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Enhancing Virtual Team Dynamics

Freddie L. Stephens II

ENHANCING VIRTUAL TEAM DYNAMICS

THESIS

Freddie L. Stephens II, Captain, USAF

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DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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Freddie L. Stephens II, BS

Captain, USAF

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Freddie L. Stephens II, BS
Captain, USAF

Committee Membership:

Dr. John J. Elshaw
Chair

Col Paul Cotellesso, PhD
Member

Maj Vhance V. Valencia, PhD
Member

Abstract

With the activation of the Air Force Civil Engineer Center in 2012, the United States Air Force initiated an effort to centralize installation and mission support management throughout the Air Force, while decentralizing the execution at the base level. The measurement of success for such a decision extends beyond the reduction of overhead costs. The goal was to build a responsive, mission-focused organization. This research evaluated specific factors associated with the characteristics of virtual team dynamics to improve the perceived responsiveness of a centralized organization. Leader-member exchange (LMX) theory is a relationship-based approach to leadership that focuses on the quality of the exchanges between two members. Previous research regarding LMX theory has focused on explaining how people relate to each other. However, this research developed a model to predict how to actually improve the quality of these exchanges. Base Civil Engineers participated in a survey to measure the current dynamic between AFCEC and Civil Engineer squadrons. This research revealed that trust and depth of communication were significant predictors of LMX. These results affirmed the importance of establishing a personal relationship between team members and demonstrated that LMX increases when the leader seems trustworthy or more like a friend to others.

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Freddie L. Stephens II

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I. Introduction

General Issue

With the activation and basing of the Air Force Civil Engineer Center (AFCEC) Regional Support Teams (RST) and Installation Support Teams (IST) in 2012, the United States Air Force initiated an effort to centralize installation and mission support management throughout the Air Force, while decentralizing the execution at the base level. The measurement of success for such a decision extends beyond the reduction of overhead costs. The goal was to build a responsive, mission-focused organization that assists in the full-spectrum of installation engineering services. This research will evaluate specific factors associated with the characteristics of virtual team dynamics to improve communication and the perceived responsiveness of an organization's headquarters to fielded units. In October 2012, the Air Force Civil Engineer Support Agency merged with the Air Force Real Property Agency to form AFCEC. Figure 1 displays the new virtual team formed through this merger. AFCEC itself became a highly-distributed virtual team worldwide expanding from Asia to Europe and serving every major command (MAJCOM) within the United States Air Force. However, the merger created an additional virtual team which exists between AFCEC as an organization and each of the individual Air Force bases that AFCEC serves. Each IST is responsible for between two and 14 operating locations. While centralization of key functions is not new to the Air Force, there is no published report on how well those efforts are performing in regards to virtual team dynamics. Communication gaps often

exist between organizations where the operational and administrative control functions are separated (Powell, Piccoli, & Ives, 2004). Civil Engineer (CE) squadrons essentially, simultaneously serve bilateral, independent superiors. CE squadrons are forced to balance the needs of the collocated superiors at the Air Force Group and Wing-levels against the instructions of the virtual leadership from AFCEC.

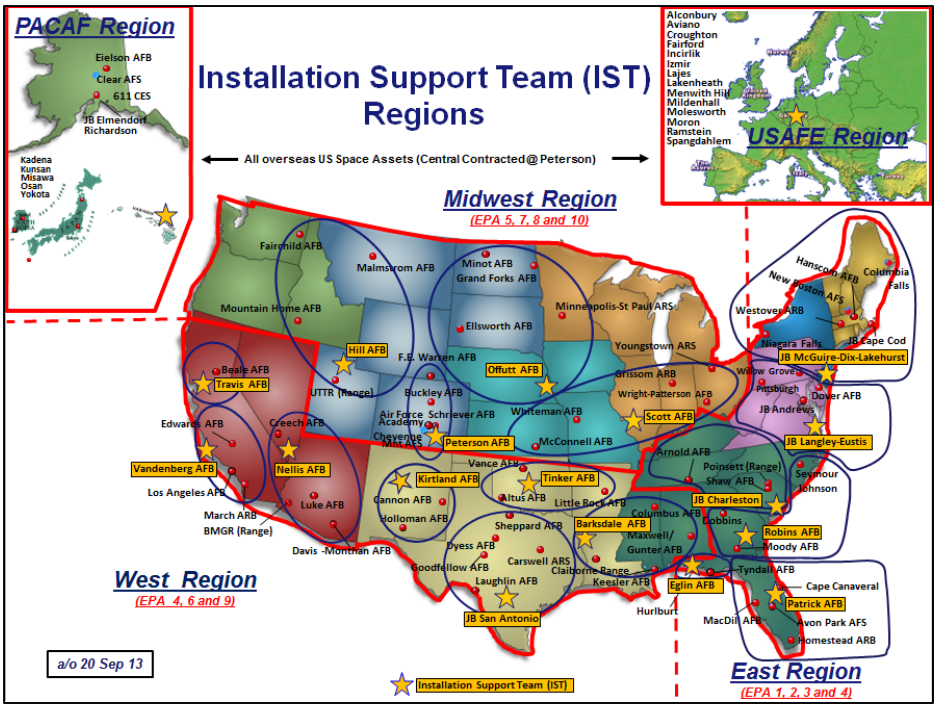

Figure 1: AFCEC Installation Support Team Regions (Barry, 2015)

Problem Statement

The perception of centralization efforts is that it creates virtual teams that do not have effective communication between the centralized organization headquarters and the decentralized fielded units. Additionally, the perception is that the fielded units or base-level are dissatisfied with the centralized aspect of the organization or AFCEC. The purpose of this research was to identify and measure factors that promote successful communication and responsiveness in organizations that operate in highly-distributed

environments. This research aimed to go a step further by developing a model to predict how to actually improve the quality of the leader-member exchanges that occur between Air Force Civil Engineer Squadrons and AFCEC.

Research Objectives/Questions/Hypotheses

The research throughout this study will center around two main questions: (1) "How do you improve the virtual team dynamics of a globally-distributed team?" and (2) "How do you improve the perceived responsiveness of a centralized organization by fielded units?" Specifically, this research may serve as a gauge for how AFCEC's Midwest Region Environmental Directorate is currently operating from the Air Force base-level perspective regarding both research questions. Responsiveness encapsulates the speed, depth, and accuracy of information provided upon request. Discussions with the base-level field grade officers (FGOs) operating within the Midwest Region revealed an acknowledgement that AFCEC's virtual team dynamics are as effective as can be expected given the current fiscal environment and constraints (Barry, 2015). However, varying opinions of AFCEC's processes are matters of erratic information flow and a lack of familiarity with AFCEC operating procedures, guidance, and institutional boundaries. Therefore, expectations derived from known and unknown constraints that differ from person to person shape the perceptions of the organization.

Methodology

This research will continue efforts to further the understanding of virtualness in the workplace. An extensive literature review of current rhythmic temporal patterns throughout Air Force Civil Engineering and past methodological approaches determined

key factors that affect responsiveness. Based on those findings, the researchers conducted a survey of Civil Engineer Squadron Commanders, Directors, and Deputy Commanders, who communicate with the same point(s) of contact within AFCEC. AFCEC's Midwest Region Environmental Directorate served as the control group within this study. The researchers administered surveys via the Air Force Institute of Technology's (AFIT) Web Survey Information Retrieval System (WebSIRS) online survey tool. The researchers examined and compared the results of the survey to the results from previous archival data in order to identify similarities of the sample pool to the larger Air Force population and distinct differences that may be specific to Air Force Civil Engineers.

Assumptions/Limitations

The researchers limited the subjects of the survey to strictly Air Force military personnel in the grades of O-4 and O-5 and civilian personnel in the grades of GS-14 and GS-15, who served as Commander, Director, or Deputy Commander of a Civil Engineer Squadron within AFCEC's Midwest Regional bases, which constitutes approximately 20 different duty locations. Assumptions of this study included that each subject is highly familiar with AFCEC's operating procedures and common communication methods and that communication patterns are consistent among the subjects. While there may be limitations due to the survey's sample size, the participants involved are the most qualified to make accurate assessments, and the results are representative of AFCEC's Midwest Region Environmental Directorate's virtual team performance.

Implications

Despite the limitations of this research, the results may have an immediate impact to Air Force operations. The researchers will utilize the results of this research to develop a model for rhythmic temporal patterns of interaction and provide information on specific factors that AFCEC, and later the Air Force Installation and Mission Support Center (AFIMSC), could modify in order to improve communication and perceived responsiveness. The current and future Air Force centralization efforts will have a baseline for comparison. Negative results will serve as a resource for lessons learned. Meanwhile, positive results will assist other regions within AFCEC's organizational structure that may be lacking in virtual team dynamics.

II. Literature Review

Chapter Overview

This chapter will summarize the published literature on virtual teams, communication, and consequential performance due to the perceptions of communication channels. Additionally, this chapter examines the antecedents of the research model used to measure the perceptions of AFCEC responsiveness based on the perspective of Air Force base-level civil engineers including self-efficacy theory, leader-member exchange theory, and remote best practices.

Virtual Teams

Powell et al. (2004) define virtual teams as "groups of geographically, temporally, and/or organizationally dispersed knowledge workers brought together across time and space by way of information and communication technologies." Virtual teams overcome the limitations of time, space, and organizational affiliation that traditional teams face. Consequently, virtual teams are created with an expectation to enable organizations to be more suited for a service environment rather than a production environment and the increasing requirement for cross-organizational strategic cooperation (Townsend, DeMarie, & Hendrickson, 1998). AFCEC as an organization in cooperation with Air Force Civil Engineer Squadrons forms the virtual team that is the ultimate subject of this virtual team dynamics research. Powell et al. (2004) considered a class of virtual teams that offered unprecedented levels of flexibility and responsiveness.

Virtual teams do not face the same obstacles as their traditional counterparts. Technological support and collaboration in distributed environments have become more

readily accessible through recent information technology advancements (Constant, Sproull, & Kiesler, 1996). Powell et al. (2004) suggested that social and managerial challenges now represent the major hurdles to successful adoption of this organizational form. Virtual teams must be able to effectively use information technology to quickly blend the skills of dispersed co-workers into interdependent products. Powell et al. (2004) primarily focused on determining the effect that control mechanisms have on outcomes in the virtual team and what effect control mechanisms have on work processes such as coordination and communication effectiveness.

Control Mechanisms

One form of control mechanisms is behavior control—a type of formal control designed to structure the transformation process of work as opposed to the outputs of work activities (Snell, 1992). Early virtual team research endorsed behavior control as a method of managerial control in virtual teams. Townsend et al. (1998) indicate that "clear schedules must be established of when the team will provide reports, interim deliverables, and the final product." However, the majority of virtual team research has focused on self-directed teams that have no behavior control (Powell et al., 2004).

A second form of control in team management is self-direction. Team self-direction is an informal control that develops over time based on the socialized norms and practices exhibited by the team. Initially, there are no formal processes; however, over time the norms, values, and goals important to the team are established. Powell et al. (2004) found that even when there are some formal controls levied on a virtual team, team members will create their own informal control mechanisms.

Communication

Effective communication processes are essential to the effectiveness of traditional teams. In virtual teams, the infrequent face-to-face meetings, geographical and temporal dispersion, and reliance on communication technology create new obstacles to effective communication. Electronic media are intrinsically leaner than face-to-face communication and convey a limited set of communication cues (Sproull & Kiesler, 1986). Team members find it more challenging to convey the same rich information that they could convey during face-to-face meetings. Rich communication refers to the contextual cues either verbal or nonverbal communication may convey in a conversation. A communication partner may perceive happiness or agreement if the other partner smiles. However, an e-mail or text message cannot convey the same level of communication through text. With less rich communication, social relationships are more difficult to develop (Walther & Burgoon, 1992). Individuals who interact through information and communication technologies tend to be less attentive and receptive to contextual cues (Sproull & Kiesler, 1986). Their interaction appears to be more impersonal, task-oriented, and businesslike (Bordia, 1997). The research on virtual team dynamics will explore these findings more specifically within AFCEC's organizational construct and communication with Air Force Civil Engineer Squadrons.

Methodology of Communication

Powell et al. (2004) developed hypotheses to test the relationship between team control structure and virtual team communication effectiveness as well as the relationship between virtual team performance and communication effectiveness. 201 students who

were enrolled in electronic commerce courses at six different universities participated in the research. 48 teams of four subjects and 3 teams of only three subjects were formed. To reduce the aspects of cultural differences, the researchers chose schools from three countries that are similar in all cultural dimensions. The research subjects were well educated and employed in knowledge work positions. No two students from the same university were placed on the same team.

All subjects completed a preliminary survey, which collected information on demographic variables, work experience, experience working in teams, self-reported experience using available communication and collaboration technologies, attitudes toward information technology, and computer self-efficacy. The preliminary survey found no pre-treatment difference between the treatment and control groups. A substantial percentage (20-25 percent) of each student's final grade was assigned to the exercise to provide motivation. The research subjects were also offered a financial incentive of 1,500 US dollars to be equally shared among the members of the two best teams.

Before the main project was administered, the teams participated in two preliminary exercises that lasted a combined three weeks. These exercises were designed to help familiarize the subjects with the available communication and collaboration technologies, to stimulate early communication and team development, and to allow students to become familiar with the challenges of virtual teams. Powell et al. (2004) reported no systematic difference on communication existed between the treatment and control groups prior to the main project.

The main project lasted five weeks and consisted of the development of a business plan for a newly formed company that specializes in developing and marketing a business innovation. Upon completion of the project, a post-test questionnaire was given, which measured the same items as the pre-test. Team performance was based on the quality of the final product of each team. Two independent experts evaluated each team's business plan. The experts were blind to the research hypotheses and team assignment.

Results of Communication

The first hypothesis stated that self-directed teams would have higher communication effectiveness than teams under managerial control. The researchers found weak evidence to support the hypothesis, which indicated that self-directed teams achieved slightly higher communication effectiveness than those under behavioral control. The second hypothesis stated that virtual team performance improves as communication effectiveness increases. The researchers did not find evidence to support this hypothesis. The final hypothesis stated that individual satisfaction increases as communication effectiveness increases. Based on the results of the post-test questionnaire, the researchers concluded that communication effectiveness was a significant predictor of individual satisfaction.

While communication effectiveness was not indicative of virtual team performance, communication effectiveness had a significant relationship to individual satisfaction, or perception. Low individual satisfaction is detrimental to organizational commitment. Dissatisfied employees are more likely to exit the organization, which

leads to increased turnover and decreased continuity. The organization is consequently forced to utilize additional resources to train and educate replacement employees. Team dynamics transform with each new hire. This research will explore the literature surrounding communication perception as it pertains to virtual teams utilizing information technology tools.

Channel Expansion Theory

Channel expansion theory as described by Carlson (1995) identifies certain experiences as important in shaping how an individual develops richness perceptions for a given communication channel. Four experiences are annotated as being the most relevant: experience with the channel, experience with the messaging topic, experience with the organizational context, and experience with the other communication participants. Communication richness extends beyond the literal meaning of the spoken words or written text. This research aims to investigate individuals' communication richness perceptions through information technology tools based on the communication participant by reducing the range of experience levels with civil engineering processes. For example, Employee A and Employee B have similar professional backgrounds, education, and training. Employee A and Employee B have worked within the United States Air Force Civil Engineer community for comparable lengths of time. However, Employee A and Employee B have varying degrees of familiarity with each employee's primary point of contact (POC) for civil engineering support. How each employee perceives the richness of the communication from the support personnel will be mainly based on the experience that each employee has with the POC. The POC may have

personalized phrases or written symbols to convey emotions of anger, disappointment, or anxiety. If Employee B is unfamiliar with these phrases or symbols, then the contextual clues will not be effectively received.

A communication participant must rely on his or her experience with information technology tools in order to effectively communicate with another participant who is geographically separated. As the communication participants increase their acquired relevant experience with the communication tools, they develop knowledge bases that may be used to more accurately both encode and decipher rich messages within that communication channel. Otherwise, communication participants, who do not increase their familiarity with a communication channel, will not be able to participate in richer communication, regardless of the amount of time spent using the communication channel or the frequency of messages. Therefore, Carlson and Zmud (1999) hypothesized that the knowledge-building experiences an individual has with a communication channel will be positively related to that individual's perception of the channel's richness.

As communication participants become more familiar with one another, the communication participants develop a knowledge base specific to each other. The shared knowledge base enables the encoding of messages tailored to that individual, allows the use of cues relevant to him or her, and permits information having a richer meaning for that communication partner. For example, the communication will contain more shared jargon or acronyms that are applicable to and understood by both participants. Walther (1992) argued that individuals are motivated to acquire a social-psychological knowledge about others that will enable the development of relationships through communication technology. The social-psychological knowledge is increased and acquired through on-

going communication to develop individuating knowledge about others (Walther, 1992). Consequently, Carlson and Zmud (1999) hypothesized that the knowledge-building experiences an individual has with a communication partner will be positively related to that individual's perception of the richness of the channels used in communicating with that partner.

As individuals develop experience with a particular topic, they may develop a knowledge base that enables the encoding of messages with richer meaning for the other communication participants. Communication partners with similar experience within the messaging topic may facilitate richer messages through the use of jargon. Alternatively, communication partners with less experience within the messaging topic may rely more heavily on task information more suitable to their topic knowledge to decode richer messages. Carlson and Zmud (1999) hypothesized that the knowledge-building experiences an individual has concerning a message topic will be positively related to that individual's perception of the richness of the channels used in communicating with others about that topic. This research will assume the subjects of the virtual team dynamics survey have similar experiences with the messaging topics as AFCEC points of contact. The researchers specifically selected the survey audience to reduce the variability of the messaging topic knowledge levels.

Carlson and Zmud (1999) proposed that "as individuals develop communication experience within a specific organizational context, they may develop a knowledge base for that context enabling the encoding of messages with richer meaning for similarly knowledgeable communication partners." Due to an increasing sophistication of their organizational knowledge base, individuals may learn to interpret messages received

within this organizational context more richly. Therefore, Carlson and Zmud (1999) hypothesized that the knowledge-building experiences an individual has concerning his or her organizational context will be positively related to that individual's perception of the richness of the channels used to communicate within this context.

Methodology of Channel Expansion Theory

Carlson and Zmud (1999) developed a survey instrument and administered it to a random sample of faculty, staff, and administrative e-mail users at a large southeastern university. First, a brief instrument was sent to 1,000 randomly selected individuals to determine willing participants who were active e-mail users. Then, the full instrument was administered to the 362 individuals who volunteered their participation. 197 usable responses were collected. There was a relatively even split of faculty and non-faculty respondents. The faculty respondents were not significantly different from the non-faculty respondents in regards to their perception of e-mail's richness, experience with e-mail, experience with the messaging topics, and experience with the organizational context. However, the faculty members were more likely to select communication partners with whom they had greater experience.

Carlson and Zmud developed five themes relevant to this research for the survey instrument: total messages processed, experience with electronic mail, experience with communication partner, experience with messaging topic, and experience with organizational context. Carlson and Zmud utilized the five themes as independent variables used to measure the dependent variable, perceived media richness. The researchers developed a regression model with perceived richness of e-mail as the

dependent variable and the independent variables entered in three stages; however, only the first two stages are relevant to the virtual team dynamics research. The experiential model based on the four knowledge-based factors was entered as stage 1. The total messages processed variable was entered as stage 2 in order to examine whether it made an independently significant contribution to the model.

Results of Channel Expansion Theory

Carlson and Zmud (1999) found that stage 1 was significant ($p < .001$) and explained 20 percent of the variance in richness perceptions. Experience with e-mail and experience with a communication partner both positively and significantly related to richness perceptions. The relationship between experience with messaging topic and perceived media richness was only marginally supported. The individual experience sub-factor relating to organizational context was positive and significant; however, the shared experience sub-factor was not supported as a predictor. Therefore, the results only partially supported the hypothesis regarding the knowledge-building experiences that an individual has concerning his or her organizational context.

Self-efficacy Theory

Self-efficacy theory essentially is the theory that believing in one's self will result in higher performance. Self-efficacy theory has even been emphasized in modern times through Platt & Munk's 1930 children's book *The Little Engine That Could.* The story's signature phrase "I think I can" teaches children the value of optimism and hard work, while the National Education Association listed the book as one of its "Teacher's Top 100 Books for Children" in an online poll (NEA, 2015). This concept was also

popularized through Walter D. Wintle's famous 20th century poem *Thinking*. The poem concludes, "Life's battles don't always go to the stronger or faster man; but sooner or later the man who wins is the one who thinks he can!" Remote self-efficacy (RSE) is defined as an employee's confidence in his or her ability to work in a geographically separated environment or as a member of a virtual team when the necessary information technology tools are made available.

Similar to the concept that communication effectiveness is not significantly related to performance, Staples, Hulland, & Higgins (1998) did not attempt to measure the level of performance of the various tasks that comprised the RSE scale. This was because the authors felt it would be difficult to obtain accurate self-assessments on actual levels of performance on the wide range of tasks faced by remote employees. Instead, they measured the respondents' beliefs about the effectiveness of working remotely in general as well as their own overall perceived productivity. Their results were consistent with the previous self-efficacy research, which has demonstrated strong links between self-efficacy beliefs and performance. Additionally, Staples et al. (1998) concluded that employees with more experience and training at working remotely will have higher levels of RSE. This, in turn, is positively related to performance and behaviors.

Leader-Member Exchange (LMX) Theory

Self-efficacy theory is similar to the idea that expecting an event or having confidence could increase the likelihood that the event would occur or be successful, which has been classified as self-fulfilling prophecy. Expectations are an antecedent to leader-member exchange (LMX) theory. In other words, what one person expects from

another person affects the perception of the interactions between the two people from both perspectives. Liden, Wayne, & Stilwell (1993) stated, "Leader-member exchange theory suggests that leaders differentiate among their subordinates within the work unit." The researchers investigated the first 6 months that newly hired employees and their immediate supervisors worked together. Expectations, perceived similarity, liking, demographic similarity, and performance were examined as determinants of LMX.

In natural settings, or settings where expectations are not manipulated, individuals form expectations of others based on information available to them. Leaders indirectly derive information about members from test scores, recommendations, or interviews (Phillips & Dipboye, 1989) or directly from the member during the first few days on the job (Hollander & Offermann, 1990). Members also derive information about the leader from secondary sources and directly from the leader during the interview as well as the first few days on the job (Fisher, 1986; Jablin, 1987). Therefore, the formation of expectancies applies to leaders and members, as both form expectations of each other before or early in the life of the dyadic relationship (Hollander & Offermann, 1990; Jablin, 1987). Although all discussion of self-fulfilling prophecy has focused on the expectancies that a relatively higher power and status individual has concerning a target, as in a teacher regarding a student, Hollander & Offermann (1990) conclude that relatively less formal power and status individuals also form expectancies concerning a higher power and status target, as in a subordinate regarding a supervisor. Therefore, the dyadic relationship between each Air Force Civil Engineer Center (AFCEC) point of contact (POC) and Base Civil Engineer (BCE) is valid within the construct of the self-fulfilling prophecy. The AFCEC POC fills the role of the relatively higher power and

status individual, because AFCEC controls the funding and engineering processes for base-level projects and program requirements. The BCE will form expectancies of AFCEC based on information received during initial meetings and from secondary sources such as other Civil Engineer Squadron Commanders prior to meeting the point of contact.

Previous research had found LMX to be related to job attitudes, leader attention, leader support, participation in decision making, and the amount of time and energy invested in the job. While the authors discovered that perceived similarity and liking are strong predictors of member LMX, demographic similarity was not significant in the prediction of leader or member perceptions of LMX at any of the time periods (Liden et al., 1993). Therefore, actual demographics of the Air Force base-level personnel and the AFCEC POCs within this research will not be collected. Liden et al. (1993) suggest that affective variables, such as expectations, perceived similarity whether through familiarity or actual history, and liking, can also be important in the development of LMX.

Additionally, LMX at earlier time periods was always a significant predictor of LMX at later time periods**.** The concept that first impressions are lasting impressions was supported within this LMX research as Liden et al. (1993) found that an individual's resulting expectation concerning the other will influence subsequent social exchanges between the two parties. As a result, this virtual team dynamics research assumed the number of years served in the current position of the Air Force base-level personnel will not significantly predict the member LMX. Rather, the current LMX, whether the dyadic relationship is young or old, is representative of the LMX viewed from the member perspective throughout the life of dyad. For example, some BCEs are Federal Civil

Service employees who have held their current position for more than 10 years, while other BCEs are military members who have held their position for less than 2 years. However, a military BCE's LMX in the first 2 years is indicative of what his or her LMX would be if the member stayed in the same position for as long as the civilian counterparts.

Manager Communication Performance

In order to evaluate member expectations of the supervisor, a set of expected behaviors must be developed and standardized across the dyadic relationships between subordinate and supervisor. Staples & Webster (2007) investigated the relationship between a team member's effectiveness, cognitive beliefs about his or her ability to perform proposed best practices or tasks necessary to be an effective member of a team, and relevant environmental factors, such as coaching by leaders. Social cognitive theory suggests that behaviors, personal cognitive factors, and environmental factors influence each other reciprocally.

Staples & Webster (2007) compared the effects of proposed best practices for three types of team structures: traditional teams in which all members are located in the same building, hybrid teams in which some team members are located in the same building and others are distant, and distributed teams in which all team members are in a different location than the focal team member. Differences across traditional, distributed, and hybrid teams might arise for a variety of reasons. One reason relates to the structure of hybrid teams where some members are collocated and others are remote. This structure provides the potential to create in groups and out groups. However, through

analysis of case studies Staples & Webster (2007) identified several practices common to all types of teams that were suggested as being important for improving the effectiveness of individual virtual team members. Manager Communication Performance (MCP) is the ability of the leader or manager to perform these practices, which included supporting other team members, communicating effectively, and having a variety of specific skills. Interviewees desired a respectful team environment where members were unafraid to openly discuss ideas, where people could be reached, and where team members responded appropriately to requests for help. Effective communication involved sharing information, transferring ideas, listening to and internalizing the ideas of others, and notifying team members of any problems or issues. Effective communication was even more important in virtual teams. As a solution, virtual team members suggested working hard to keep lines of communication open by using information technology tools and providing for informal interactions. Interviewees reported the ability to organize effectively, competency in an individual's area of responsibility, adequate technical skills as required to use information technology tools available, and good time management skills as very important.

III. Methodology

Chapter Overview

Introduction

This chapter will explain the methodology of data collection and data analysis for this research. The purpose of the investigation is to measure the virtual team dynamics that exist between local Air Force Base Civil Engineers and their primary points of contact within the Air Force Civil Engineer Center (AFCEC), respectively. Additionally, this research explored possible solutions or strategies to improve the virtual team dynamics between Air Force bases and the field operating agency. This chapter will present the selection criteria for the AFCEC region used for data collection. Also, this chapter will exhibit the basis of the survey used for data collection and discuss the validity of the survey subject pool. Finally, this chapter will discuss the quantitative and qualitative data analyses of the collected field data.

Test Subjects

AFCEC Regional Selection

Powell et al. (2004) define virtual teams as "groups of geographically, temporally, and/or organizationally dispersed knowledge workers brought together across time and space by way of information and communication technologies." Figure 1 shows the five regions that encompass all of AFCEC's Installation Support Teams (IST). Each region coordinates with at least one IST; however, the Midwest Region is the only region that spans all four time zones within the continental United States. Therefore, the

geographical and temporal dispersion within the Midwest Region tests the virtual team dynamics more so than any other AFCEC region.

Survey Subject Selection

Carlson (1995) identified four experiences that shape how an individual develops richness perceptions for a given communication channel within Channel Expansion Theory. The most relevant experiences are: experience with the channel, experience with the messaging topic, experience with the organizational context, and experience with the other communication participants. The researchers decided to use Air Force military personnel in the grades of O-4 and O-5 and civilian personnel in the grades of GS-14 and GS-15 who serve as Commander, Director, or Deputy Commander of a Civil Engineer Squadron to evaluate the virtual team dynamics between local Air Force bases and their respective primary points of contact within AFCEC. Civil Engineer Squadron Commanders and Directors are also known as the Base Civil Engineer (BCE), while the Deputy Commanders are also known as the Deputy BCE. The selection of BCEs and Deputy BCEs reduced the variability of three of the four most relevant experiences of Channel Expansion Theory that would exist between less experienced personnel both military and civilian who work within local Air Force base Civil Engineer squadrons. These three experiences were: experience with the communication channel, experience with the messaging topic, and experience with the organizational context. BCEs and Deputy BCEs have attended more professional development courses and/or professional military education courses than junior engineers. Many of these developmental courses are conducted virtually, thus the BCEs and Deputy BCEs have a higher level of experience with the communication channel, messaging topic, and organizational context.

BCEs and Deputy BCEs are more likely to have varying degrees of an established personal, professional relationship with the other communication participant within AFCEC due to the rotational nature of the military personnel. Therefore, reducing the variances in experience with the communication channel, messaging topic, and organizational context allowed the data to rely more heavily on the experience with the other communication participant. 36 BCEs and Deputy BCEs were invited to complete a survey. Of these, 13 agreed to participate with 12 providing usable surveys (i.e. 33% response rate). The BCEs and Deputy BCEs involved were the most qualified to make accurate assessments of the virtual team dynamics between Civil Engineer squadrons and AFCEC, and the results were representative of AFCEC's Midwest Region Environmental Directorate's virtual team performance.

Materials and Equipment

An archived survey served as the basis for the virtual team dynamics survey found in Appendix A. The archived survey utilized a 139-question 7-point Likert scale survey to evaluate virtualness in the Air Force and the link to performance and commitment (Elshaw, 2010). Over 2000 Air Force personnel from various career fields participated in the archived survey. The respondents, both officers and enlisted, in the previous study were stationed at bases spanning the entire globe and included units that worked in traditional, virtual, and hybrid environments.

The researchers in this virtual team dynamics study selected the 65 most relevant quantitative survey questions from the archived survey that focused on communication richness, perception of the job, perception of the unit, and perception of the relatively

higher power and status individual. The survey measured 12 dimensions. These dimensions were leader-member exchange (LMX), remote self-efficacy (RSE), manager communication performance, interpersonal justice, formality, depth, affection, trust, behavior control, outcome control, history, and synchronicity. Each variable was measured utilizing one or more scales from varying sources. The researchers analyzed the data only from the selected survey questions for comparison with the archival data. The new survey modified the original survey questions by changing the word "manager" to "point of contact within AFCEC's Environmental Directorate" to be more specific regarding the relationship between the Air Force base-level personnel and AFCEC. The quantitative survey items utilized a 7-point Likert-scale ranging from *strongly disagree (1)* to *strongly agree (7).* Also, the researchers created qualitative survey items that were opened-questions designed to solicit responses based on the personal experience of each respondent. An example qualitative survey item was "What do you think could enhance virtual team dynamics over the next 2-3 years?" Another qualitative survey item inquired about the dynamic of base-level squadrons being outside of the operational control and administrative control of AFCEC. Specifically, the respondents were asked, "What effect, if any, does this have on your communication relationship with that individual?"

Each of the quantitative survey items from the archived survey were based on the previous published literature regarding virtual team dynamics. Seven questions were adapted from Liden, Wayne & Stillwell (1993) to measure the quality of leader-member exchanges. For example, one survey item stated, "I would view my working relationship with my point of contact within AFCEC's Environmental Directorate as extremely effective." 11 survey items were adapted from Staples, Hulland, & Higgins (1999) to

measure remote self-efficacy, which is an employee's confidence in his or her ability to work in a geographically separated environment or as a member of a virtual team when the necessary information technology tools are made available. For example, one survey item asked how confident a person feels in "[Communicating] with others in my duty section effectively, even when I must depend on technology to do so." 12 questions were adapted from Staples & Webster (2007) to measure manager communication performance, which is the ability of the leader or manager to execute patterns of communication identified as the best suggested practices for improving the effectiveness of individual virtual team members. For example, one survey item stated, "He/she has good communication skills (e.g. a good listener, asks for clarification when needed, sets a positive tone)." Three questions were adapted from Colquitt (2001) to measure interpersonal justice, which is a measurement of how a person is treated fairly, with dignity, and with respect. For example, one survey item stated, "He/she treats me in a polite manner."

14 questions were adapted from Burgoon & Hale (1987) to measure Psycho-Social Distance Relational Communication dimensions of formality, depth, affection, and trust. Specifically, three survey items measured formality, which is the rigid observance of organizational rules and etiquette. Virtual team members suggested informal interactions are desirable for open communication (Staples & Webster, 2007). The survey items for formality were worded in a manner where informal communication received higher ratings. For example, "He/she wants our communication to be casual." Three survey items measured depth, which is a measure of the intimacy level of communication that would be present between personal friends. Communication is more

in-depth when it extends beyond surface level conversations. For example, one survey stated, “He/she seems to care if I like him/her.” Five survey items measured affection, which is a measure of how enthusiastic or interested a personal is while engaging with the communication partner. For example, one survey item stated, “He/she acts bored in our conversations.” Finally, three survey items measured trust, which is a measure of the reliability of the information received. For example, one survey item stated, “He/she is honest in communicating with me.”

Six survey items were developed to measure the level of autonomy granted to the base-level members. These survey items focused on the control mechanisms implemented by AFCEC. Three of these survey items focused on the actual behavior control of the individuals or the specific actions taken by base-level personnel in the accomplishment of their duties. For example, one survey item stated, “He/she tends to closely monitor how my work gets done.” The other three survey items focused on the outcome control of the individuals or the final product of a task. For example, one survey item stated, “He/she is results oriented.” Behavior control focuses on the details of how work is accomplished, while outcome control focuses on the quality of the final product.

Lastly, eight specific questions were developed to measure history and synchronicity of period and phase. Three survey items measured history, which is the level of familiarity between the base-level member and the AFCEC point of contact. For example, one survey item stated, “I feel like I know my point of contact within AFCEC’s Environmental Directorate well.” Five survey items measured synchronicity, which is the degree to which the two members’ schedules align. For example, one survey item specifically stated, “My point of contact within AFCEC’s Environmental Directorate and

I have difficulties aligning our schedules." But, another survey item examined the availability by stating "My point of contact within AFCEC's Environmental Directorate is available whenever I need him/her."

Procedure

The researchers transformed the original survey into a web-based survey through the Air Force Institute of Technology's (AFIT) Web Survey Information Retrieval System (WebSIRS) online survey tool. The researchers e-mailed a web link to the target audience, which consisted of 36 Civil Engineer Squadron Commanders, Directors, and Deputy Commanders who were located within AFCEC's Midwest Region. The e-mail notified the recipients that participation in the survey was voluntary, anonymous, and that there was no penalty for non-participation. For the purposes of identifying collocation with AFCEC RSTs and ISTs, duty location was the only personally identifiable information collected. Over the course of the collection period, 13 of the recipients agreed to participate in the study. The AFIT WebSIRS online tool aggregated the responses into a single spreadsheet for quantitative and qualitative data analyses.

Quantitative Regression Analysis

The researchers used regression analysis to build models which attempt to illustrate the relevant variables that predict both remote self-efficacy and leader-member exchange. Multicollinearity was assessed through examining the variance inflation factors (VIFs) of each variable. The VIFs of the collected data ranged from 1.000 to 1.544. As no VIFs approached the value of 10.0, multicollinearity was determined not to be an issue. The researchers created a correlation table, which included all of the

dimensions. The dimensions that were significantly correlated to RSE were entered into a multiple linear regression model as independent variables. Each variable was entered separately by entering each independent variable into the model based on the probability of F less than or equal to .05 and removing the variable when the probability of F became greater than or equal to .100. Additionally, the dimensions that were significantly correlated to LMX were entered into a linear regression model as independent variables. Each variable was entered separately by entering each independent variable into the model based on the probability of F less than or equal to .05 and removing the variable when the probability of F became greater than or equal to .100. For both models, the final independent variables were considered significant predictors for the dependent variables RSE and LMX, respectively.

Qualitative Data Analysis

The researchers analyzed the qualitative data by following a process outlined by Baden & Major (2013). First, the researchers characterized the responses and cut the relevant information. Next, the researchers coded the data based on identified trends. Finally, the researchers categorized the accumulative codes into themes.

IV. Results and Analysis

Chapter Overview

Introduction

This chapter will provide a summary of the results from all analyses conducted on the collected data and archived data. Regression models are presented to identify the significant predictors of remote self-efficacy (RSE) and leader-member exchange (LMX) for each type of data.

Collected Data

The term "collected data" refers to the direct responses of the survey respondents from the WebSIRS survey. Means, standard deviations, reliabilities and correlations for all study variables involved in analyses are given in Table 1. Sample sizes vary, because one participant failed to complete all survey items and because of missing responses on one or more items.

Table 1: Means, Standard Deviations, Reliabilities, and Correlations among Study Variables

			Correlations											
Dimension	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. RSE (n = 13)	5.17	1.05	(0.873)											
2. LMX	4.53	1.18	0.486	(0.934)										
3. Behavior Control (n=13)	2.77	1.24	0.235	-0.231	(0.537)									
4. Outcome Control (n=13)	4.49	1.13	0.619*	0.303	0.279	(0.247)								
5. MCP (n=13)	4.51	1.26	0.808**	0.740**	-0.155	0.631*	(0.939)							
6. Interpersonal Justice	5.72	1.20	0.117	0.606*	-0.407	0.050	0.395	(0.898)						
7. Formality	4.83	0.88	0.055	0.492	-0.337	0.127	0.335	0.517	(0.653)					
8. Affection	4.99	1.31	0.540	0.816**	-0.057	0.327	0.733**	0.830**	0.480	(0.945)				
9. Depth	4.14	0.89	0.569	0.826**	-0.162	0.611*	0.876**	0.333	0.584*	0.601*	(0.767)			
10. Trust	4.92	0.90	0.290	0.843**	-0.304	0.167	0.629*	0.839**	0.502	0.935**	0.594	(0.798)		
11. History	4.11	1.49	0.267	0.820**	-0.342	0.006	0.547	0.360	0.532	0.562	0.749**	0.672*	(0.878)	
12. Synchronicity	4.03	1.35	0.590*	0.781**	-0.210	0.378	0.796**	0.350	0.331	0.666*	0.799**	0.687*	0.827**	(0.921)

Note: Unless otherwise stated, n = 12. Reliabilities are shown in parenthesis along the diagonal.
* $p < 0.05$, ** $p < .01$

RSE Predictors

In assessing the dimensions, the bi-variate correlations gave a general sense of the relevant variables associated with RSE. Manager communication performance (MCP) was positively correlated to RSE ($r = .808$, $p < .01$). Outcome control and synchronicity were also positively correlated to RSE ($r = .619$ and $r = .590$, $p < .05$, respectively). Based on the significant factor correlations, the researchers conducted a stepwise regression of RSE by entering each independent variable into the model based on the probability of F less than or equal to .05 and removing the variable when the probability of F became greater than or equal to .100. The researchers found only MCP, which was entered into Model 1, to be a significant predictor of RSE. Model 1 was significant with an adjusted squared multiple correlation of .529. A summary of the results can be found in Table 2 and Table 3.

Table 2: RSE Stepwise Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.756[a]	0.572	0.529	0.67171	0.572	13.338	1	10	0.004

a. Predictors: (Constant), MCP

Table 3: RSE Stepwise Regression Coefficient Summary

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.258	0.786		2.873	0.017		
	MCP	0.641	0.175	0.756	3.652	0.004	1.000	1.000

a. Dependent Variable: RSE

LMX Predictors

In assessing the dimensions, the bi-variate correlations gave a general sense of the relevant variables associated with LMX. Trust, depth, history, affection, synchronicity, and MCP were significantly, positively correlated to LMX ($r = .843$, $r = .826$, $r = .820$, $r = .816$, $r = .781$, $r = .740$, $p < .01$, respectively). Additionally, interpersonal justice was significantly, positively correlated to LMX ($r = .606$, $p < .05$). Based on the significant factor correlations, the researchers conducted a stepwise regression of LMX by entering each independent variable into the model based on the probability of F less than or equal to 0.05 and removing the variable when the probability of F became greater than or equal to 0.100. The researchers found only trust and depth to be significant predictors of LMX. In Model 1, trust was entered into the regression model. Then, depth was added to the regression model in Model 2. Model 2 was significant with an adjusted squared multiple correlation of .847. A summary of the results can be found in Table 4 and Table 5.

Table 4: LMX Stepwise Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.843[a]	0.710	0.681	0.66616	0.710	24.525	1	10	0.001
2	.935[b]	0.874	0.847	0.46225	0.164	11.769	1	9	0.008

a. Predictors: (Constant), Trust

b. Predictors: (Constant), Trust, Depth

Table 5: LMX Stepwise Regression Coefficient Summary

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-0.898	1.114		-0.807	0.439		
	Trust	1.105	0.223	0.843	4.952	0.001	1.000	1.000
2	(Constant)	-1.726	0.810		-2.132	0.062		
	Trust	0.713	0.192	0.544	3.706	0.005	0.647	1.544
	Depth	0.666	0.194	0.503	3.431	0.008	0.647	1.544

a. Dependent Variable: LMX

Archived Data

The term "archived data" refers to the data collected by Elshaw (2010). Means, standard deviations, reliabilities and correlations for all archived variables involved in analyses are given in Table 6. Sample sizes vary due to missing responses on one or more items.

Table 6: Means, Standard Deviations, Reliabilities, and Correlations among Archived Variables

			Correlations											
Dimension	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. RSE (n = 1547)	5.66	1.39	(0.847)											
2. LMX (n = 1303)	5.43	1.42	0.376**	(0.941)										
3. Behavior Control (n = 1324)	3.88	1.69	-0.147**	-0.043	(0.849)									
4. Outcome Control (n = 1324)	4.97	1.13	0.257**	0.292**	-0.118**	(0.342)								
5. MCP (n = 1319)	5.51	1.26	0.359**	0.836**	0.041	0.269**	(0.946)							
6. Interpersonal Justice (n = 1303)	5.90	1.35	0.300**	0.745**	-0.129**	0.268**	0.702**	(0.849)						
7. Formality (n = 1304)	4.88	1.21	0.163**	0.420**	-0.268**	0.242**	0.323**	0.390**	(0.626)					
8. Affection (n = 1301)	5.43	1.36	0.323**	0.777**	-0.170**	0.193**	0.723**	0.728**	0.475**	(0.885)				
9. Depth (n = 1297)	4.25	1.30	0.223**	0.573**	0.058*	0.205**	0.483**	0.480**	0.382**	0.511**	(0.651)			
10. Trust (n = 1294)	5.66	1.49	.339**	0.857**	-0.111**	0.285**	0.793**	0.803**	0.415**	0.817**	0.552**	(0.935)		
11. History (n = 1289)	5.39	1.35	.372**	0.774**	0.008	0.221**	0.698**	0.553**	0.329**	0.611**	0.489**	0.658**	(0.876)	
12. Synchronicity (n = 1258)	5.34	1.21	0.389**	0.754**	-0.025	0.210**	0.751**	0.610**	0.333**	0.681**	0.420**	0.696**	0.666**	(0.841)

Note: Reliabilities are shown in parenthesis along the diagonal.
* p < 0.05, ** p < .01

Archived RSE Predictors

In assessing the dimensions, the bi-variate correlations gave a general sense of the relevant variables associated with RSE. All of the dimensions were significantly correlated to RSE. Specifically, LMX, history, MCP, trust, affection, interpersonal

justice, synchronicity, outcome control, depth, and formality were positively correlated to RSE (r = .376, r = .372, r = .359, r = .339, r = .323, r = .300, r = .273, r = .257, r = .223, r = .163, $p < .01$, respectively). Also, behavior control was negatively correlated to RSE (r = -.147, $p < .05$). Based on the significant factor correlations, the researchers conducted a stepwise regression of archived RSE by entering each independent variable into the model based on the probability of F less than or equal to .05 and removing the variable when the probability of F became greater than or equal to .100. The researchers found only synchronicity, outcome control, history, behavior control, and formality to be significant predictors of archived RSE. In Model 1, synchronicity was entered into the regression model. Then, outcome control was added to the regression model in Model 2. Next, history was added to the regression model in Model 3. Then, behavior control was added to the regression model in Model 4. Finally, formality was added to the regression model in Model 5. Model 5 was significant with an adjusted squared multiple correlation of .199. A summary of the results can be found in Table 7 and Table 8.

Table 7: Archived RSE Stepwise Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.389[a]	0.152	0.151	1.29828	0.152	223.284	1	1250	0.000
2	0.431[b]	0.186	0.185	1.27202	0.035	53.148	1	1249	0.000
3	0.448[c]	0.201	0.199	1.26115	0.014	22.607	1	1248	0.000
4	0.465[d]	0.216	0.214	1.24946	0.015	24.460	1	1247	0.000
5	0.468[e]	0.219	0.216	1.24727	0.003	5.385	1	1246	0.020

a. Predictors: (Constant), Synchronicity

b. Predictors: (Constant), Synchronicity, Outcome Control

c. Predictors: (Constant), Synchronicity, Outcome Control, History

d. Predictors: (Constant), Synchronicity, Outcome Control, History, Behavior Control

e. Predictors: (Constant), Synchronicity, Outcome Control, History, Behavior Control, Formality

Table 8: Archived RSE Stepwise Regression Coefficient Summary

Model		Unstandardized Coefficients		Standardized	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.219	0.166		19.355	0.000		
	Synchronicity	0.454	0.030	0.389	14.943	0.000	1.000	1.000
2	(Constant)	2.285	0.207		11.018	0.000		
	Synchronicity	0.407	0.030	0.349	13.381	0.000	0.956	1.046
	Outcome Control	0.238	0.033	0.190	7.290	0.000	0.956	1.046
3	(Constant)	2.111	0.209		10.109	0.000		
	Synchronicity	0.284	0.040	0.243	7.129	0.003	0.552	1.811
	Outcome Control	0.221	0.033	0.176	6.767	0.040	0.943	1.060
	History	0.171	0.036	0.163	4.755	0.000	0.549	1.822
4	(Constant)	2.595	0.229		11.338	0.000		
	Synchronicity	0.277	0.039	0.238	7.025	0.000	0.552	1.813
	Outcome Control	0.202	0.033	0.161	6.199	0.000	0.930	1.075
	History	0.180	0.036	0.171	5.043	0.000	0.548	1.826
	Behavior Control	-0.104	0.021	-0.125	-4.946	0.000	0.984	1.016
5	(Constant)	2.831	0.250		11.321	0.000		
	Synchronicity	0.290	0.040	0.249	7.297	0.000	0.540	1.850
	Outcome Control	0.212	0.033	0.169	6.462	0.000	0.914	1.094
	History	0.193	0.036	0.184	5.358	0.000	0.533	1.875
	Behavior Control	-0.118	0.022	-0.142	-5.398	0.000	0.910	1.099
	Formality	-0.077	0.033	-0.066	-2.321	0.020	0.781	1.281

a. Dependent Variable: RSE

Archived LMX Predictors

In assessing the dimensions, the bi-variate correlations gave a general sense of the relevant variables associated with LMX. Trust, MCP, affection, history, synchronicity, interpersonal justice, depth, formality, RSE, and outcome control were significantly, positively correlated to LMX ($r = .857$, $r = .836$, $r = .777$, $r = .774$, $r = .754$, $r = .745$, $r = .573$, $r = .420$, $r = .376$, and $r = .292$, $p < .01$, respectively). Based on the significant factor correlations, the researchers conducted a stepwise regression of archived LMX by entering each independent variable into the model based on the probability of F less than or equal to 0.05 and removing the variable when the probability of F is greater than or equal to 0.100. The researchers found only trust, history, MCP, depth, synchronicity, affection, interpersonal justice, and formality to be significant predictors of archived LMX. In Model 1, trust was entered into the regression model. Second, history was

added to the regression model in Model 2. Third, MCP was added to the regression model in Model 3. Fourth, depth was added to the regression model in Model 4. Next, synchronicity was added to the regression model in Model 5. Next, affection was added to the regression model in Model 6. Then, interpersonal justice was added to the regression model in Model 7. Then, formality was added to the regression model in Model 8. Finally, outcome control was added to the regression model in Model 9. Model 9 was significant with an adjusted squared multiple correlation of .853. A summary of the results can be found in Table 9 and Table 10.

Table 9: Archived LMX Stepwise Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.856[a]	0.734	0.733	0.73101	0.734	3440.49	1	1250	0.000
2	0.903[b]	0.815	0.815	0.60920	0.082	550.861	1	1249	0.000
3	0.917[c]	0.840	0.840	0.56639	0.025	196.918	1	1248	0.000
4	0.919[d]	0.845	0.844	0.55839	0.005	37.049	1	1247	0.000
5	0.922[e]	0.850	0.849	0.54996	0.005	39.530	1	1246	0.000
6	0.923[f]	0.852	0.851	0.54670	0.002	15.884	1	1245	0.001
7	0.923[g]	0.853	0.852	0.54471	0.001	10.128	1	1244	0.006
8	0.924[h]	0.854	0.853	0.54325	0.001	7.701	1	1243	0.006
9	0.924[i]	0.854	0.853	0.54225	0.000	4.178	1	1242	0.041

a. Predictors: (Constant), Trust
b. Predictors: (Constant), Trust, History
c. Predictors: (Constant), Trust, History, MCP
d. Predictors: (Constant), Trust, History, MCP, Depth
e. Predictors: (Constant), Trust, History, MCP, Depth, Synchronicity
f. Predictors: (Constant), Trust, History, MCP, Depth, Synchronicity, Affection
g. Predictors: (Constant), Trust, History, MCP, Depth, Synchronicity, Affection, Interpersonal Justice
h. Predictors: (Constant), Trust, History, MCP, Depth, Synchronicity, Affection, Interpersonal Justice, Formality
i. Predictors: (Constant), Trust, History, MCP, Depth, Synchronicity, Affection, Interpersonal Justice, Formality, Outcome Control

Table 10: Archived LMX Stepwise Regression Coefficient Summary

Model		Unstandardized Coefficients		Standardized	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.793	0.082		9.698	0.000
	Trust	0.819	0.014	0.856	58.656	0.000
2	(Constant)	-0.010	0.076		-0.130	0.897
	Trust	0.581	0.015	0.607	37.598	0.000
	History	0.399	0.017	0.379	23.470	0.000
3	(Constant)	-0.370	0.075		-4.904	0.000
	Trust	0.422	0.018	0.442	23.120	0.000
	History	0.306	0.017	0.291	17.836	0.000
	MCP	0.319	0.023	0.282	14.033	0.000
4	(Constant)	-0.465	0.076		-6.127	0.000
	Trust	0.392	0.019	0.41	20.998	0.000
	History	0.286	0.017	0.272	16.624	0.000
	MCP	0.316	0.022	0.280	14.127	0.000
	Depth	0.091	0.015	0.083	6.087	0.000
5	(Constant)	-0.598	0.078		-7.692	0.000
	Trust	0.369	0.019	0.386	19.721	0.000
	History	0.257	0.018	0.245	14.67	0.000
	MCP	0.263	0.024	0.233	11.106	0.000
	Depth	0.093	0.015	0.085	6.344	0.000
	Synchronicity	0.131	0.021	0.112	6.287	0.000
6	(Constant)	-0.637	0.078		-8.176	0.000
	Trust	0.327	0.021	0.342	15.240	0.000
	History	0.255	0.017	0.242	14.597	0.000
	MCP	0.255	0.024	0.226	10.797	0.000
	Depth	0.087	0.015	0.080	5.977	0.000
	Synchronicity	0.115	0.021	0.098	5.450	0.000
	Affection	0.082	0.021	0.079	3.985	0.000
7	(Constant)	-0.713	0.081		-8.781	0.000
	Trust	0.297	0.023	0.311	12.709	0.000
	History	0.257	0.017	0.244	14.777	0.000
	MCP	0.245	0.024	0.217	10.31	0.000
	Depth	0.085	0.015	0.078	5.816	0.000
	Synchronicity	0.114	0.021	0.097	5.406	0.000
	Affection	0.071	0.021	0.068	3.392	0.001
	Interpersonal Justice	0.063	0.020	0.060	3.182	0.001
8	(Constant)	-0.808	0.088		-9.192	0.000
	Trust	0.296	0.023	0.310	12.717	0.000
	History	0.255	0.017	0.243	14.696	0.000
	MCP	0.251	0.024	0.222	10.554	0.000
	Depth	0.078	0.015	0.072	5.303	0.000
	Synchronicity	0.113	0.021	0.097	5.383	0.000
	Affection	0.057	0.021	0.054	2.654	0.008
	Interpersonal Justice	0.059	0.020	0.057	3.020	0.003
	Formality	0.041	0.015	0.035	2.775	0.006
9	(Constant)	-0.900	0.099		-9.114	0.000
	Trust	0.292	0.023	0.305	12.462	0.000
	History	0.255	0.017	0.242	14.676	0.000
	MCP	0.247	0.024	0.219	10.351	0.000
	Depth	0.078	0.015	0.071	5.267	0.000
	Synchronicity	0.114	0.021	0.097	5.416	0.000
	Affection	0.063	0.022	0.061	2.927	0.003
	Interpersonal Justice	0.057	0.020	0.055	2.900	0.004
	Formality	0.037	0.015	0.031	2.437	0.015
	Outcome Control	0.030	0.015	0.024	2.044	0.041

a. Dependent Variable: LMX

Time Zone Differential

To further analyze the RSE and LMX of the respondents, the researchers considered the time zone differential between each respondent and the AFCEC point of contact whom each respondent considered to be his or her primary point of contact. A time zone differential value of "0" means that both communication participants, the base-level personnel and AFCEC point of contact, were located within the same time zone regardless of whether or not the communication participants were located at the same base. A time zone differential value of "1" means that the communication participants were located in separate time zones within the continental United States. Sample sizes, minimum values, maximum values, means, and standard deviations of RSE based on time zone differential are given in Table 11. The summary of the analysis of variance for RSE based on time zone differential is given in Table 12. The researchers rejected the hypothesis that the RSE between base-level personnel and AFCEC points of contact are the same between groups of communication participants within the same time zone and communication participants in different time zones.

Table 11: RSE Descriptive Statistics by Time Zone Differential

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	6	4.5000	0.71755	0.29294	3.7470	5.2530	3.36	5.55
1	6	5.5791	0.94466	0.38566	4.5878	6.5705	3.73	6.18
Total	12	5.0396	0.9784	0.28244	4.4179	5.6612	3.36	6.18

Table 12: RSE ANOVA by Time Zone Differential

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.494	1	3.494	4.965	0.050
Within Groups	7.036	10	0.704		
Total	10.530	11			

Sample sizes, minimum values, maximum values, means, and standard deviations of LMX based on time zone differential are given in Table 13. The summary of the analysis of variance for LMX based on time zone differential is given in Table 14.

Table 13: LMX Descriptive Statistics by Time Zone Differential

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for		Minimum	Maximum
					Lower Bound	Upper Bound		
0	6	4.4921	1.07356	0.43828	3.3654	5.6187	3.14	6.14
1	6	4.5754	1.38115	0.56385	3.1260	6.0248	2.29	6.43
Total	12	4.5337	1.18019	0.34069	3.7839	5.2836	2.29	6.43

Table 14: LMX ANOVA by Time Zone Differential

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.021	1	0.021	0.014	0.909
Within Groups	15.301	10	1.530		
Total	15.321	11			

The researchers fail to reject the hypothesis that the LMX between base-level personnel and AFCEC points of contact are the same between groups of communication participants within the same time zone and communication participants in different time zones. Base-level personnel have the same level of LMX regardless of any time zone differential between themselves and the respective AFCEC points of contact.

Summary

The collected data, although unreliable due to sample size (Cohen, 1992), produced similar results to the archived data when predicting LMX. A summary of the significant predictors of each dependent variable based on the collected data and archived data with the amount of variance explained in each model can be found in Table 15. MCP was the significant predictor of RSE in the collected data; however, synchronicity, outcome and behavior control, history, and formality were significant predictors of the archived RSE. Trust and depth were the common significant predictors in each model for LMX.

Table 15: Significant Predictors by Dependent Variable Summary

Dependent Variable	Collected Data (n = 12)	Archived Data (n = 1252)
RSE	Manager Communication Performance (52.9%)	Synchronicity, Outcome Control, History, Behavior Control, Formality (21.6%)
LMX	Trust, Depth (84.7%)	Trust, History, Manager Communication Performance, Depth, Synchronicity, Affection, Interpersonal Justice, Formality, Outcome Control (85.3%)

Note: The amounts of variance explained (adjusted R square) of each model are shown in parenthesis.

Base-level personnel have higher levels of RSE when they are not within the same time zone as the respective AFCEC point of contact; however, the time zone differential between the base-level member and the AFCEC point of contact does not significantly affect the LMX as viewed by the member. The qualitative data was categorized into two

themes, which were relationships and role ambiguity through chain of command independence.

V. Discussion

Chapter Overview

Introduction

This chapter will provide a discussion of the quantitative results from the previous chapter and the qualitative data provided by the survey respondents. The significant regression model predictors will be examined to determine which areas are most important in improving the virtual team dynamics between AFCEC and base-level engineers. Finally, this chapter will discuss the themes identified by the respondents. These themes were: relationships and role ambiguity through chain of command independence.

Model Predictors

The analyses of the collected data and archived data revealed that remote self-efficacy (RSE) was difficult to predict. Manager communication performance (MCP) was significant in predicting RSE; however, MCP only accounted for 52.9% of the variance. This means that affective behaviors unique to individual humans account for the differences between each individual. While improving a manager's ability to effectively communicate with remote team members can increase the level of confidence that team members have in their ability to work remotely causing them to become less dependent on the manager, dimensions not investigated in this study may also be significant predictors of RSE and increase the power of model.

The analyses of the data regarding leader-member exchange (LMX), however, revealed trust and depth as significant predictive factors. These results affirm the

importance of establishing a personal relationship between team members. When the leader displays trustworthy attributes or seems more like a friend to the communication partner, the LMX as viewed by the member increases. LMX is developed early in the relationship between the leader and member. Liden et al. (1993) found that LMX at earlier time periods within the relationship was always a significant predictor of LMX at later time periods**.** First impressions are lasting impressions, however, it is never too late to develop and improve the personal relationship between team members.

Relationships

The qualitative data analysis revealed that one of the ways to improve the relationship is for AFCEC to provide timely responses to information requests from the bases. Just as Staples & Webster (2007) found, improving the perceived responsiveness can be accomplished by quickly returning telephone calls and responding to e-mails even if it is just to say, "I don't have time right now, but I will get back to you in 2 days with the answer." Being honest and sincere in their communication is how AFCEC personnel can establish higher levels of trust with the base-level engineers. AFCEC should be more receptive to the ideas and suggestions from base-level personnel to foster the personal relationships that exist between decentralized team members and centralized points of contact.

Role Ambiguity

The qualitative data analysis also identified role ambiguity through chain of command independence as an important concern among Base Civil Engineers (BCE).

With the Air Force Installation & Mission Support Center (IMSC) activating, AFCEC's role within civil engineering processes is still evolving. Because AFCEC is not within the base-level personnel's direct rating chain, communication from AFCEC occurs at different levels within the squadrons and AFCEC appears to be less customer-oriented. Previous squadron-level positions held by AFCEC personnel have biased the expectations from AFCEC to base-level personnel.

One of the survey respondents stated that he or she did not believe that there are any problems with the current virtual team dynamics. Instead, the respondent thinks the current difficulties that exist are internal to AFCEC and are a result of the organization standing up. AFCEC in its current organizational structure has been in existence for less than 4 years, and key personnel positions remain unfilled (Barry, 2015). A common idea among the respondents was that as AFCEC and IMSC mature and stabilize some of the internal issues will be resolved.

AFCEC personnel are not in the base-level engineers' direct rating chain. The survey respondents were asked, "What effect, if any, does this have on your communication relationship with that individual?" Three respondents believed that it has no effect on their relationship at all as there is largely a feeling of mutual respect; however, the other respondents believed this has a significant impact on the relationship. The other respondents felt as though being customers and not owners restrict their ability to impact AFCEC's responsiveness. One respondent believed that this dynamic causes AFCEC to be less customer-oriented toward the needs and ideas from the base-level engineers. Also, differences are difficult to resolve, because there is no lower or mid-level point where there is an individual with mutual oversight.

Jumping the chain of command appeared to be prevalent. Although AFCEC is not within the rating chain, the additional assignments that are directed by AFCEC affect how the base-level personnel are rated by the squadron leadership. A respondent explained that AFCEC directly tasking the base-level program managers or element leaders without going through the proper chain of command (i.e. the BCE or Deputy) disrupts the squadrons internally. At this particular base, the Squadron Commander and Deputy were not aware of all the work the Environmental section was doing, which directly impacted ratings and additional duties that may also be assigned by the Squadron Commander and Deputy. Squadron leadership must know what their personnel are doing and what manpower or resources are being utilized by AFCEC in order to properly level human resources and provide accurate personnel ratings.

Finally, there was a sense that because the IST works for AFCEC and the staff at the IST held previous MAJCOM assignments, the BCEs are subordinate to the staff. Previous experience in Squadron Commander billets may create bias toward the individuals currently filling those roles. Expectations, which affect the LMX, are developed based on past experiences. Although no influence on the rating chain exists in reality, one respondent thought the AFCEC staff feels there is a command relationship to the BCE. This is not only counterproductive, but also contradictory to Headquarters United States Air Force Program Action Directive (PAD) 12-03, which identifies AFCEC as fulfilling a supportive function to base-level squadrons. A repetitive response was that AFCEC needs to let the bases manage the installations' program, because AFCEC is to "support" the installation not control it.

Recommendations

The quantitative and qualitative responses by the BCEs and Deputy BCEs identified the establishment of personal relationships and the clarity or reduction of role ambiguity as the most important courses of actions in improving the virtual team dynamics of a globally-distributed team. The BCEs suggested that AFCEC can enhance their virtual team dynamics by being reducing its behavior control and outcome control. The BCEs would like AFCEC to be less controlling over the engineering processes and being more receptive to base-level input allowing the bases to be more autonomous in their execution of duties. Additionally, the BCEs felt the virtual team dynamics can be enhanced by asking the bases what they need first and then coordinating with the bases. One respondent specifically demanded that AFCEC should not set something up and then force feed it to the installations. Some of the BCEs were uncertain of why the environmental program is the only program where the requirements and project programming are completed by the field operating agency. CE squadrons would like to have increased control over the programming of environmental requirements at the base-level.

Another recommendation from the BCEs was to establish relationships with the base-level personnel through formal sessions to first introduce the team, establish role expectations, and set a foundation for future working relationships. The BCEs felt that AFCEC should build relationships with the local regulators to replicate what occurred at the installations before AFCEC inherited environmental oversight. Consistent with the quantitative data regarding leader-member exchange, the relationships are viewed more positively when higher levels of trust and communication are developed.

Finally, the squadrons would like to see more use of information technology, whether through Defense Connect Online (DCO) and video teleconferences (VTCs) to facilitate individual base discussions in lieu of orchestrating virtual nationwide meetings. While there is tremendous benefit for the Major Commands or Installation Support Team (IST) to conduct meetings with all the squadron commanders, some of the squadron commanders do not think their time is being effectively used while listening to other bases' issues. The technology should be more effectively used for the customer to make executing work easier on the bases. The current bi-monthly meetings between with each base and the Regional Support Team are viewed as useful in building the relationships between AFCEC and base-level personnel. But, the bases would like to see more of this partitioning in regards to the IST.

In conclusion, virtual team dynamics are affected by more than just information technology tools and organizational structure. Personal relationships must be established, developed, and fostered in order to improve virtual team dynamics. This research revealed that trust and depth of communication were significant predictors of the perception of relationship-based exchanges between the Air Force Civil Engineer Center and the Air Force Base Civil Engineer Squadrons. These results affirmed the importance of establishing a personal relationship between team members and demonstrated that LMX increases when the leader seems trustworthy or more like a friend to others

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Appendix A. Virtual Team Dynamics Survey

Air Force Institute of Technology (AFIT) Research Survey

Enhancing Virtual Team Dynamics

Researcher: Captain Freddie L. Stephens II

Research Advisor: John J. Elshaw, Ph.D.

Research Sponsor: Headquarters Air Force Installation Strategy and Plans Division (HAF/AF4CI)/Air Force Civil Engineer Center (AFCEC)

You are being asked to participate in a short survey. This survey is part of research examining the characteristics of distributed team dynamics to improve communication and perceived responsiveness of organization headquarters to the fielded units. Please answer the questions according to your personal experiences while communicating with AFCEC. Each question in Part 1 and Part 2 is based on a 7-point Likert-scale in which (7) is Strongly Agree, (6) is Agree, (5) is Somewhat Agree, (4) is Neutral, (3) is Somewhat Disagree, (2) is Disagree, and (1) is Strongly Disagree. This should take approximately 25-30 minutes of your time.

Your participation in this survey is voluntary. You may answer one, two, all, or none of the survey questions. There is no penalty for non-participation and no anticipated risks are associated with participation.

No personally identifiable information (PII) will be collected. The only demographical information that is being requested should you choose to participate is the location of your current assignment.

Part 1: Perceptions of Your Job, Your Unit, and Yourself

On a day to day basis, how confident do you feel in accomplishing the following activities regarding your job?

1) Accomplish my tasks in my duty section, even when I must rely heavily on communication technology to do so.
2) Communicate with others in my duty section effectively, even when I must depend on technology to do so.
3) Coordinate activities in my duty section, even if members in my section are separated from me.
4) Get a response from my point of contact within AFCEC's Environmental Directorate for a request for advice or help within the same day.
5) Get a response from my point of contact within AFCEC's Environmental Directorate for a request for advice or help within 2 to 3 days.
6) Locate my point of contact within AFCEC's Environmental Directorate and contact him/her immediately.
7) Coordinate with others in my duty section to get the job done, even if I must rely solely on communication technology to do so.
8) I can achieve my work objectives even when all members of my duty section are out of sight.
9) I can use technology to effectively communicate with others in my duty section.
10) I can be effective, even without members of my duty section nearby.
11) I am effective at my job, even without my point of contact within AFCEC's Environmental Directorate nearby.

Part 2: Perceptions of Your Point of Contact within AFCEC's Environmental Directorate

12) He/she tends to closely monitor how my work gets done.
13) He/she is results oriented.
14) He/she always wants to know every detail of how I conduct my work.
15) As long as there are no complaints, my point of contact within AFCEC's Environmental Directorate leaves me alone.
16) He/she closely supervises my behaviors on the job.
17) He/she doesn't care how I get my work done, as long as I get it done.
18) He/she runs meetings effectively (e.g. sets agendas, publishes minutes).
19) He/she has good communication skills (e.g. a good listener, asks for clarification when needed, sets a positive tone).
20) He/she asks for and listens to my ideas and solutions.

21) He/she uses e-mail effectively to send information updates to the work group.
22) He/she uses available information technology tools effectively.
23) He/she uses and runs teleconference calls effectively.
24) He/she encourages me to use available information technology tools effectively.
25) He/she sets expectations about the frequency, method, and subjects of communications between the two of us.
26) He/she keeps an accessible schedule so that I know where to locate him/her.
27) He/she communicates goals and priorities to me.
28) He/she is available for consultation and advice.
29) He/she supports and promotes social activities and team building activities.
30) He/she treats me in a polite manner.
31) The communication between me and my point of contact within AFCEC's Environmental Directorate is informal.
32) He/she understands my problems and needs.
33) He/she communicates coldness rather than warmth.
34) He/she acts like a good friend.
35) He/she acts bored in our conversations.
36) He/she shows enthusiasm when talking with me.
37) He/she tries to move our conversations to a deeper level.
38) He/she creates a sense of distance between us.
39) He/she seems to care if I like him/her.
40) He/she is sincere.
41) He/she is honest in communicating with me.
42) He/she is open to my ideas.
43) He/she makes our interactions very formal.
44) He/she treats me with dignity and respect.
45) He/she wants our communication to be casual.
46) He/she is interested in talking with me.
47) He/she refrains from improper remarks.
48) I am very familiar with how my point of contact within AFCEC's Environmental Directorate makes decisions.
49) My point of contact within AFCEC's Environmental Directorate would be personally inclined to use his or her power to help me solve problems in my work.
50) I can count on my supervisor to "bail me out", even at his/her own expense, when I really need it.
51) I would view my working relationship with my point of contact within AFCEC's Environmental Directorate as extremely effective.
52) I have enough confidence in my supervisor that I would defend and justify his/her decisions if he/she were present to do so.
53) I usually know where I stand with my point of contact within AFCEC's Environmental Directorate.
54) I usually know how satisfied my point of contact within AFCEC's Environmental Directorate is with me.

55) My point of contact within AFCEC's Environmental Directorate and I always seem to be in tune as to what we are doing.
56) My point of contact within AFCEC's Environmental Directorate work schedule is in-synch with my own work schedule.
57) My point of contact within AFCEC's Environmental Directorate and I have difficulties aligning our schedules.
58) My point of contact within AFCEC's Environmental Directorate is available whenever I need him/her.
59) My point of contact within AFCEC's Environmental Directorate responds to my messages (e.g. phone, e-mail) in a timely manner.
60) It is often difficult to get in touch with my point of contact within AFCEC's Environmental Directorate.
61) My point of contact within AFCEC's Environmental Directorate explains his/her decisions thoroughly.
62) I feel like I know my point of contact within AFCEC's Environmental Directorate well.
63) I am very familiar with how my point of contact within AFCEC likes to receive information.

Part 3: Communication Richness

64) Units often restructure their organizations, changing, for example, who reports to whom. Based on your experience, how likely is it that you will have the same point of contact within AFCEC's Environmental Directorate 1 year from now?
65) Estimate the distance (in miles) between your primary work location and that of your point of contact within AFCEC's Environmental Directorate. Enter a 0 if you both primarily work in the same building.
66) Consider the last three months, estimate the number of days with which you and your point of contact within AFCEC's Environmental Directorate worked in different locations, where you were physically separated by distance and therefore could not meet face to face.
67) What do you think could enhance virtual team dynamics over the next 2-3 years?
68) Your point of contact within AFCEC's Environmental Directorate is not within your rating chain. What effect, if any, does this have on your communication relationship with that individual?
69) If you have any additional comments feel free to add those here. We are particularly interested in identifying opportunities and challenges you have faced with respect to coordination, responsiveness, and team dynamics when all or part of your unit are separated from each other.
70) Please enter your current base or duty location.
71) How many years have you served in your current position?

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Vita

Captain Freddie L. Stephens II graduated from Elgin High School in Elgin, Oklahoma. He entered undergraduate studies at the University of Oklahoma in Norman, Oklahoma, where he graduated with a Bachelor of Science degree in Mechanical Engineering in May 2005. He received a commissioned from Officer Training School (OTS) at Maxwell AFB, Alabama in December 2009.

His first assignment was to the 628th Civil Engineer Squadron at Joint Base Charleston, South Carolina where he served as a Project Engineer and later as the Chief of Simplified Acquisition of Base Engineering Requirements element. While stationed at Joint Base Charleston, he deployed overseas in February 2011 to spend seven months in Kabul, Afghanistan as the Combined-Joint Engineer Directorate, NATO Training Mission-Afghanistan & Combined Security Transition Command-Afghanistan as an Afghan Uniform Police Program Manager. In October 2011, he was assigned to the 24th Training Squadron at Maxwell AFB, Alabama as a Flight Commander/Instructor. He later served as the Assistant Director of Operations of the 22d Training Support Squadron, where he was responsible to the Commander for training Air Force officers in expeditionary readiness and physical conditioning. In October 2014, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will be assigned to the 12th Air Force at Davis-Monthan AFB, Arizona.

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14. ABSTRACT With the activation of the Air Force Civil Engineer Center in 2012, the United States Air Force initiated an effort to centralize installation and mission support management throughout the Air Force, while decentralizing the execution at the base level. The measurement of success for such a decision extends beyond the reduction of overhead costs. The goal was to build a responsive, mission-focused organization. This research evaluated specific factors associated with the characteristics of virtual team dynamics to improve the perceived responsiveness of a centralized organization. Leader-member exchange (LMX) theory is a relationship-based approach to leadership that focuses on the quality of the exchanges between two members. Previous research regarding LMX theory has focused on explaining how people relate to each other. However, this research developed a model to predict how to actually improve the quality of these exchanges. Base Civil Engineers participated in a survey to measure the current dynamic between AFCEC and Civil Engineer squadrons. This research revealed that trust and depth of communication were significant predictors of LMX. These results affirmed the importance of establishing a personal relationship between team members and demonstrated that LMX increases when the leader seems trustworthy or more like a friend to others.			
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