing approach

outlined by Gaskin (2012). Descriptive statistics are provided in Table 4.   As a first step

I fitted a CFA model. The latent factors for the initial model included external

leadership, internal leadership, transition processes, action processes, interpersonal

processes, emergent states, and outcomes. Indicators were specified based on the theory

previously outlined. Because the sample size for this study was small, consisting of only

32 teams, I removed indicators with factors loadings below .75 unless this would leave a

latent variable with less than three indicators. The intention was to increase the

likelihood of good convergent validity.   Typically a sample size of 50 is required for a

factor loading of .75 to be sufficient (Gaskin, 2012). In addition, I also removed indiators

that had high cross loadings and limited discriminant validity. As a result, I removed

producer from the external leadership factor and the entire internal leadership factor and

its indicators, which included mentor, monitor, coordinator, and facilitator. Scales for

transition and action processes were combined into one factor and indicators with poor

loadings or high cross loadings, including resource and systems monitoring, team

monitoring and back up, and coordination, were removed. The remaining items from

transition and action processes were all associated with a factor related to goal setting and

monitoring so I will refer to the combined scales as "goal setting and monitoring" for the

remainder of this article. Conflict management was removed from the interpersonal

factor. Finally, emergent states and team outputs were highly correlated, so I removed

emergent states and indicators with insufficient loadings on outcomes from further

analysis. This resulted in removing shared understanding, potency, psychological safety,

viability, and the objective performance criterion.   In total, I ended up removing 13 out a

potential 25 indicators before achieving adequate fit. Finalized scales can be seen in

Table 5 and the revised models can be seen in Figure 4.

Table 4: Descriptive Statistics and Intercorrelations

	1	2	3	4	5	6	7	8	9	10	11	12
1.Innovator	1											
2.Broker	.80**	1										
3.Producer	.52**	.73**	1									
4.Director	.55**	.72**	.73**	1								
5.Coordinator	.41*	.49**	.46**	.70**	1							
6.Monitor	.31	.37*	.41*	.54**	.71**	1						
7.Facilitator	.63**	.71**	.70**	.73**	.62**	.45**	1					
8.Mentor	.44*	.35*	.37*	.54**	.61**	.33	.72**	1				
9.Mission Analysis	.17	.40*	.40*	.42*	.13	.20	.45**	.22	1	.		
10.Goal Setting	.36*	.43*	.46**	.48**	.42*	.36*	.47**	.32	.68**	1		
11.Strategy Formulation	.39*	.45**	.41*	.40*	.30	.30	.40*	.24	.73**	.79**	1	
12.Goal Monitoring	.21	.39*	.46**	.48**	.32	.38*	.40*	.10	.78**	.78**	.80**	1
13.Resource Monitoring	.17	.23	.23	.27	.23	.39*	.24	.11	.63**	.65**	.64**	.64**
14.Monitoring & Back Up	.53**	.66**	.61**	.49**	.29	.46**	.63**	.32	.69**	.60**	.66**	.57**
15.Coordination	.52**	.74**	.65**	.55**	.27	.32	.64**	.29	.61**	.37*	.57**	.55**
16.Conflict Management	.42*	.67**	.60**	.64**	.30	.39*	.53**	.14	.29	.06	.13	.28
17.Motivation	.36*	.57**	.65**	.55**	.34	.38*	.67**	.46**	.65**	.52**	.56**	.59**
18.Affect Management	.52*	.69**	.73**	.58**	.39*	.45*	.73**	.43*	.49**	.53**	.53**	.52**
19.Potency	.41*	.57**	.72**	.72**	.52**	.49**	.70**	.45*	.45**	.43*	.46**	.60**
20.Psycological Safety	.35	.50**	.65**	.62**	.37*	.27	.65**	.38*	.27	.24	.18	.29
21.Shared Understanding	.26	.51**	.69**	.68**	.58**	.40*	.48**	.38*	.43*	.53**	.44*	.59**
22.Performance	.39*	.55**	.66**	.47**	.43*	.39*	.73**	.33	.51**	.50**	.53**	.52**
23.Viability	.56**	.70**	.77**	.57**	.34	.30	.67**	.31	.23	.20	.27	.31
24.Satisfaction	.42*	.58**	.69**	.60**	.47**	.41*	.73**	.49**	.37*	.40*	.35	.42*
25.Innovation	.49**	.55**	.45*	.49**	.43*	.47**	.68**	.43*	.37*	.37*	.38*	.48**
Mean	3.79	3.97	4.34	4.10	3.92	3.58	4.18	4.05	3.69	3.09	3.01	3.27
SD	.52	.52	.36	.38	.52	.55	.45	.51	.57	.67	.60	.66

* p<.05 and ** p<.01

Table 4: Descriptive Statistics con't

|	13	14	15	16	17	18	19	20	21	22	23	24	25
1.Innovator													
2.Broker													
3.Producer													
4.Director													
5.Coordinator													
6.Monitor													
7.Facilitator													
8.Mentor													
9.Mission Analysis													
10.Goal Setting													
11.Strategy Formulation													
12.Goal Monitoring													
13.Resource Monitoring	1												
14.Monitoring & Back Up	.52**	1											
15.Coordination	.25	.75**	1										
16.Conflict Management	-.05	.48**	.71**	1									
17.Motivation	.37*	.78**	.75**	.48**	1								
18.Affect Management	.31	.82**	.79**	.53**	.82**	1							
19.Potency	.42*	.50**	.71**	.54**	.62**	.66**	1						
20.Psycological Safety	.27	.51**	.57**	.56**	.54**	.69**	.69**	1					
21.Shared Understanding	.31	.35*	.44*	.40*	.49**	.50**	.68**	.50**	1				
22.Performance	.31	.58**	.71**	.41*	.60**	.67**	.78**	.46**	.49**	1			
23.Viability	.08	.51**	.76**	.67**	.61**	.70**	.76**	.66**	.50**	.70**	1		
24.Satisfaction	.23	.48**	.67**	.47**	.53**	.67**	.84**	.72**	.68**	.75**	.73**	1	
25.Innovation	.35*	.53**	.64**	.41*	.56**	.65**	.74**	.58**	.50**	.62**	.56**	.75**	1
Mean	3.21	3.46	3.99	4.48	4.11	3.85	4.24	4.28	4.16	4.18	4.48	4.24	3.82
SD	.65	.70	.49	.49	.49	.49	.40	.43	.43	.38	.38	.39	.54

* $p<.05$ and ** $p<.01$

I report multiple fit indices, including (a) $\chi^2/$ df which is considered acceptable if less than 3, (b) the CFI which is acceptable if over .90, (c) RMSEA which is moderately acceptable below .10 and good if below .05, and (d) PCLOSE which should be greater than .05 (Gaskin, 2012). Overall, the CFA model provided reasonable fit ($\chi^2 = 41.852$, df = 48, CMIN/ DF = .872, CFI = 1.000, RMSEA = .000 PCLOSE = .825). Table 6 show composite reliabilities (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV) and scale correlations. The CR is similar to a Cronbach's alpha and should be .70 or greater. It is based on factor loadings and the error of those loadings. All composite reliabilities in Table 6 are above .70. The average variance extracted (AVE) is a measure of convergent validity and should be greater than .50. An AVE of .50 would mean that 50% of the variance in the factor was explained by the indicators loading onto that factor. The AVE for all factors in Table 6 is above .70, suggesting that the respective indicators of each factor explained a minimum of 70% of the variance in that factor. The Maximum Shared Squared Variance (MSV) refers to the maximum variance a factor shares with another factor. This value should be less than AVE because an MSV higher than AVE would mean that the variance in a particular factor was being explained by another factor. All MSV values were less than the corresponding AVE value, suggesting good discriminant validity. To the right of the MSV column is a correlation table for the factors in the analysis. All correlations in the table were less than the variances on the diagonal, which demonstrates good convergent and discriminant validity (Hair, Black, Babin, & Anderson, 2010; Hu & Bentler, 1999: Gaskin, 2012).

Table 5: Finalized SEM Scales

External Leadership	Goal Setting & Monitoring (Previously Transition/ Action Processes)	Outcomes
• Innovator • Broker • Director	• Mission Analysis • Goal Specification • Strategy Formulation and Planning • Monitoring Progress Towards Goals	• Team Performance • Team Satisfaction • Team Innovation
	Interpersonal Processes • Motivating and Confidence Building • Affect Management	

Figure 4: Revised Models

A. Fully Mediated Model
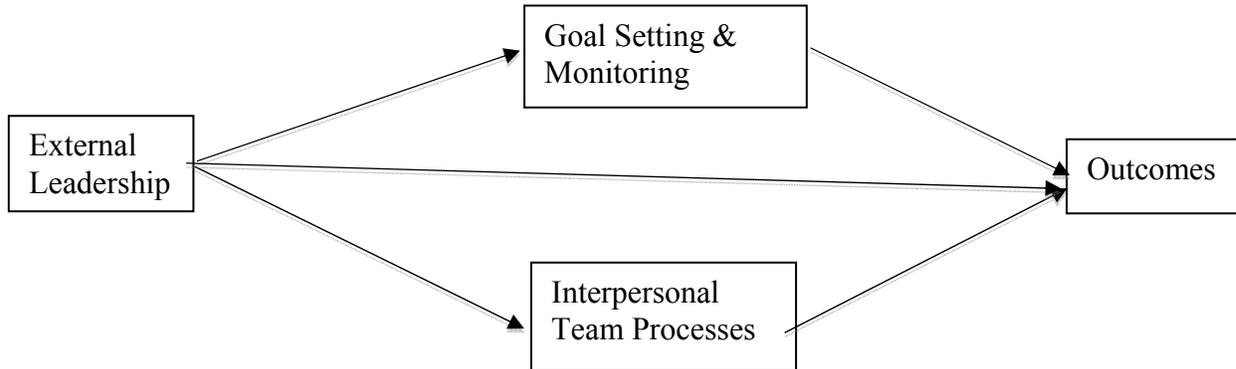
B. Partially Mediated Model

Goal Setting & Monitoring

External Leadership
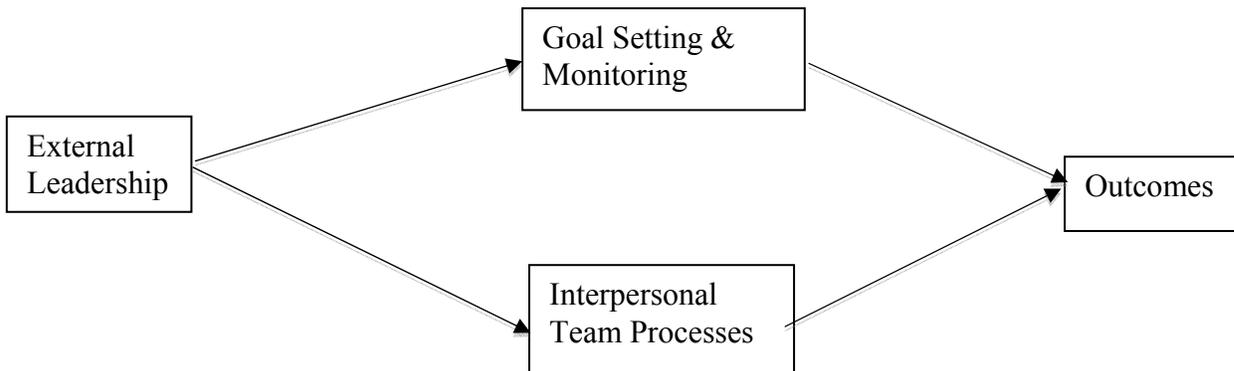
Outcomes

Interpersonal Team Processes

Table 6: Validity Criteria.

	CR	AVE	MSV	External Leadership	Goal Setting & Monitoring	Interpersonal Processes	Outcomes
External Leadership	.882	.716	.507	.846			
Goal Setting and Monitoring	.927	.761	.421	.478	.873		
Interpersonal Team Processes	.903	.823	.642	.712	.649	.907	
Outcomes	.884	.719	.642	.663	.564	.801	.848

Finally, I tested for common method bias by including a common latent factor. Examination of standardized regression weights indicated that this common latent factor should not be retained prior to imputing variables for the structural equation model.

Revised Hypothesis Testing

Because a number of factors were removed from the final measurement model due to small sample sizes, poor factor loadings, and poor discriminant validity, I could not test all of the hypotheses as originally intended. The hypotheses I was able to test are outlined here. In most cases hypotheses associated with internal leadership have been revised to remove any references to internal leadership. In other cases, measures have been combined to create composite variables and hypotheses have been adjusted accordingly. Any hypotheses related to transition processes or action processes have been combined because transition processes and action processes loaded onto one factor. This new factor is the factor that is highly related to setting goals and monitoring progress towards goals, which I re-labeled as goal setting and monitoring. Hypotheses referencing emergent states were removed because scales related to emergent states were highly correlated with outcomes and were not included in further analysis. Even though the scale for empowerment did not achieve a Cronbach's alpha of .70 I included hypotheses related to empowerment as an exploratory analysis. Specific indicators are outlined in Table 5.

H1R: Virtual teams ratings on external leadership (i.e., broker, innovator, director) are positively related to ratings on overall virtual team outcomes (i.e., team innovation, team satisfaction, team performance).

H2R: Virtual team ratings on goal setting and monitoring (i.e., mission analysis, goal specification, strategy formulation and planning, monitoring progress towards goals) are positively related to ratings on overall virtual team outcomes (i.e., team innovation, team satisfaction, team performance)

H3R: External leadership roles account for more variance in ratings on overall

virtual team outcomes than team goals setting and monitoring.

H4aR: Empowerment will mediate the positive relationship between external

leader roles and goals setting and monitoring in virtual teams.

H4bR: Empowerment will mediate the positive relationship between external

leader roles and team interpersonal processes in virtual teams.

H5R: Virtual team ratings on interpersonal processes (affect management,

motivation and confidence building) are positively related to ratings on overall

virtual team outcomes.

Structural Equation Models

I fit the revised fully mediated structural equation model as shown in Figure 4a

and obtained poor fit (χ^2 = 12.241 df = 2, CMIN/ DF = 6.120, CFI = .872, RMSEA =

.406, PCLOSE = .003). Then I added a path from external leadership to outcomes and

tested the partially mediated model and obtained a similar (poor) fit (χ^2 = 11.034, df = 1,

CMIN/ DF = 11.034, CFI = .875, RMSEA = .569, PCLOSE = .001). The path from goal

setting and monitoring to outcomes was not significant so it was removed from the

model. Because not having a direct or indirect path from goal setting and monitoring to

outcomes does not make theoretical sense a path was added from goal setting and

monitoring to interpersonal processes. This led to acceptable fit (χ^2 = .119, df = 1,

CMIN/ DF = .119, CFI = 1.000, RMSEA = .000, PCLOSE = .740). However, when

controlling for percent of face-to-face interaction, interdependence, and usefulness of e-

collaboration tools, this led to a poor fitting model (χ^2 = 26.669, df = 13, CMIN/ DF =

2.051, CFI = .856, RMSEA = .184, PCLOSE = .025). Because face-to-face interaction

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and workflow interdependence did not account for significant variance in outcomes, I did

not include them in further analyses. See Figure 5 for the final model that shows β' s for

all paths. Thus the final model including e-collaboration as a control had fit statistics as

follows (χ^2 = 4.429, df = 4, CMIN/ DF = 1.107, CFI = .995, RMSEA = .059, PCLOSE =

.392). All paths were significant except for the path from external leadership to

outcomes. The R^2 for the model was .74.

I also tested a model including objective outcomes operationalized as percent of

target achieved. However, because there were no significant relationships with the

measure of objective outcomes I did not include objective outcomes in any further

analysis of the structural equation model.

Figure 5: Final Mediation Model with Parameters
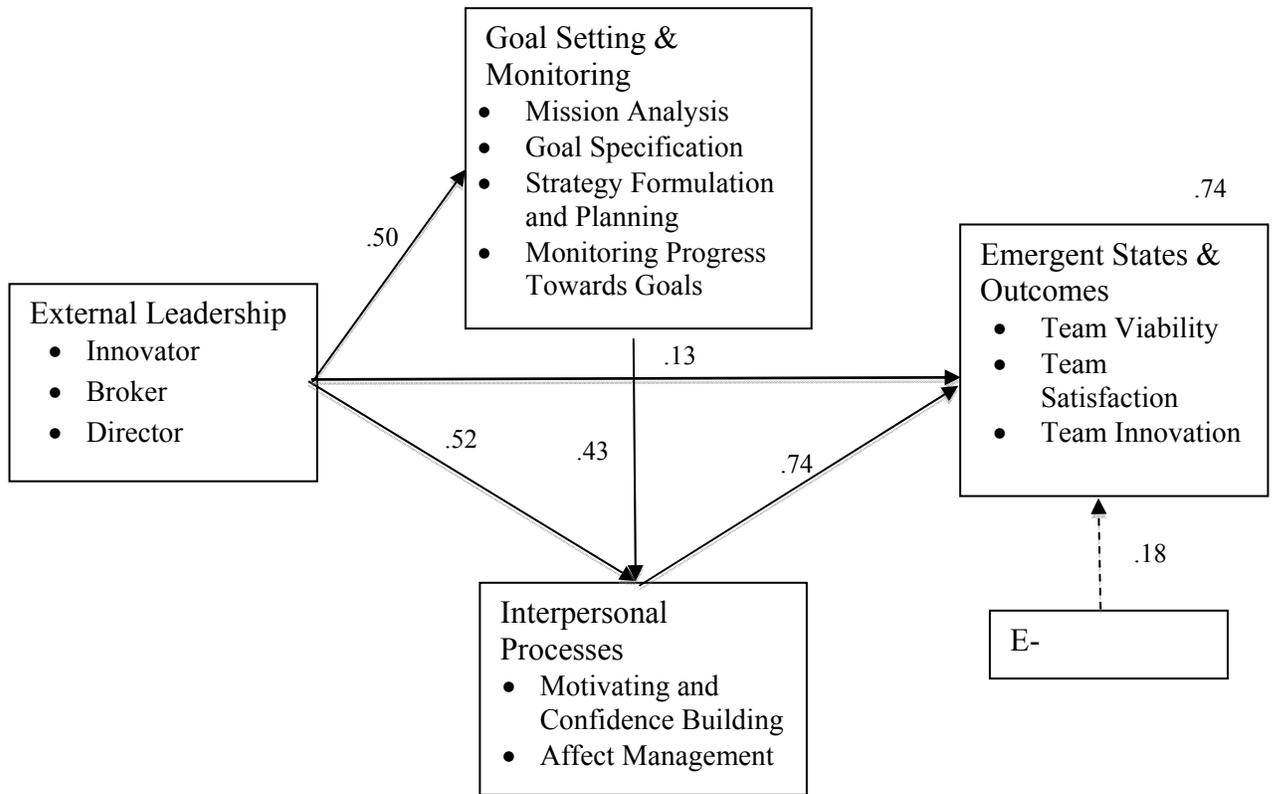
Mediational Analyses

I used Baron and Kenny's (1986) approach with bootstrapping to test for mediation (Gaskin, 2012). First, I tested the mediating effect of goal setting and monitoring on the relationship between external leadership and interpersonal processes (see Table 7). The direct effect of external leadership on interpersonal processes, which I tested by removing all indirect effects, was significant (β = .74, p <.001). With goal setting and monitoring present this effect was reduced but remained significant (β = .53, p <.001). This suggests that team goal setting and monitoring partially mediated the relationship between external leadership and interpersonal processes, which was supported through bootstrapping results (p<.01).

Next, I tested if interpersonal processes mediated the effect between external leadership and outcomes. The direct effect between external leadership and outcomes was significant (β = .65, p <.001) and the indirect effect of external leadership on outcomes via interpersonal processes was not significant (β = .14, ns), indicating that the relationship between external leadership and outcomes was fully mediated by interpersonal processes. Bootstrapping provided additional support for full mediation (p<.01).

Finally, I tested if interpersonal processes mediated the effect of team goal setting and monitoring on outcomes. The direct effect of team goal setting and monitoring on outcomes was significant (β = .34, p <.001) and the indirect effect of team goal setting and monitoring on outcomes via interpersonal processes was not significant (β = .03, ns). This suggests that the relationship between team goal setting and monitoring and outcomes was fully mediated by interpersonal processes, which was supported by bootstrapping (p<.01).

Table 7: Test for Mediation

Relationship	Direct without Mediator β	Direct with Mediator β	Indirect, No mediation Bootstrap results
External Leadership → Goal Setting and Monitoring → Interpersonal Processes	.737(.001)	.525(.001)	Partial Mediation (.01)
External Leadership → Interpersonal Processes → Outcomes	.649(.001)	.139 (ns)	Full mediation (.01)
Goal Setting and Monitoring → Interpersonal Processes → Outcomes	.338(.001)	.037 (ns)	Full Mediation (.01)

Hypothesis Tests

Because the original measurement model was different from the hypothesized model, it was not possible to directly test the relationships originally hypothesized for this study. However, there were trends supporting some of the originally hypothesized relationships, which are outlined here. Overall, Hypothesis 1R was supported. It did appear that virtual teams that emphasized external leadership roles had higher ratings on outcomes (team innovation, team satisfaction, and team performance). Although it was not possible to test this relationship against leaders who emphasized internal leadership roles, it does seem that virtual teams with leaders who spend time creating an environment for innovation, brokering external relationships, and setting direction do perform better than virtual teams with leaders who do not engage in these roles, which provides support for Hypothesis 1R. Although not originally hypothesized, this relationship was fully mediated by interpersonal processes.   All correlations between

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indicators of virtual team outcomes and indicators of external leadership were positive and significant at least at the .05 level.

Similarly, teams that performed goal setting and monitoring activities also received higher ratings on outcomes. Virtual teams that engaged in mission analysis, goal specification, strategy formulation and planning, and monitoring progress towards goals also had higher rating on outcomes (i.e, team innovation, team satisfaction and team performance), which provides support for Hypothesis 2R. Similar to Hypothesis 1R, this relationship was also fully mediated by interpersonal processes. Except for team satisfaction and strategy formulation, all correlations between aspects of virtual team outcomes and goal setting and monitoring were significant at least at the .05 level.

Although mediating relationships were not originally hypothesized, relationships between external leadership and outcomes, and goal setting and monitoring and outcomes, were both fully mediated by interpersonal processes. As can be seen in Table 7, external leadership did accounted for more direct variance in outcomes ($\beta = .65$, P<.001) than goal setting and monitoring ($\beta = .34$, P<.01), however, this relationship was fully mediated by interpersonal processes. This suggests that Hypothesis 3R was partially supported.

I also did an exploratory test to determine if empowerment mediated the relationships between external leadership and goal setting and monitoring as well as external leadership and interpersonal processes. The model did not fit the data when empowerment was included so hypotheses 4aR and 4bR were not supported.

Finally, Figure 5 shows that interpersonal processes did account for significant variance in outcomes ($\beta = .74$, P<.001), providing support for Hypothesis 5R. All

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correlations between aspects of interpersonal processes and outcomes were significant at least at the .05 level.

Although I did not originally hypothesize mediating relationships, I did test for them in the revised model. Team goal setting and monitoring partially mediated the relationship between external leadership and interpersonal processes. Interpersonal processes fully mediated the relationship between external leadership and team outcomes. Interpersonal processes also fully mediated the relationship between goal setting and monitoring and outcomes.

Discussion

The intent of this study was to do an initial test of a comprehensive model to develop understanding of the impact of leadership behavior and team processes on emergent states and outcomes in virtual teams. However, because of the number of variables in the initial study, a small sample size of 32 teams, and 159 usable individual responses, a number of variables were dropped from the final analyses and the original hypotheses had to be revised to reflect the variables that remained in the study.

Although the results should be interpreted with caution, they do provide some interesting patterns to be further investigated in future research. The final SEM model shows that interpersonal processes mediate the relationships between external leadership and virtual team outcomes, as well as between goal setting and monitoring and virtual team outcomes. External leadership was composed of the leadership behaviors of broker, innovator, and director. Goal setting and monitoring included mission analysis, goal specification, strategy formulation and planning, and monitoring progress towards goals.

Interpersonal processes included affect management and confidence building and outcomes included team innovation, team performance, and team satisfaction.

From a practical standpoint this suggests that virtual team leaders who focus on innovator, broker and director behaviors will support their virtual team in defining their objectives by supporting their readiness and flexibility as well as establishing parameters for goal setting. By acquiring external resources, building support, facilitating change through creative mechanisms, and building the external legitimacy of the team through developing, marketing to, negotiating with, and maintaining external contacts, the virtual team leader sets the foundation for the virtual team's success. The virtual team leader also has the role of planning and goal setting, clarifying roles and objectives, generating rules and policies, defining problems, establishing clear expectations, and evaluating performance (Quinn, 1988). These results also lend support for Carte et al.'s (2006) findings that virtual team leaders will likely need to at least set the higher level or bigger picture direction for virtual teams because of the limited time available for virtual team members to discuss and come to agreement on roles, responsibilities, and team direction.

With the aforementioned support structures and goal setting parameters available, the members of the virtual team are then able to engage in goal setting and monitoring, consisting of mission analysis, goal specification, strategy formulation, and monitoring progress towards goals (Marks et al., 2001). Virtual teams are often composed of professionals with the technical knowledge required to enable the virtual team to effectively achieve outcomes (Zigurs, 2003). Thus, they may be less likely to require technical mentorship from team leaders. With knowledge of resources, environmental conditions, program parameters, and support for progressive change provided by virtual

team leaders, virtual team members can then engage in evaluating the team's mission and identifying main tasks. Virtual team members are also involved in identifying and prioritizing goals and sub-goals (this is not done by the virtual team leader who only provides high level goals) and developing alternative courses of action to achieve desired outcomes. As professionals, virtual team members are also able to monitor their own progress towards goals by tracking their progress on individual tasks, determining what factors are contributing to gaps in goal accomplishment, and sharing knowledge about progress and barriers within the team members.

The results of this study suggest that if virtual team leaders engage in external leadership behaviors and create an environment that supports progressive change, acquire and share knowledge about the resources availability, and set high-level goals, roles, and objectives, then virtual team members will be able to engage in the details of goal setting. The details of goal setting may involve task prioritization, developing alternative courses of action, and sharing knowledge of progress, or identifying barriers towards progress. If these conditions are met, the results of this research suggest that team members will also engage in building confidence, motivation, and task-based cohesion of team members that, in turn, encourage effective task completion (Marks et al., 2001). Team members will also take on the role of regulating team members' emotions, and managing aspects of team functioning such as cohesion, frustration, and excitement.

Finally, if team members are motivated, confident in their abilities, and extreme emotions of frustration and excitement are managed, team members will report higher levels of team performance, team innovation, and team satisfaction. Thus, it appears that if virtual team leaders create the appropriate context, virtual team members can set and

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achieve goals, which will facilitate their ability to enhance motivation, confidence, and manage affect within the team. Motivated team members with a supportive context, clear goals, strategies for meeting these goals, and balanced affect will subsequently report more positive perceptions of team outcomes.

Although this study is primarily exploratory due to limitations stemming from a small sample size, it does suggest that the role of the virtual team leader may be more externally focused than that of a face-to-face team leader. This makes sense, given that members of virtual teams are often professionals who are able to motivate themselves and possess the technical skills to achieve high levels of performance (Zigurs, 2003). Even though virtual team leaders may be distanced from their team members, they will likely have increased accessibility to senior leaders, key stakeholders, and those who have access to key resources such as information, tools, funding, and better access to knowledge regarding organizational objectives, and environmental or market influences. With this accessibility, it seems that the virtual team leader would provide the most support to virtual team members by creating the context to allow team members to set manage and monitor appropriate goals, given knowledge that the virtual team leader has shared regarding the external environment. Trust would then develop through meeting objectives and performance standards over a period of time with contextual support provided by the virtual team leader and production effort provided by team members.

These findings suggest that virtual teams may be the most successful when there is an implicit and default environment for trust. Virtual team members must trust that virtual team leaders will advocate on their behalf, clear barriers, and do what they can to access the resources required by virtual team members to achieve their goals in a timely

manner. Conversely, virtual team leaders need to trust that virtual team members, if given the appropriate information, resources, and support, will put their full effort toward achieving their goals. Team members also need to trust one another to enhance motivation, build confidence, and manage and not exacerbate intense affective expression, such as excitement or frustration. This is similar to Ilgen's et al.'s (2005) original notion that trust is based both on competence and a belief that team members will not harm one's own interests. Furthermore, if there is trust between virtual team members and virtual team leaders, there will be an expectation that everyone will play their part and this can drive motivation (Zaccaro & Bader, 2003; Zigurs, 2003). Team members may quickly establish unconditional trust as they work towards a common purpose, mission, and goals (Shamir et al., 1993) or they may establish trust over time through met expectations (Jones & George, 1998; Zaccaro & Bader, 2003).

Limitations

This study has a number of limitations. First, I was only able to obtain a small sample size of 32 teams. This limits the confidence that can be had in the results. Maximum likelihood is fairly robust even with small N, except for factors with two-indicators which can lead to biased parameter estimates and apparent fit that is slightly positively biased. Since interpersonal team processes were composed of only two indicators, results should be interpreted with caution (Hau & Marsh, 2004).

Second, empowerment did not meet the cut-off for Cronbach's alpha of .70 and was dropped from the main analysis. However, because empowerment was part of the originally proposed theory I did do an exploratory analysis with empowerment fully mediating the direct relationship between external leadership and goal setting and

monitoring as well as the direct relationships between external leadership and interpersonal processes. However, this model, as well as alternative models, was a poor fit for the data ($\chi^2 = 26.882$, df = 9, CMIN/ DF = 2.987, CFI = .839, RMSEA = .253, PCLOSE = .003). The model including empowerment is shown in Figure 6.

Figure 6: Exploratory Model Including Empowerment as Mediator
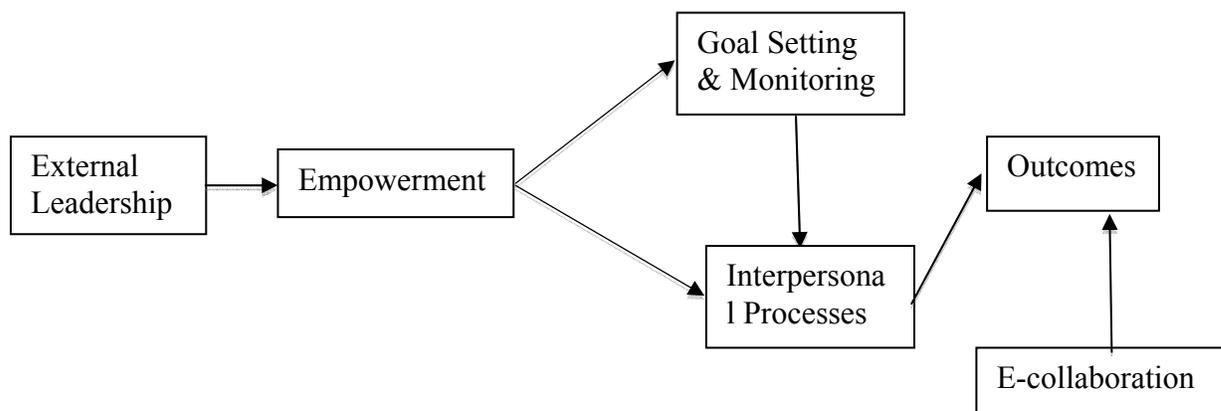
Similar to this situation with empowerment, psychological safety just met the .70 cutoff but had bivariate correlations of .05 between scale items.   It was originally included as part of the final analysis but was dropped due to poor factor loadings. In addition, 13 out of the 25 remaining variables had to be removed from further analyses due to poor factor loadings and poor discriminant validity in the confirmatory factor analysis. This also meant that I was not able to test for relationships associated with emergent states.

Third, because all responses were collected via a single survey, there is potential for common method bias. On the positive side, introducing a common latent factor did

not significantly change standardized regression weights, so this common latent factor was not retained.

Fourth, even though it was decided that results could be analyzed at the team level, not all r_{wg} and ICC(1) and ICC(2)'s met the typical required cut-off for aggregation. However, all but two ICC(1) values were within the range of .06 to .48 and all r_{wg} values were within the range of .46 to .90. It's possible that, in some cases, a calculation of r_{wgp} (LeBreton & Sentor, 2008) for bi-modal distributions would have been more appropriate because of multimodal data that could result from in-group and out-group leadership effects. However, I did not do this calculation, as it was not specified a priori.

Finally, future researchers may wish to capture information about virtual teams using longitudinal methods. As these data were captured at a single point in time, it is not possible to be confident about the order of events in this study.

Future Research

This study combines two bodies of research.   To date, there are few studies of virtual team leadership that also highlight the role of virtual team members (cf., Zander et al., 2013), whereas research emphasizing virtual teams tends not to explicitly highlight the role of virtual team leaders. The current study suggests that both virtual team leadership and virtual team process positively contribute to virtual team outcomes and takes an initial step toward the integration of the research on virtual teams and virtual team leadership. The current research specifically suggests that virtual team leaders may have a larger role influencing external stakeholders with access to resources and information and then relaying this information back to virtual team members. Members

of virtual teams would have the role of using this information to set goals, build strategies, and communicate progress and barriers towards goals.

In addition, this research suggests that members of virtual teams may not treat emergent states and outcomes as indicators of distinct factors. Future research might further investigate if emergent states are perceived independently from outcomes in virtual teams. If they are not perceived independently, is there some factor unique to virtual teams that impacts perceptions of emergent states, such as shared understanding, potency, trust, cohesion, and psychological safety. As emergent states still need more attention in research addressing the face-to-face work environment, this lack of distinction may not be unique to the virtual team environment.

Unfortunately, this study did not have enough respondents to run all variables in the study. Therefore, future researchers may wish to look at additional components of the study. One of the key areas that could not be studied because of poor factor loadings was the effect of internal leadership on virtual team outcomes. Future research could further investigate if the impacts of internal leadership differ from external leadership or alter the influence of external leadership in virtual teams. Thus, continuing this line of research combining virtual team leadership with virtual team processes can help to further clarify where virtual team members can add value and what is really required of virtual team leaders to create the most positive impact on virtual team performance. Future research might also distinguish between different types of teams, such as product teams, production teams, and service teams, since the role of virtual team leaders and virtual team members may differ based on the type of team and the desired outcomes.

Virtual team leaders have challenges that may not be encountered as frequently by face-to-face leaders. Virtual teams can have team members that are globally distributed, with different perspectives regarding what makes virtual team leadership effective. Additionally, different functional backgrounds and country specific cultures can influence team member's perceptions regarding the importance of various virtual team outcomes. Global and cultural factors provide a rich opportunity for additional research on virtual team leadership and group process.

Overall, the full model presented here requires more research with more teams. Additional data would increase the confidence that can be had with regard to the accuracy of the current findings. On a positive note, effect sizes in the study are fairly large, providing some confidence with respect to the results.

Conclusions

This study provides some interesting, though very preliminary results related to leadership in virtual team environments. Even though this study is exploratory in nature, it does suggest that virtual team leaders may have a more significant role exerting upward influence and influencing key stakeholders outside of the virtual team in order to gather resources, support, and information. In addition, virtual team members take on the responsibility of setting specific goals, defining team strategy, and monitoring and communicating goal progress and barriers to the team. The combined roles of virtual team leaders and virtual team members then impact affect management and motivation and confidence building, which subsequently have positive correlations with team outcomes such as team innovation, team performance, and satisfaction. These relationships may all be held together by trust. The ability to trust colleagues to take on

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their specific roles and perform to required standards is likely prerequisite to effective

virtual team functioning. Understanding how the roles of virtual team leaders and virtual

team members are different but related in their ability to impact team outcomes may also

help to reduce conflict and confusion. Role clarity may have the additional benefit of

reducing overall workloads in virtual teams, again leading to more positive outcomes.

Additional field research comparing contributions of virtual team members and virtual

team leaders is strongly encouraged. This study just begins to scratch the surface of this

major workplace trend.

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Appendix

Survey Items

Workflow Interdependence

How dependent is your work on the work of your team members?

1. My work is independent from the work of my team members.

2. My work is slightly dependent on the work of my team members.

3. My work is moderately dependent on the work of my team member.

4. My work is very dependent on the work of my team members.

5. My work is extremely dependent on the work of my team members. Work and information frequently flows back and forth during the completion of a project or average day.

Virtuality

What percent of time do you spend communicating with your team members face-to-face?

< 20%   21-40%   41-60%   61-80%   80-100%

Team size

How many members are on your team? _____

Type of Team

My team is primarily a (circle the item that applies):

1. Production Team (e.g., automobile assembly)

2. Service Team (e.g., retail)

3. Management Team (e.g, senior management for HR, Finance, or Operations etc.)

4. Project Team (e.g., to develop new products or processes)

5. Action and performing team (e.g., surgical team, aircrew, military team etc.)

Perceived Usefulness of E-Collaboration Tools

Indicate the extent to which you agree with each of the following statement using the following scale: 1, "Strongly Disagree"; 5, "Strongly Agree".

1. The e-collaboration tools used by my team improve my performance on the job.

2. The e-collaboration tools used by my team increase my productivity.

3. The e-collaboration tools used by my team increase my effectiveness.

4. I find the e-collaboration tools used by my team to be useful in my job.

Experience with Collaborative Technologies

Identify the collaborative technologies that you or your team members have used to increase collaboration/ productivity. Please check all that apply.

1. Email (Gmail, Outlook)

2. Blogging/ website tools (WordPress, Blogger/ Blogspot, Edublogs, Tumblr)

3. Wiki/ Website tools (Wikispaces, Google Sites, PBWorks)

4. Video tools - viewing, creating, sharing (YouTube, TED Talks/ Ed, Khan Academy, Movie Maker, Vimeo, iMovie)

5. Audio Tools (Audacity, iTunes and iTunesU)

6. Web conferencing tools (Adobe Connect, Blackboard Collaborate, WebEx)

7. Live communication/ feedback tools (Skype, Poll, Everywhere)

8. Enterprise collaboration platforms (Sharepoint, Google Apps, Buddypress)

9. Public Social Networks (Twitter, Facebook, Google+/Hangouts, LinkedIn)

10. Private social networking platforms (Yammers, Edmodo, Ning, Buddypress)

11. Social bookmarking tools (Diigo, Delicious, Popplet)

12. Pinboarding tools (Pinterest, Learnist)

13. Content curation tools/ social magazines/ newspapers (Scoopit, Flipboard, Zite, Paper.li)

14. Digital organizers (Livebinders, Symbaloo, MentorMob)

15. Mindmapping tools (Mindmeister, Mindjet)

16. Note taking tools (Evernote, OneNote)

17. Survey Software (SurveyMonkey)

18. File synchronization/ cloud storage (Dropbox, Windows Skydrive)

Leadership Complexity Measure

Listed below are some statements that describe management behaviors. Indicate how often you engage in each of these behaviors when doing your job using the following scale: 1, "Never"; 5 "To a Great Extent".

External Leader Roles

Innovator (Alpha = .90)

1. Comes up with inventive ideas.

2. Experiments with new concepts and procedures.

3. Does problem solving in creative, clever ways.

4. Searches for innovations and potential improvements.

Broker (Alpha = .85)

1. Exerts upward influence in the organization.

2. Influences decisions made at higher levels.

3. Gets access to people at higher levels.

4. Persuasively sells new ideas to higher-ups.

Producer (Alpha = .72)

1. Maintains a "results" orientation in the unit.

2. Sees that the unit delivers on stated goals.

3. Pushes the unit to meet objectives.

4. Emphasizes unit's achievement of stated purposes.

Director (Alpha = .79)

1. Defines areas of responsibility for subordinates.

2. Makes sure everyone knows where the unit is going.

3. Sets clear objectives for the work unit.

4. Clarifies priorities and direction.

Internal Leader Roles

Coordinator (.77)

1. Protects continuity in day-to-day operations.

2. Minimizes disruptions to the workflow.

3. Keeps track of what goes on inside the unit.

4. Brings a sense of order to the unit.

Monitor (Alpha = .73)

1. Carefully reviews detailed reports.

2. Compares records, reports, and so on to detect discrepancies.

3. Works with technical information.

4. Analyzes written plans and schedules.

Facilitator (Alpha = .89)

1. Facilitates consensus building in the work unit.

2. Encourages participative decision making in the group.

3. Encourages subordinate to share ideas in the group.

4. Builds teamwork among group members.

Mentor (Alpha = .87)

1. Listens to the personal problems of subordinates.

2. Shows empathy and concern in dealing with subordinates.

3. Treats each individual in a sensitive, caring way.

4. Shows concern for the needs of subordinates.

Team Process (Items not to be shared without permission)

Rate the items below using the following scale: 1, "Never"; 5, "To a Great Extent".

Transition Processes

Mission Analysis

Goal Specification

Strategy Formulation & Planning

Action Processes

Monitoring Progress Toward Goals

Resource and Systems Monitoring

Team Monitoring and Backup

Coordination

Interpersonal Processes

Conflict Management

Motivating & Confidence Building

Affect Management

Empowerment

Indicate the extent to which you agree with each of the following statement using the following scale: 1, "Strongly Disagree"; 5, "Strongly Agree".

1. My team is empowered to change work processes in order to improve performance.

2. My team is empowered to allocate resources in order to improve performance.

3. My team is empowered to allocate budget in the best way in order to improve performance.

4. Members of my team are responsible for identifying the best way to satisfy customer needs.

5. Members of my team are responsible for monitoring our own progress.

6. Members of my team are responsible for developing our own strategy to achieve goals.

Potency Measure

Indicate the extent to which your team demonstrated each of the following feelings or beliefs using the following scale: 1, "Never"; 5, "To a Great Extent".

1. Does your team have confidence in itself?

2. Does your team expect to be known as a high-performing team?

3. Does your team feel it can solve any problem it encounters?

4. Does your team believe it can be very productive?

5. Does your team believe it can get a lot done when it works hard?

6. Does your team believe no task is too tough for this team?

7. Does your team expect to have a lot of influence around your workplace?

8. Does your team believe it can become unusually good at producing high quality work?

Psychological Safety Measure

Indicate the accuracy of each of the following statements using the following scale: 1, "Very Inaccurate"; 5, "Very Accurate".

1. If you make a mistake on this team, it is often held against you (reverse scored).

2. Members of this team are able to bring up problems and tough issues.

3. People on this team sometimes reject others for being different (reverse scored).

4. It is safe to take a risk on this team.

5. It is difficult to ask members of this team for help (reverse scored).

6. No one on this team would deliberately act in a way that undermines my efforts.

7. Working with members of this team, my unique skills and talents are valued and utilized.

Shared Understanding

Indicate the extent to which your team has clarity with respect to the following areas using the following scale: 1, "Never"; 5, "To a Great Extent".

1. Most of my team members have a clear sense of the roles and responsibilities on this team.

2. Most of my team members have a clear sense of the goals of this team.

3. Most of my team members have a clear sense of the strategy for this team.

4. Most of my team members have a clear sense of how to effectively use the technological tools (phone, email etc.) available to this team.

5. Most of my team members have a clear sense of how to effectively use the technological tools (phone, email etc.) available to this team.

6. Most of my team members have a similar understanding of how close we are to achieving our goals.

Team Effectiveness

Indicate the extent to which you agree with each of the following statements using the following scale: 1, "Strongly Disagree"; 5, "Strongly Agree".

Team Performance

1. My team outperforms most other teams in my organization.

2. My team continuously meets or exceeds expectations.

3. My team does excellent work.

Team Viability

1. I believe this team would perform successfully on similar task in the future.

2. I believe this team could continue to work together successfully in the future.

3. I would choose to work with this team on similar tasks in the future.

4. Being a member of this team is a positive experience.

Team Satisfaction

1. Some aspects of my team's work processes could be improved (reverse scored).

2. Overall I am satisfied with the working relationships on my team.

3. When compared to other teams I have worked with in the past, I would prefer to work on my current team.

4. I am happy with the contributions that my team members make.

5. I believe my team members enjoy working with me.

Innovation

1. Team members often implement new ideas to improve the quality of our products and services.

2. This team gives little consideration to new and alternative methods and procedures for doing their work (reverse scored).

3. Team members often produce new services, methods, or procedures.

4. This is an innovative team.

Effectiveness – Managers only

What was the key metric that your team was measured on during the last quarter (i.e., sales target, production target, utilization target etc.)?:

_____

What percentage of the above target was achieved during the most recent quarter?

< 25%   25-50%   50-75%   75-100%   >100%

Vita

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- 2005 Master of Science Industrial Organizational Psychology at the Pennsylvania State University

- 1998 Bachelor of Science Biopsychology at the University of British Columbia

Technical Reports

McNeese, M. D., Connors, E., Jefferson, T., Terrell, I., Jones, R., & Bains, P. (2004). An interdisciplinary approach to distributed cognition: New applications of theory, research, technology, and practice (Tech. Rep. No. 0016). University Park, PA: The Pennsylvania State University, School of Information Sciences and Technology

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