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LEADERSHIP, TRUST, AND EFFECTIVENESS IN VIRTUAL TEAMS

Leadership, confiance et efficacité dans les équipes virtuelles Completed Research Paper

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Abstract

Many organizations are using virtual teams to meet the increasing time and quality expectations of contemporary marketplaces. While virtual teams present advantages for cost control, access to expertise, and serving markets, they also engender practical challenges as a result of the geographic and temporal distribution of members. Previous research has suggested several factors that are critical for the functioning of virtual teams. We build upon this research with an exploration of the relationships between team leader personality, team member trust, and perceived team effectiveness in virtual teamwork. Participants in the study included 873 virtual team members within a combined government and commercial engineering environment. Our findings suggest that multiple facets of a team leader's personality have a significant impact on team effectiveness, but this effect is largely mediated through team trust. Implications for organizational managers, virtual team leaders, and the research community are discussed.

Key words: Virtual teams, virtual team trust, team leadership, personality, virtual team effectiveness.

Résumé

Cette étude explore les relations entre la personnalité du leader, la confiance des membres de l'équipe et l'efficacité perçues au sein des équipes virtuelles. Nos résultats suggèrent que la personnalité du leader exerce un effet significatif sur l'efficacité des équipes virtuelles. Toutefois, cet effet est principalement véhiculé par la confiance au sein de l'équipe.

Introduction

In most contemporary work environments, it is likely that workers will be called upon to participate on virtual teams at several points throughout their careers. Whether working on a project, contributing to a task force, or managing the global operations of an organization, modern professionals are frequently required to collaborate with individuals who they have never met face-to-face or who live and work thousands of miles away. The emergence of advanced information and communications technologies (ICTs), such as email, video conferencing, and online collaborative environments, has enabled the development of a wide variety of such distributed work arrangements. As a result, commercial activity on an expanded geographic scale and continuous timeline has become a prevailing reality.

Virtual teaming presents organizations with a range of potential benefits, including improved access to high-level talent, increased flexibility for knowledge professionals, enhanced ability to serve markets on a global scale, and reduction in travel costs and other expenses associated with traditional meeting arrangements (Lipnack and Stamps 1997; Majchrzak et al. 2000; Mowshowitz 1997). Yet significant challenges remain. While technology has created new horizons for communication and interaction over time and space, these novel work arrangements demand a set of interpersonal competencies, coordination processes, and leadership skills that are markedly distinct from those required in co-located team environments (Jarvenpaa and Leidner 1999). To achieve the envisioned benefits of virtual teaming, organizations must bring the right people together at the right time and do so quickly (Townsend et al. 1998). As working virtually becomes increasingly commonplace it is important to understand what factors influence the effectiveness of a virtual team.

The current study explores the factors that drive team effectiveness within virtual teaming arrangement. A number of such factors have been proposed within the research community, including the technologies employed and it's adaptation by team members (King and Majchrzak 2003; Majchrzak et al. 2000), patterns of communication (Pauleen 2003), the frequency of face-to-face interaction (Handy 1995), and incentive structures for team members (Lawler III 2003). Perhaps no facet of virtual team dynamics has received more attention than the question of trust among team members. Drawing upon the centrality of trust in traditional group dynamics research, several researchers have considered the degree to which various forms of trust are established and nurtured in virtual team environments (Iacono and Weisband 1997; Jarvenpaa and Leidner 1999; Kanawattanachai and Yoo 2002; Meyerson et al. 1996). Another area of significant interest in the management of virtual teams is the role of team leadership (Bell and Kozlowski 2002; Kayworth and Leidner 2001; Pauleen 2003; Poole and Zhang 2005; Yoo and Alavi 2004; Zigurs 2003). Many of these studies have focused on the emergence of leaders in *ad hoc* virtual teams, while others have called for greater research into the nature of virtual team leadership (Zigurs 2003).

In the present study, we seek to combine a consideration of leadership qualities with the dynamics of trust in virtual teams and their effects on team effectiveness. Specifically, we assess the degree to which personality traits of virtual team leaders impact the emergence of various forms of trust with virtual teams and in turn the effectiveness of the team's processes as perceived by it's members. In this effort, we focus on the following research questions:

What is the affect of a team leader's personality on the existence of trust within virtual teams? Which personality factors have the greatest influence?

What is the affect of a team leader's personality on the perceived effectiveness of a virtual team? Again, which personality factors are most relevant in this regard?

What forms of trust have the greatest influence on the perceived effectiveness of a virtual team?

To address these questions, we completed a large scale study of existing virtual teams within a large organization that is actively experimenting with, and expanding its use of, distributed work arrangements, namely the U.S. Department of Defense. With this focus on actual virtual teams and their experiences, we hope to advance research on the dynamics of virtual teams as they occur *in situ*.

In developing our analysis, we first provide a brief overview of the research on virtual teams with an emphasis on the roles of team leadership and trust in the management of such groups. We then present the theoretical model that grounds our study and the research methodology employed. The methodology is followed by a thorough discussion of our research findings. We then turn to a discussion of the significant implications of the research before offering some concluding thoughts.

Conceptual Foundations

Virtual Teams

Virtual team dynamics have a key area of interest with the information systems discipline since the mid-1990's. While the term has been defined in a variety of ways by different authors (Bell and Kozlowski 2002; Knoll and Jarvenpaa 1998; Majchrzak et al. 2000), the basic features of a virtual team are geographic and temporal distribution of team members with limited face-to-face communication and interactions mediated by ICTs (Poole and Zhang 2005). In their description, Jarvenpaa and Leidner (1999) add that virtual teams are generally temporary in nature, being rapidly formed (and disbanded) in an effort to address the emergent demands of a changing marketplace. Consistent with this fundamental picture of virtual teams, Henry and Hartzler (1997) offer a more detailed delineation of a team marked by the following: 1) relatively small size (i.e., usually consisting of less than 20 individuals), 2) geographical distribution, 3) working apart more frequently than in the same location, 4) making decisions based on a stratification of work, and 5) shared accountability for team results.

The emergence of virtual teams over the past two decades has been driven by several factors. Perhaps foremost among these is the tremendous advancement in computing and communications media in the later half of the 20th Century, including the development of such resources as email, instant messaging, video conferencing, electronic information exchange, and shared data repositories and other online collaborative systems (Majchrzak et al. 2000). In addition to these technological enablers, virtual teaming has been encouraged by the development of global markets for goods and services, the expansion of the network organizational form, and the creation of flexible work arrangements in many industries (Poole and Zhang 2005).

As noted in the introduction, virtual teams confront a wide range of both opportunities and challenges. One of the key benefits of distributed work arrangements is that organizations are no longer limited by geography in their pursuit of top quality personnel (Lipnack and Stamps 1997). Businesses and other entities can access key talent from around the world through virtual teaming. On the worker's side, knowledge professionals now enjoy tremendous flexibility in structuring the timing and location of their work (Davis 2004). Virtual team arrangements also offer significant cost savings over traditional collocated group efforts, because of reduced travel, less potential for work interruption, and the elimination of unnecessary meetings (Mowshowitz 1997). Finally, distributed groups enable organizations to explore commercial and other opportunities on a global scale (Kayworth and Leidner 2001).

While there are many apparent advantages to virtual teams, a range of challenges persist. One of the key questions in this regard is what is lost when team members are no longer co-located. A large body of research reveals that face-to-face communication engenders several key advantages in group formation, including the social bonding and symbolic commitment of group members (Nardi and Whittaker 2002), the promotion of cooperative choices (Sally 1995), and the coordination of group activity (Weick and Roberts 1993). Indeed, even the mere presence of other individuals (i.e., with no verbal communication) has been shown to have a positive effect of group outcomes, increasing individual attention and feelings of connection (Kiesler and Cummings 2002). The loss of this social presence combined with the asynchronous nature of their work poses significant communication and coordination challenges for virtual teams members (Montoya-Weiss et al. 2001). These coordination challenges are often acerbated by the cultural and professional diversity observed in virtual environments (Kayworth and Leidner 2001).

Trust in Virtual Teams

The significant interpersonal impediments posed by virtual teaming help to explain why trust has been a popular focus in research on the phenomenon. For the present discussion, *trust* is understood to mean "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer et al. 1995: 712). The expectation that a positive outcome will result from someone else's action has an element of risk for the trusting party. The ability to trust is, as Panteli (2005) stated, "a dynamic and emergent social relationship that develops as participants interact with each other over time and depending on the situation." Researchers have consistently argued that trust among virtual team members is a critical success factor (Kostner 1996; Nilles 1998).

Trust has been well-established as bellwether of team performance among traditional, face-to-face teams (Bromiley and Cummings 1995; Butler Jr 1991; McAllister 1995) High levels of trust have been reported to reduce interpersonal transaction costs (Handy 1995), increase security in relationships (Stinnett and Walters 1977), promote open information exchange (Larzelere and Huston 1980), enable risk taking (McAllister 1995), and contribute to the

well being of individuals and the stability of organizations (Cook and Wall 1980). Morgan and Hunt (1994) found that trusting work relationships influenced cooperation, reduced conflicts, increased commitment to the organization, and reduced the tendency to leave.

Thus, the importance of trust to effective team dynamics is clear. Yet, if face-to-face interaction is considered the sine qua non for the development of interpersonal trust (Nohria and Eccles 1992), how can trust be created and maintained in distributed work arrangements? Iacono & Weisband (1997) found that high levels of trust were achieved by virtual teams who remained focused on the work content of their group, moved efficiently between work tasks, and engaged in regular and frequent communication. While work focus was important, the researchers also found that groups who achieved significant social penetration (i.e., a social understanding between group members) early in a project effort exhibited higher levels of intragroup trust. In addition, Iacono & Weisband contend that the trust observed within virtual teams tends to take the form of "swift trust" (Meyerson et al. 1996), in which team members import expectations of trust from past experiences for time-limited projects with clear task objectives. In another study on trust in virtual teams, Jarvenpaa & Leidner (1999) investigated the issue through the analysis of email archives and interviews with participants in a global virtual collaboration. As with Iacono & Weisband (1997), they found that effective groups tended to exhibit swift trust, and teams marked by significant trust were those in which members maintained a strong task focus and a capacity for managing the ambiguities of their project. In addition, they found that initiative-taking (i.e., volunteering to complete some task) on the part of individual members was key to the development of trust, but that initiative-taking members required rapid and frequent feedback to sustain their initiative.

The idea of swift trust in virtual teams calls attention to the observation that trust is not a monolithic concept; multiple dimensions of trust can be considered. In their analysis of trust in virtual teams, Kanawattanachai and Yoo (2002) focus on the distinction between cognitive (i.e., based on rational assessments of trustworthiness and merit) and affective (i.e., driven by emotional bonds between individuals) forms of trust drawn form Lewis and Weigert (1985). They found that the cognitive element of trust is more significant than the affective element among high-performing virtual teams. Furthermore, they reinforce the findings of Jarvenpaa & Leidner (1999) regarding the importance of swift trust at the outset for high-performing teams. Importantly, it should be noted that both the studies by Kanawattanachai and Yoo (2002) and Jarvenpaa & Leidner (1999) focused on *ad hoc* virtual teams organized in an academic context, suggesting that the opportunities for the formation of affective trust may have been more limited than those for cognitive-based trust.

Leadership in Virtual Teams

Another key theme in the research on virtual teams is the role of leadership. In a review of the virtual teams literature, Poole & Zhang (2005) observe that "it appears that in comparison to traditional teams, virtual team leaders play a more important role in scheduling and structuring the communication practices as well as the work process" (p. 377). This finding is somewhat intuitive as the reduced salience of interpersonal commitments in virtual teams might be expected to result in diffusion of responsibility among members. The necessity of a leader to structure the group's activities thus takes on greater relevance (Bell and Kozlowski 2002; Kayworth and Leidner 2001). In many work groups, the role of leader may be determined a priori (e.g., a project manager). At other times, the leader emerges from within the group. In distributed teams, Yoo & Alavi (2004) found that leader emergence was tied to one's degree of effort in communication. Communications from the individuals that became leaders of their groups were more extensive, more frequent, and pulled together the ideas expressed by other participants. In addition to coordinating the efforts of the team, distributed group leaders can play a crucial role in resolved intragroup conflict. Armstrong and Cole (2002) have suggested that a virtual team leader can address conflict through multiple means, including polling of participants outside of group discussions, promoting appropriate dialogue when disagreements emerge, and fostering the input of the more introverted members of a group.

One of the fundamental tensions underlying the discussion of leadership in virtual teams is that between control and empowerment. Virtual team leaders must empower and motivate their team members to work independently, while at the same time exerting sufficient control over individual and group processes to ensure the maintenance of shared objectives and a common structure. As a result of geographic and temporal distribution, team leaders are less able to engage active oversight of team member's activities. It appears that traditional leadership approaches to the control of subordinates are poorly suited for distributed work environments. Indeed, Zigurs (2003) has suggested that virtual teaming arrangements necessitate a thoroughgoing examination and redefinition of leadership behavior. She contends that leaders in virtual teams must be less focused on overt control than on fostering relational development

within a team – compensating for the absence of more traditional opportunities for the creation of interpersonal bonds. This argument is echoed by several other researchers. Kayworth and Leidner (2001) find that successful virtual team leaders are those are capable of exerting authority in ways that are not perceived as overly rigid and overbearing. Similarly, Yoo and Alavi (2004) argue that individuals who emerge as leaders in newly formed virtual teams control the outcomes of the group by acting as integrators. Furthermore, they find that emergent leaders often initiate the process structure of a virtual team, but they do not seek to control the entire structuring process. Rather, such leaders allow the development of process structures through group collaboration and consensus building.

The facilitative demands of leadership in virtual teaming arrangements can also be understood to resonate with the ideas of earlier management theorists. For example, Fells (2000) argues that contemporary organizational practices are consistent with the framework for the balancing of control and empowerment developed by Fayol (1949). In his Gangplank Theory, Fayol holds that organizations achieve substantive improvement through the use of lateral (i.e., sideways or horizontal) communication. While Fayol maintained the need for traditional vertical control, he emphasized lateral communication that created structured opportunities for individuals and at the same level to exchange ideas across departmental and functional boundaries (O'Connor 2006). This is the relevant concept for the modern virtual team, because it suggests an improved mechanism for collaborative action, with teams identifying and solving problems as they occur (Haas 2003).

Finally, the interplay of trust and leadership behavior is a critical consideration which has received limited empirical analysis. Piccoli & Ives (2000) suggest that the open exchange of information which provides a key basis for the development of trust (especially, trust of the cognitive variety) within a group is critically tied to the leadership behavior within the team. Team members who share mutually valuable information with others establish a core for success within their teams. Team leaders are essential in fostering this sharing behavior (Cramton and Orvis 2003). Team members must be encouraged to help others and share what they know. In turn, they can expect the same behavior of other members. Thus, when team leaders promote this behavior by setting the example for others, trust among the members can be enhanced (Duarte and Snyder 2000).

Despite the research conducted in recent years, some authors have argued that we still know relatively little about the dynamics of leadership in virtual teaming environments (Zigurs 2003). Much of the recent research has focused on the concept of *emergent* leadership (i.e., the development of a leadership role in newly formed groups); less study has been directed at the role of formal or assigned leaders, despite the fact that this represents the more common condition in organizational practice. Similarly, a significant portion of virtual team literature has focused on team dynamics in *ad hoc* groups rather than the processes of existing virtual teams within organizations. Finally, much of the extant research considers the facilitating behaviors of virtual team leaders, but little work has been completed which incorporates an analysis of the personal characteristics of the leaders themselves – despite the existence of an extensive history of research examining the link between personality characteristics and effective leadership. Personality characteristics have been shown to predict overall leader effectiveness, and executive derailment (Barry & Stewart, 1997). Furthermore, personality is also predictive of emergent leadership - that is, early identification of leadership potential (Hogan, Curphy & Hogan, 1994).

Effectiveness of Virtual Teams

As with other technology-enabled innovations, the discussion of virtual teams must ultimately turn to the question of team performance or effectiveness. While our understanding of virtual team effectiveness in real work settings is still somewhat limited (Piccoli and Ives 2000), a number of studies have shed some light on the subject. Building upon earlier group dynamics research (most notably, Hackman 1990), Lurey and Raisinghani (2001) propose three criteria for assessing the effectiveness of virtual teams. First, team effectiveness can assessed based on the group's productivity and the degree to which the deliverables of the team address the requirements of the organization in which they are situated. Such measures of effectiveness can be assessed by the degree to which a virtual team's processes support the learning and maintenance of the team's function. Finally, the degree of satisfaction with team processes among members of the team provides a third approach to the measurement of virtual team effectiveness.

While acknowledging the challenges of using subjective measures of team performance, Lurey and Raisinghani (2001) note that such perceptual measures enable researchers to assess team effectiveness while a team is still in operations, in contrast to productivity measures which can often only be established after the fact. This point is reinforced by Campion et al. (1996), who argue that perceptual measures of team effectiveness provide accurate

predictions of a team's performance. In addition, Campion et al. (1996) call attention to the challenges posed by the relative dearth of clear-cut productivity measures in group work and limited comparability across teams.

Objective measures of virtual team effectiveness have included decision quality and quantity of output. The use of such objective measures appears to be particularly common in the assessment of ad hoc virtual teams in experimental studies. Kanawattanachai and Yoo (2002) divided teams of MBA students into high-performing and low-performing categories based on decision quality results in a strategic business simulation game. Similarly, Warkentin et al. (1997) compared virtual and traditional (i.e., face-to-face) teams based on the successful completion of information sharing task. Several researchers have looked to the quantity of ideas generated by virtual teams as a measures of team performance (e.g., Archer 1990; Chidambaram and Bostrom 1993; Chidambaram and Tung 2005).

Subjective measures of virtual team performance have included evaluations made by both team members and thirdparty entities. In several studies, the evaluation of team performance by professors or expert raters was used as a measure of team effectiveness (e.g., Aubert and Kelsey 2003; Chidambaram and Tung 2005; Iacono and Weisband 1997; Montoya-Weiss et al. 2001). Among studies of practicing work teams, the assessment of effectiveness by managers and team members is frequently employed (e.g., Edwards and Sridhar 2003; Hinds and Mortensen 2005; Maznevski and Chudoba 2000). Finally, team member satisfaction with the virtual team experience has been commonly applied as a measure of team effectiveness (e.g., Kayworth and Leidner 2001; Lurey and Raisinghani 2001; Warkentin et al. 1997). As we discuss later in the paper, the present study integrates both measures of perceived effectiveness and perceived satisfaction on the part of virtual team members.

Theoretical Framework

In the present study, we seek to build upon these varied streams of virtual teams research to explore the dynamics of leadership and trust within existing virtual teams. While a significant amount of the research literature has focused on emergent leadership, we believe it is essential that researchers consider the influence of formal or assigned team leaders, since this is the prevailing condition in most organizations. Whether they are given the label of senior manager, project manager, systems architect, or some other formal title, virtual team leadership is often established before team members interact for the first time or even before the team composition is established. Thus, it is relevant to consider what characteristics of virtual team leaders engender trust amongst team members and lead to effective virtual team experiences. To address the range of questions surrounding this domain, we adopt multi-dimensional measures of team leader personality, team trust, and perceived virtual team effectiveness. Our the hypothesized relationships between the five facets of virtual team leader personality, three dimensions of virtual team trust, and two measures of perceived virtual team effectiveness. Fundamentally, we seek to determine how various dimensions of team leader personality influence personality-based, institutional-based, and cognitive-based forms of trust, and in turn perceived virtual team performance and satisfaction.



Figure 1. Virtual Team Effectiveness Conceptual Model

Before we elaborate on the formal hypotheses reflected in our model, a more detailed discussion of construct definitions is in order.

Operational Definitions

As noted above, we have employed multi-dimensional measures of virtual team leader personality, virtual team member trust, and virtual team performance. The operational definitions for each of these constructs are provided in the following discussion. A summary table of all constructs is provided in Appendix 1.

Team Leader Personality Constructs

In this study, we assess the relevant characteristics of virtual team leaders using a widely-employed model of individual personality traits, often referred to as the *Big Five*. Consensus is emerging that a five-factor model can be used to describe the most salient aspects of individual personality (Goldberg 1990). Building on work by (Norman 1963) and (Tupes and Christal 1992), the efficacy of the five-factor structure has been repeatedly reproduced in factor analytic studies of existing personality inventories, analyses of trait adjectives in various languages, and decisions regarding the dimensionality of existing measures made by expert judges (McCrae and John 1992). In addition, the cross-cultural generalizability of the five-factor structure has been established through research in multiple countries (McCrae and Costa 1997), and the evidence suggests that the Big Five model has been stable over time (Costa and McCrae 1988; Digman 1989).

The dimensions comprising the five-factor model are Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. *Openness* refers to a disposition to be imaginative, nonconforming, open to ideas, and unconventional (McCrae and Costa Jr 1997). *Conscientiousness* is comprised of two related facets: a behavioral organizing or task-orientation element and an element of prudence or dependability (McCrae and John 1992). *Extraversion* represents the tendency to be sociable, assertive, and active, and to experience positive affects, such as energy and zeal (Watson and Clark 1997). *Agreeableness* refers to the tendency to be trusting, compliant, caring, and gentle (Digman 1990). Finally, *Neuroticism* refers to the tendency to exhibit poor emotional adjustment and experience negative affects, such as anxiety, insecurity, and hostility.¹

One of the most popular applications of the five-factor model has been to the area of job performance, in which a number of meta-analyses have been conducted (Anderson and Viswesvaran 1998; Barrick and Mount 1991; Hough et al. 1998; Hurtz and Donovan 2000). In the last decade there have been a series of advances which demonstrate convincingly that personality, as assessed through standardized instruments, has a predictive relationship with job performance – approaching, and in some cases exceeding, that of cognitive ability (Goffin et al. 1996; Nowack 1996). In addition, the Big Five traits have been found to be relevant in assessing many other aspects of personal behavior, such as subjective well-being (DeNeve and Cooper 1998) and even longevity (Friedman et al. 1995).

There are several reasons why we believe that personality should be considered when examining virtual teams. Individuals working in teams each bring something to the team that affects the way the team interacts. This "something" consists of expertise, cognitive ability, and the personalities exhibited by each team member. Hoyle and Crawford (1994) asserts that the analysis of a group or work team should include what the group member brings to the group. Many virtual teams are largely self-managed. In these particular work arrangements, management and leadership roles may not be the same as those in traditional teams. As Barry and Stewart (1997) note:

"Personality may be particularly important in self managed teams...the role of personality within self managed teams must be examined from a perspective that allows roles to evolve through interpersonal interactions. One method of determining this effect is to examine how group processes and performance vary with the number or proportion of group members with relatively high scores on personality traits that are theoretically related to group process and performance." p. 65.

The predictive utility of personality assessment is enhanced when job type and personality constructs are matched either based on the findings of previous research, rational analysis, or a thorough personality oriented job analysis (Raymark et al. 1997). This is to say, different tasks demand different personality profiles (Hogan et al. 1996). Thus,

¹ Several authors have employed the more positive and inverse framing for the construct of *Neuroticism* as *Emotional Stability*. We have opted to maintain the label of neuroticism because it reflects the current prevailing approach to the five-factor model (McCrae & John 1992).

we assert that the application of the five factor personality model to the characteristics of virtual team leaders provides a critical insight into the aspects of leadership that are most relevant in virtual team environments.

Team Member Trust

As we have noted above, a recognition of the multi-dimensional nature of trust has been widely observed in the research on virtual teams (e.g., Jarvenpaa & Leidner 1999, Kanawattanachai and Yoo 2002). In one particularly insightful study, Sarker et al. (2003) define virtual team trust as "the degree of reliance individuals have on their remotely located team members taken collectively (i.e., as a group)" (p. 37). They recognize three distinct dimensions of VT trust:

- 1. Personality-based trust Develops due to a person's propensity to trust.
- 2. Institutional-based trust A function of an individual's belief in institutional norms/procedures.
- 3. *Cognitive-based trust* Develops from social cues, impressions and interactive tasks that an individual receives/delivers to/from another.

In the present study, we adopt this three-faceted conception of trust, because we believe it incorporates and extends the distinction between cognitive and affective trust established by Lewis and Weigert (1985).

Perceived Team Effectiveness

Following Lurey and Raisinghani (2001) and Walters (2004), we adopt an operational definition of perceived team effectiveness as the sum of perceived satisfaction and perceived performance. We decided to employ perceptual measures of the virtual team effectiveness because such measures allow for assessment of effectiveness during the lifecycle of the team, i.e., while the team is still engaged in work. The virtual teams that we have studied were extant and in process; therefore, we approach perceived team effectiveness as a process measure, rather than an objective outcome measure. *Perceived performance* refers to team members' discernment of the team's ability to complete their work assignments. *Perceived satisfaction* refers to the levels of satisfaction with the team processes achieved by team members.

Hypotheses

The primary focus of this study is to understand the relationships between team leader personality, team member trust, and perceived virtual team effectiveness. In general, we expect positive measures of team leader personality to positively influence the levels of various forms of trust amongst team members.² Consistent with earlier research, enhanced team trust in turn is expected to result in higher measures of virtual team effectiveness. The detailed version of our hypothesized model is provided in Appendix 2. We propose the following formal hypotheses:

- *H₁*: A virtual team leader's personality traits of openness, extraversion, agreeableness, (low) neuroticism, and conscientiousness have a positive effect on team trust.³
- H_2 : A virtual team leader's personality traits of openness, extraversion, agreeableness, low neuroticism, and conscientiousness have a positive effect on perceived virtual team effectiveness.
- *H₃*: *Team member trust (in personality-, institutional-, and cognitive-based forms) has a positive effect on perceived virtual team effectiveness.*⁴

As these hypotheses convey, we expect to see both direct and indirect effects of team leader personality characteristics. We anticipate that the personalities of virtual team leaders have a direct relationship with the

² Four of the five personality scale items used can be characterized as "positive" measures with higher values indicating more generally desirable personality states. In the case of *Neuroticism*, the sole exception to this pattern, we expect an inverse relationship with both trust and virtual team performance.

³ For the sake of parsimony, we have clustered all of the personality constructs in the articulation of H1 and H2. Detailed subhypotheses could be stated for each constructs as these relationships were tested in the study.

⁴ As with the distinct leader personality characteristics, separate hypotheses could be stated for each of the forms of trust reflected in our theoretical model. Since the theorizing direction of influence is the same for all variants of trust, we have consolidated them into one stated hypothesis in the pursuit of parsimony.

perceived effectiveness of virtual teams. We also expect some partial mediation of the virtual team leader personality constructs through the three forms of trust employed.

Research Methodology

Background of the Study

In 1995, the United States Department of Defense (DoD) adopted the integrated product team approach in an effort to improve its processes for weapon systems acquisition (GAO 2001). The *integrated product team* (IPT) is a team structure and method that emphasizes multi-disciplinary representation and military-civilian collaboration. The IPT format is used to manage the acquisition of a wide range of products, including software systems and aircraft to support the United States military. While the DoD has seen several advances in efficiency and effectiveness as a result of IPT concept, the results of effort remain mixed. Despite the intent of the program, the generation of cross-functional solutions to acquisition problems has not been uniformly achieved (GAO, 2001). The management of distributed team members has been cited as one of the central challenges of the IPT approach (GAO 2001).

A large number of DoD IPTs are operated as virtual teams, with members geographically spread throughout the world. The U.S. General Accounting Office contends that the physical arrangement of DoD teams has sub-optimized IPT effectiveness (GAO, 2001). The current virtual team approach utilized by DoD information technology (IT) project teams has been shown to inhibit consistent delivery of quality programs on time and within budget (Haas 2003). Haas (2003) concludes that 83 percent of DoD IT acquisitions fail. In this context, failure can mean program cancellation, cost/schedule overruns, or inability to meet major functional requirements (Haas, 2003).

A virtual IPT within the DoD has decentralized core capabilities that are often clustered together along lines of responsibility linked to program execution. For example, a cluster in one geographic area may have acquisition responsibility for engineering products and services, while supporting and being supported by a user-community cluster that is responsible for requirements generation and management and is located in a separate area. An overarching oversight cluster for the program may be located elsewhere. A top-down management approach hinders the ability to engage in horizontal communication.

Thus, the DoD is currently wrestling with the challenges of moving from traditional teaming to a virtual team environment. The ambiguities around the function of leadership in this emergent operational environment suggest that the DoD experience provides a fruitful context for exploring the questions that drive the present research. Accordingly, we have conducted a large scale study of existing virtual IPTs. The data sample reflects government and commercial virtual engineering teams responsible for acquiring, developing, and fielding engineering solutions for the Department of Defense. The specific structure of the engineering teams varied, with roles and responsibilities stratified to leverage the knowledge, skills, and abilities of the diverse organizations involved. In our data collection efforts, we sought qualified respondents from teams that had a mix of contractor, military, and other government personnel who were geographically distributed and did not meet face-to-face on a regular basis.

Data Collection and Sample Characteristics

Of the 3,500 virtual team members surveyed, 1,045 participants responded, for a response rate of 29.9%. Of those participants who took the survey, 873 records were maintained, while 172 were eliminated due to reporting errors or incomplete responses. Of those participants who reported virtual team leader gender, there were 522 males (59.8%) and 351 females (40.2%). Teams consisting of 4 to 9 members dominated at 588 teams (67.4%). Teams having 10 to 19 members accounted for an additional 19.6%. The remaining 13.1% represented teams having 20 members or more. With regard to team leader selection, 53.7% of leaders were appointed, 17.6% were formally elected by team members, and 28.6% emerged informally. Over half (53.5%) of the team leaders had 5 years of experience or less; 24.5% had 6 to 9 years of experience; and 22% had over 10 years of experience in leading a virtual team. With respect to project topics, 28.5% were technical in focus, 39.8% were management-related, and 31.7% were a combination of management and technical. Finally, contractors held 74.2% of the virtual team leader positions, civil servants held 23.2%, and military personnel held 2.7%.

A survey instrument was sent to engineering and management personnel within the DoD and the commercial acquisition community.⁵ The survey consisted of demographic questions and items to measure team leader

⁵ The survey instrument is available via the web at: <u>http://filer.case.edu/swh4/PierceHansen_2008_Instrument.pdf</u>.

personality, team trust, and perceived team effectiveness constructs.⁶ Senior leaders within the organization facilitated initial access to virtual team members. To ensure confidentiality, participants were blind-copied on an email containing the instructional information and a link to the on-line survey. Completed surveys were submitted to a third-party vendor's website and were subsequently downloaded into SPSS and AMOS statistical software for analysis. In total, the survey took approximately 20 to 25 minutes for each participant to complete.

Data Analysis

The interpretation of the data consisted of an iterative process that began with close analysis of the descriptive statistics to gain an overall impression of normality, means, and standard deviations for each data item. Structural equation modeling (SEM) was used to test for significant correlations and relationships between the independent and dependent variables. Reliability analysis was conducted on all constructs, with all Cronbach's α measurements exceeding .758. A comprehensive test for mediation was also conducted using the causal steps method developed by Baron and Kenny (1986; MacKinnon 2008). The initial theoretical model was compared with a range of alternative SEM models to identify the most parsimonious quantitative model (i.e., reflecting the best goodness-of-fit results without overspecification).

Results

Evaluation of the Measurement Model

Utilizing exploratory factor analysis (EFA), there is clear evidence of convergent and discriminate validity for all items within the research model. The pattern matrix for the complete model reveals the expected major loadings for all items, with no significant cross-loadings.⁷ The factor correlation matrix indicates no cross-factor correlations greater than .685. Using AMOS, confirmatory factor analysis (CFA) identifies ten first order latent constructs and one second order latent construct (i.e., perceived effectiveness). The CFA produces the following model fit statistics: Chi-square = 1152.78, df = 396, p = .000; CFI=.961, PCFI=.818, NFI=.942, IFI=.961, and RMSEA=.047. The standardized factor loadings were all statistically significant (t-values > 2.32, p <.001) and all greater than .5, with the vast majority between .7 and .9. Overall, the analysis of measurement model strongly suggests that the items are suitable and that the constructs are appropriate for subsequent analysis and interpretation.

Evaluation of the Theoretical Model

SEM results for the path model including the tests for mediation are provided in Appendix 3. The analysis provides strong evidence that team leader personality traits do indeed have a positive effect on both team trust and perceived team effectiveness to varying direct and indirect degrees. In addition, the findings suggest that all three forms of trust have a statistically significant (p=<.01) effect on perceived team effectiveness, with cognitive-based trust having the most profound effect. Details regarding how individual personality traits and the team trust factors interrelated will be discussed in the following section. The findings pertaining to the hypotheses articulated for this study include the following:

 H_1 : A virtual team leader's personality traits of openness, extraversion, agreeableness, low neuroticism, and conscientiousness have a positive effect on team trust.

The results (see Appendix 3 for a summary of the results for the three models evaluated) indicate very strong support for H_1 , with coefficients for all five personality factors range between .7 and .85 (in the case of *neuroticism*, the direction of effect is as expected inverse with coefficients ranging from -.779 to -. 852 for the three forms of trust). For all personality trait-trust construct relationships, a significance of p < .001 was observed in both the full and partial mediation conditions assessed. This indicates a statistically significant relationship between each of the five leader personality factors and the individual factors defining team trust.

⁶ Theoretical constructs were measured using adaptations of Goldberg's (1990) Five Factor Personality Inventory [44 items], Sarker et al.'s (2003) Virtual Team Trust instrument [32 items], and Lurey and Raisinghani's (2001) perceived virtual team effectiveness instrument [9 items].

⁷ Major loadings include those greater than .500. Significant cross-loading would be indicated by differences of less than .300 between primary and secondary loadings across distinct constructs.

*H*₂: A virtual team leader's personality traits of openness, extraversion, agreeableness, low neuroticism, and conscientiousness have a positive effect on perceived virtual team effectiveness.

The results from the unmediated model suggest support for H₂. The coefficients for the four positive leader personality factors of agreeableness, openness, extraversion, and conscientiousness have an effect on perceived virtual team effectiveness with a significance ranging from p = .012 to p < .001. Similarly, the "negative" construct of neuroticism is, as anticipated, inversely related to perceived virtual team effectiveness (B= -.217, p < .001).

Interestingly, in the partially-mediated model, the results indicate that only conscientiousness has a statistically significant direct effect (B=.236, p = .013) on perceived virtual team effectiveness (when partially-mediated by cognitive and personality based trust). Finally, in the fully-mediated model, the remaining four leader personality factors (openness, extraversion, agreeableness, neuroticism) are statistically significant (p < .001) in their effects on the three forms of trust. Assessing the three models together, we see a clear indication that the effects of virtual team leader personality on virtual team effectiveness are almost completely mediated through the constructs of team trust. Specifically, the effects of these team leader characteristics appear to be mediated through the cognitive- and personality-based form of trust. Intriguingly, institutional-based trust does not serve a significant mediating role. The implications of these results will be addressed further in the Discussion section.

*H*₃: Team member trust (in personality-, institutional-, and cognitive-based forms) has a positive effect on perceived virtual team effectiveness

The results offer complete support for H₃. In the case of personality-based trust, the unmediated model reveals a strong and statistically significant influence on perceived virtual team effectiveness (B=.160, p < .001). Similarly, the results indicate a significant relationship between institutional-based trust and perceived virtual team effectiveness, although the loading is the weakest of the three trust constructs (B=.068, p < .01). Finally, the consideration of cognitive-based trust reveals the strongest loading of the three trust constructs on perceived virtual team effectiveness (B=.283, p < .001). Thus, these results reinforce earlier findings regarding the relationship between various forms of trust and virtual team effectiveness.

Discussion

The nuances observed between the different dimensions of virtual team leader personality and virtual team trust in their effects on perceived virtual team effectiveness provide several critical insights. Some of these observations reinforce arguments in the existing literature on virtual teams, while others push the virtual team research in new and intriguing directions. The strong support for each of the hypothesized sets of relationships in our theoretical model presents a range of significant implications for researchers, managers, and other knowledge professionals.

The Role of Leadership

One of the most interesting findings from the current study is that the personality traits of virtual leaders have a substantive influence on the perceived effectiveness of their teams, but this influence is almost completely mediated through the development and maintenance of team trust (specifically, the cognitive- and personality-based dimensions of trust). Virtual team leaders who are agreeable, emotionally stable, extraverted, open, and conscientious may have a positive effect on the performance of their teams, because they engender feelings of trust among the team members. This has a number of important implications. The findings suggest qualities that organizational leaders should consider in the hiring and assignment of virtual teams leaders. As with virtual teams in real-world organizational contexts, most of the virtual teams in the study have leaders that were assigned from the inception of the group, underscoring the importance of leadership selection criteria and assignment processes employed by organizational executives. Many companies use personality assessment tools (e.g., the Myers-Briggs Type Indicator) to assist in matching the personality attributes of employees to specific work assignments. This study presents a number of the personality traits that are particularly relevant for those being considered for a leadership role in a virtual team environment. The key takeaway for organizational decision-makers is that assessment of leadership potential in virtual teams is less about an individual's ability to directly affect the outcomes of a team (e.g., via strong technical skills within the relevant domain) than the professional's capacity for fostering trust among team members. The one critical exception to this insight is the observation that conscientiousness may improve virtual team performance both directly and through the development of greater levels of intra-team trust (this insight is discussed further below).

In addition to aiding in the selection of leaders in virtual team environments, the findings of this study suggest areas for ongoing training and development of virtual team leaders. In contrast to the perception that personality traits are strictly innate to an individual, a growing body of evidence suggests that organizational leaders can effectively be trained to enhance their charismatic characteristics and in turn to improve team performance (Barling et al. 1996; Kelloway & Barling 2000; Towler 2003). In the case of the virtual team leadership characteristics considered in this study, certain traits appear particularly amenable to training. For example, one might imagine that the traits of agreeableness and openness in dealing with the suggestions and contributions of team members could be effectively fostered in organizational leaders, whereas extraversion and emotional stability (i.e., the counterpoint of neuroticism) may be more difficult to influence through formal training.

This research may also pose a challenge to traditional perspectives on leadership as organizations transition to a virtual team context. Some of the personality traits that are relevant for the maintenance of team trust (e.g., openness, agreeableness) may be inconsistent with more established, control-oriented models of leadership. This insight is particularly relevant in the context that this study was conducted, because the U.S. Department of Defense has maintained a significant emphasis on bureaucratic structures and command-and-control leadership styles associated with military environment. Outside of the DOD, this "militaristic" perspective is still prevalent in contemporary approaches to leadership theory and practice (Barker 2001). The findings of this study suggest that the success of virtual teams relies more on the leader's ability to engender confidence and trust in team members than on the capacity to directly control behaviors and outcomes. These findings resonate with those who have argued that virtual team environments require a more facilitative approach to leadership (e.g., Yoo and Alavi 2004). As organizations seek to develop new team leaders they must recognize the importance of balancing requisite assertiveness and control with flexibility, imagination, and tact. In addition, managers must recognize that leadership in traditional teaming contexts may not translate effectively into virtual team environments, unless leaders are open to the contributions and competence of their team members.

Finally, it is interesting to note that, of all the virtual team leader personality traits considered, only conscientiousness had an influence on team effectiveness that was not simply mediated by the dimensions of team trust.⁸ Why is this the case? One plausible explanation is that the direct effect of conscientiousness is tied to the task-oriented facet of the construct. Readers will recall that the construct of conscientiousness incorporates both an organizing facet and a discernment-oriented facet.⁹ The organizing element may be most relevant here. Virtual team leaders who are organizationally diligent and task-oriented may be more effective at fostering the adequate structure for virtual team processes. As we noted earlier, several researchers have argued for the enhanced importance of structure as teams move from co-located to virtual contexts (Kayworth and Leidner 2001; Poole and Zhang 2005). Thus, the influence of team leader conscientiousness may go beyond the formation of team trust by supporting the structure necessary to keep team members "on the same page" operationally.

Virtual Team Effectiveness and the Dimensions of Trust

The current study provides a strong validation of earlier research regarding the role of virtual team trust in establishing a foundation for virtual team success. As we have noted, several researchers have argued that trust is a critical success factor for virtual teams (Costa et al. 2001; Jarvenpaa and Leidner 1999; Kostner 1996; Lipnack and Stamps 1997). By demonstrating a significant positive relationship between each of the three forms of team trust and perceived team effectiveness, this study reinforces the findings of these researchers. The implications for managers and other organizational leaders are substantial. It appears that virtual teams would benefit from having their members share personal information with each other. Team building exercises that help members discover the things they have in common will help strengthen their bond and cognitive trust in each other. As in traditional teams, it is important for team members to know and share a common goal and vision. Members need to feel as though they are all working toward the same mission and sharing the same challenges. Furthermore, team members must have confidence that the other members of the team have the skills and reliability to address their respective contributions to the broader effort.

While the general insight about the importance of trust for team effectiveness is interesting, the differences observed between the three forms of trust in their effect on virtual team effectiveness are even more insightful. In the study,

⁸ The direct effects of conscientiousness are in addition to indirect effects that were mediated by team trust.

⁹ The two facets of conscientiousness have been combined in the five-factor research literature because of a consistent finding of strong covariance of the facets (McCrae and John 1992).

we find the largest effect on perceived virtual team trust is associated with the cognitive-based dimension of trust. This finding offers support for the contention that cognitively-oriented trust is more relevant than affectively-oriented trust in the context of virtual teams (Kanawattanachai and Yoo 2002). In the absence of regular social interaction, virtual team members appear to place a premium on rational assessments of the dependability and competence of their fellow team members. Importantly, personality-based trust is also shown to have a significant effect on perceived virtual team effectiveness at the p < .001 level. With the third form of trust, i.e., institutional-based trust, the significance of the effect is not as strong.¹⁰ In the non-mediation model, the effect size for institutional-based trust is substantially lower than for the other two forms of trust, resulting in significance at the p = .01 level (compared to p < .001 for the other two dimensions). Furthermore, in the full and partial mediation models, the effect of institutional trust on perceived virtual team effectiveness appears to disappear altogether.

What does this suggest about the role of institutional trust in virtual teams? It appears that virtual team members are not relying on the procedural norms of the institution to lead the team to more effective outcomes. This finding may reflect the idiosyncratic nature of IPTs maintained by the Department of Development. While the virtual team members had worked together for an extended period of time, the DoD IPTs are composed of members from multiple distinct formal organizations, including contracted firms, the U.S. military, and other government entities. However, this condition is not unique to virtual teams in the DOD context, as virtual teams across the industrial spectrum frequently incorporate individuals from multiple organizations (Maznevski and Chudoba 2000; Watson-Manheim et al. 2002; Yoo and Alavi 2004). This suggests that further research might fruitfully explore the differences in the effect of institutional trust among virtual teams with a shared organizational affiliation and those with significant inter-organizational representation.

Implications for Research

Our findings suggest several intriguing avenues for additional research on the interplay between team leader personality and the emergence of trust in virtual teams. First, we believe a longitudinal study may be warranted. In the present study, we examined the relationship between virtual team leader personality, trust, and perceived virtual team effectiveness at a single point in time. However, the teams in the study had been in existence for varying lengths of time and the development of trust may be expected to vary over time. While we believe that the focus on existing virtual work teams is one of the strengths of the study, it does not allow us to assess the ways in which the dynamics of team leader characteristics, trust, and effectiveness change over time. Future research should include longitudinal studies to determine if the relationships between team leader personality, trust, and perceived virtual team effectiveness are strengthened, weakened, or simply maintained over time.

Secondly, this study was conducted within a single organizational context (albeit with individuals from across multiple "parent" organizations). Subsequent research should include participants from multiple organizations to determine if the results are similar across populations. Similarly, the population for this study was a mixture of participants who worked virtually only some of the time and those who worked virtually all of the time. The degree of virtuality may affect the relationship between virtual team leader personality, trust, and team effectiveness.

Finally, future studies should examine multiple configurations of virtual working to determine what differences exist between these populations and how the differences may affect the interplay of virtual team leadership and team trust. Of particular importance is supporting technology and how different teams with different configurations and sophistication levels may achieve differential levels of trust and in turn virtual team effectiveness.

Assumptions and Limitations

We acknowledge a number of potential limitations associated with the present study. First, the study assumes there will be a measurable level of trust among virtual teams (Walters 2004). Despite the strong validity of the Virtual Team Trust instrument, measuring trust on only three dimensions (personality, cognitive and institutional) could preclude unacknowledged factors such as fidelity and accuracy. Secondly, as Zellars and Perrewe (2001) point out, the use of single-source, self-report data can overstate the actual behavior of the team. However, the impact of this issue greatly depends upon the research questions being investigated. In this study, perceptions are of theoretical interest and thus single source bias may not be a serious concern. Other limitations may be considered based on the specific context investigated. As noted, the IPTs maintained by the DOD generally have a leader assigned prior to

¹⁰ The reader will recall that institutional-based trust refers to an individual's belief in the norms and rules of the relevant institution and the perception that these norms will guide the behavior of others (Sarker et al. 2003).

the initiative of team activities. We perceive this to be a distinct strength of our study in that it reflects the prevailing approach to the determination of leader roles in real-world virtual teaming efforts, but it may limit the generalizability of findings to virtual teams marked by emergent leadership. Similarly, while the virtual teams studied were geographically distributed, they were not global in scope – all virtual team members were based in the United States. Thus, the study does not account for global cultural differences that may emerge in virtual teams that include members from distinct national contexts. Finally, there is a potential limitation related to the characteristics of the participants themselves. Many participants in this study were members of more than one virtual team. Even though participants were instructed to rate only one virtual team (if he or she was a member of more than one team), their perceptions of the trust and effectiveness of their other teams, which could be in various stages of team development, could have spilled over into the ratings provided in the current study.

Conclusion

The use of virtual teams to mitigate the constraints of geography and to address urgent organizational needs is rapidly increasing. As in most collaboration, trust and leadership play critical roles in the effectiveness of these efforts. In this study, we examined how virtual team leader personality influences the levels of trust among team members and in turn the perceived effectiveness of virtual teams. We find strong relationships between team leader personality traits, various forms of trust, and perceived team effectiveness. Perhaps most interesting, we observe that while virtual team leader personality has a significant effect on perceived virtual team effectiveness, this influence is almost entirely mediated by cognitive- and personality-based forms of trust. These findings are important for employers, team leaders, managers, and knowledge professionals as well as researchers interested in making virtual teams more effective. Team leaders seeking better outcomes for their geographically distributed teams must recognize that their success will be inextricably tied to the degree to which they can foster trust among team members. Furthermore, a trust-building agenda may necessitate approaches to leadership that differ substantially from those that prevail in co-located team environments.

In addition to the implications for the management of virtual teams, we believe the present study contributes significantly to the research on virtual teams. First, by studying existing virtual technical and managerial teams, we provide an opportunity to better understand the dynamics of virtual teams *in situ*. The literature on ad hoc virtual teams in academic settings has established a strong base for theorizing about this emergent phenomenon, but additional research should be directed at virtual teams as they actually occur within contemporary organizations. We believe the current study contributes to this agenda. Secondly, the study introduces an empirical evaluation of the ways in which virtual team leader personality traits are relevant for the functioning of virtual teams. This creates a natural complement to the behavioral focus of the earlier virtual team leadership research. Finally, the current study offers an integrated look at antecedents of virtual team effectiveness which have generally been considered in isolation. By considering the ways in which leadership and team trust interact, we began to see a more complex and nuanced understanding of the factors that contribute to success in the management of virtual teams.

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Construct	Description	Sources						
Team Leader Personality Constructs								
Openness	A disposition to be imaginative, nonconforming, open to ideas, and unconventional	Goldberg 1990; McCrae and Costa Jr 1997; McCrae and John 1992						
Conscientiousness	The disposition that combines the tendency to be governed by conscience with diligence and thoroughness in organizing behavior [<i>The</i> <i>dimensions are combined because past research</i> <i>supports the empirical assertion of strong</i> <i>covariance in these traits (McCrae and John</i> 1992)]	Goldberg 1990; McCrae and Costa Jr 1997; McCrae and John 1992						
Extraversion	The tendency to be sociable, assertive, and active, and to experience positive affects, such as energy and zeal	Goldberg 1990; McCrae and John 1992; Watson and Clark 1997						
Agreeableness	The tendency to be trusting, compliant, caring, and gentle	Digman 1990; Goldberg 1990; McCrae and John 1992						
Neuroticism	The tendency to exhibit poor emotional adjustment and experience negative affects, such as anxiety, insecurity, and hostility	Goldberg 1990; McCrae & John 1992						
Virtual Team Trust Constructs								
Personality-based trust	Trust that develops due to the personal propensity to trust among individual team members	Sarker et al. 2003						
Institutional-based trust	Trust that is a function of the belief in institutional norms and procedures	Sarker et al. 2003						
Cognitive-based trust	Trust that develops from social cues, impressions, and interactive experiences that an individual has with others	Sarker et al. 2003						
Perceived Team Effectiveness Constructs								
Perceived performance	team members' discernment of the team's ability to complete their work assignments	Lurey and Raisinghani 2001; Walters 2004						
Perceived Satisfaction	The levels of satisfaction with the team processes achieved by team members	Lurey and Raisinghani 2001; Walters 2004						

Appendix 1. Table of Constructs



Appendix 2. Detailed Hypothesized Model with AMOS Output

Table 1. Comparison of Alternative Models and Test for Mediation								
	Partial Mediation		Full Mediation		Non-Mediation			
Relationship	Std Est.	р	Std Est.	р	Std Est.	р		
Openness \rightarrow Team Effectiveness	0.136	0.375			0.140	0.002		
Neuroticism \rightarrow Team Effectiveness	-0.059	0.762			-0.217	***		
Extraversion \rightarrow Team Effectiveness	0.483	0.459			0.158	0.012		
Agreeableness \rightarrow Team Effectiveness	0.178	0.230			0.251	0.004		
Conscientiousness \rightarrow Team Effectiveness	0.236	0.013			0.487	***		
Personality Trust \rightarrow Team Effectiveness	0.082	0.033	0.144	***	0.169	***		
Institutional Trust \rightarrow Team Effectiveness	-0.009	0.855	0.059	0.126	0.068	0.010		
Cognitive Trust \rightarrow Team Effectiveness	0.185	***	0.216	***	0.283	***		
$Openness \rightarrow Personality Trust$	0.792	***	0.791	***				
Openness \rightarrow Institutional Trust	0.861	***	0.853	***				
Openness \rightarrow Cognitive Trust	0.852	***	0.846	***				
Neuroticism \rightarrow Personality Trust	-0.779	***	-0.779	***				
Neuroticism \rightarrow Institutional Trust	-0.852	***	-0.852	***				
Neuroticism \rightarrow Cognitive Trust	-0.830	***	-0.830	***				
Extraversion \rightarrow Personality Trust	0.781	***	0.781	***				
Extraversion \rightarrow Institutional Trust	0.869	***	0.869	***				
Extraversion \rightarrow Cognitive Trust	0.868	***	0.868	***				
Agreeableness \rightarrow Personality Trust	0.823	***	0.823	***				
Agreeableness \rightarrow Institutional Trust	0.853	***	0.853	***				
Agreeableness \rightarrow Cognitive Trust	0.826	***	0.826	***				
Conscientiousness \rightarrow Personality Trust	0.795	***	0.794	***				
Conscientiousness \rightarrow Institutional Trust	0.836	***	0.837	***				
Conscientiousness \rightarrow Cognitive Trust	0.778	***	0.777	***				

Appendix 3. Comparison of Alternative Models

Table 2. Goodness-of-Fit Comparisons						
Metrics	Partially Mediated	Fully Mediated	Unmediated	Hybrid Model [*]		
Chi-Square	1684.2	1707.14	3747.4	1512.33		
df	575	580	590	516		
р	0	0	0	0		
CFI	0.952	0.951	0.863	0.954		
PCFI	0.822	0.828	0.765	0.827		
NFI	0.929	0.928	0.842	0.932		
TLI	0.944	0.944	0.845	0.947		
RMSEA	0.047	0.047	0.078	0.047		

^{*}The hybrid model reflects adjustments based on the intgeration of the other three models: Full mediation for all virtual team leader personality constructs except Conscientiousness and elimination of the Institutional Trust construct.