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An Empirical Model of Collaboration Capability and Absorptive Capacity in Virtual Teams: a Multi-Dimensional Investigation using Confirmatory Factor Analysis

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A multi-dimensional investigation using confirmatory factor analysis

By

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Virtual teams are being increasingly utilized in industry given their ability to bring together diverse knowledge and experience from individuals who are not geographically proximal. Having a diversity of knowledge within virtual teams is noted to benefit innovation outcomes; however, leveraging the benefits of diversity (both deep-level and functional level) is likely to require a capability to facilitate collaboration among team members. This dissertation examines collaboration capability and absorptive capacity at the virtual team level by evaluating the inter-relationships among the dimensions and their influence on team innovation.

This research also tests the impact of team diversity on team innovation with an additional focus on understanding the moderating impact of collaboration capability and the mediating impact of absorptive capacity. Two dimensions of team diversity are examined. The first dimension, deep-level diversity, involves the individual characteristics, values, attitudes and preferences. The second dimension, functional-level diversity, which entails the diversity in functional and expertise backgrounds.

Survey data was collected from 166 virtual team members and the validation process revealed satisfactory psychometric properties at the items and the constructs level. A confirmatory factor analysis (CFA) was carried out to determine the factor structure of the hypothesized models, as well as its reliability and validity.

DEDICATION

Psalm 115:1

To my Lord and Savior Jesus Christ.

To my loving mother Enam and my father Salameh.

To my beautiful wife Rana and to my daughters, the joy of my life,

Majd, Jenna and soon to come baby Sultan.

To my sweet sisters Hifa, Grace and Roda.

To my awesome brothers John, Maher and Mazen.

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CHAPTER I

COLLABORATION FOR INNOVATION IN DIVERSE VIRTUAL TEAMS

Technology has effectively removed constraints of time and space in ways that afford companies opportunities to move beyond traditional organizational structures and to move instead toward virtual organizational structures. The requirement for innovation has become increasingly detailed and requires in-depth and specialized knowledge. The specialized knowledge and talent required for innovation often resides around the world and organizations have no choice but to make use of virtual teams to access such dispersed knowledge and talent resources.

Virtual teams are defined as collections of individuals who "work across space, time, and organizational boundaries with links strengthened by webs of communication technologies" (Lipnack & Stamps, 2000, p. 7). Virtual teams allow remotely located technology experts to collaborate and innovate, mainly by using technology to share information, communicate, and coordinate their efforts (Lipnack & Stamps, 2000). Collaborative efforts between diverse virtual team members tend to result in enhanced innovation and creative solutions (Zakaria, Amelincks, & David, 2004). Virtual teams possess different characteristics than conventional (face-to-face) teams, and it would be unwise to attribute the same performance factors influencing conventional teams to virtual teams (Potter & Balthazard, 2002).

The ability to innovate is critical to organizational success, and is increasingly vital for competing in the global marketplace (Gorodnichenko, Svejnar, & Terrell, 2010). Virtual teams have created an unprecedented opportunity for businesses to achieve new levels of corporate effectiveness through enhanced access to new sources of external knowledge (Hosseini & Chileshe, 2013). The literature acknowledges the importance of external knowledge to innovation performance. The ability to recognize new, valuable sources of external knowledge and to integrate this knowledge into the innovation process of the firm is a crucial element in the strategic ability to stay competitive (Dahlander & Gann, 2010). Cohen and Levinthal (1990) described the "ability of the firm to recognize the value of new external information, assimilate it, and apply it to commercial ends" as absorptive capacity (ACAP). The construct of ACAP was a significant contribution to the innovation and strategic management literature, where many researchers have since established positive relationships between ACAP and innovation output (Fabrizio, 2009; Matusik & Heeley, 2005; Murovec & Prodan, 2009).

Originally, absorptive capacity was defined at the firm-level (Cohen & Levinthal, 1994), but it has been extended downward to the R&D team level (Nemanich, Keller, Vera, & Chin, 2010) and to the individual level (Matusik & Heeley, 2005). Given the fundamental importance of ACAP to the process of strategic innovation and the central importance of innovation performance in virtual teams, it is noteworthy that research to date has not fully explored the role of ACAP in virtual teams and its potential impact on innovation output. The first contribution of the present study to ACAP research is to address this omission by extending the ACAP construct as defined by Cohen and Levinthal (1990) to the virtual team level.

Despite widespread reference to the ACAP construct, it has been widely measured as unidimensional, although it is clearly defined as a multi-dimensional. Advances have been made to further understand the accuracy and precision of the multi-dimensional aspect of ACAP. Various researchers have further studied the multi-dimensional characteristics of ACAP at the firm level (Daspit & D'Souza, 2013; Sun & Anderson, 2010) and also at the R&D project team level (Nemanich, Keller, Vera, & Chin, 2005). The second contribution of this study to ACAP research is to extend the work of understanding the multi-dimensional character of ACAP to the virtual team level by incorporating the three traditional dimensions of ACAP (assess, assimilate, and apply). Deepening our basic understanding of the ACAP construct at the virtual team level will provide valuable foundational insight into the effective management of virtual teams. This research will consider how ACAP can act as a mediator to enable virtual teams to achieve their strategic innovation goals. This is done by offering an empirically tested multi-dimensional model of ACAP at the virtual team level, and by providing an appropriate level of statistical analysis for each dimension by specifying the interdependencies among the ACAP dimensions.

Since team innovation is a vital ingredient for the success of most virtual teams, it is also necessary to understand the factors that constitute successful collaboration among virtual team members. Prior research has highlighted that relational CCAP among team members has a strong association with team creativity and innovation (Blomqvist & Levy, 2006; Ostendorf, Mouzas, & Chakrabarti, 2014; Reiter-Palmon, Wigert, & Vreede, 2012). Subramaniam & Youndt (2005) argued that innovation is basically an effort of collaboration, and that social processes play a key role in innovation development.

Blomqvist and Levy (2006) identified three crucial social factors that define CCAP; these are trust, communication, and commitment. Trust is the foundation for effective communication between network partners, thus enabling knowledge creation and innovation in networks (Blomqvist & Levy, 2006). Building relationships based on mutual trust and commitment is one of the most important tasks in collaboration (Filieri, McNally, O'Dwyer, & O'Malley, 2014). Ensley et al. (2002) showed that innovative teams with higher cohesion show lower relationship conflict. In addition, Simons and Peterson (2000) empirically established that higher intragroup trust decreases the occurrence of cognitive conflict prompting relationship conflict.

The third contribution of this research is extending the theoretical concept of CCAP proposed by Blomqvist & Levy (2006) to the virtual team level. This is done by developing a multi-dimensional CCAP model specifying the interdependencies among the dimensions of trust, communication, and commitment in order to understand how these dimensions (both separately and together) influence team innovation. The literature on collaboration in virtual teams is somewhat fragmented and does not provide a comprehensive framework describing CCAP and its impact on innovation. Various researchers have studied the impact of trust on innovation (Amberg, Reinhardt, & Kittler, 2008; Xue & Luo, 2011), while others have studied the impact of communication on innovation (Chamakiotis, Dekoninck, & Panteli, 2013; Cormican, Dooley, & O'Sullivan, 2006; Gressgård, 2011); the present study, however, provides a more comprehensive framework by combining the three important CCAP factors as described by Blomqvist & Levy (2006) at the virtual team level.

Consistent with the majority of the previous work on teams, we address the research theoretical foundation through the established systems-theory Input-Process-Outcome (I-P-O) framework, which defines teams as social systems that are embedded in organizations. The I-P-O framework suggests that team inputs, team processes, and team outputs are linked to each other (McGrath, 1964). Martins et al. (2004) conducted an extensive literature review on teams, and indicated that the I-P-O model is the dominant framework and methodology used for the study of teams.

The I-P-O perspective indicates that the combined structural characteristics of the team act as inputs that effect team processes, which in turn effect team outputs (Mohammed & Hamilton 2007). The present study will adapt this approach for team level analysis based on the following factors:

- Input factors: Team diversity and media richness
- Process factors: CCAP and ACAP
- Outcome factors: Team innovation and team effectiveness

In order to arrive at the final comprehensive model, we will first conduct two preliminary studies in order to validate and test the multi-dimensional constructs of CCAP (Chapter 2) and ACAP (Chapter 3). The first study was performed in order to validate the CCAP construct at the virtual team level and to understand the relationship between the elements of CCAP (trust, communication, and commitment) and their influences on team innovation. A second study was performed in order to validate the ACAP construct at the virtual team level and to understand the relationship between the elements of ACAP dimensions (knowledge assessment, knowledge assimilation, and knowledge application) and their influences on virtual team innovation.

The third study in Chapter 4 will develop the comprehensive virtual team model, which is an extension of Chapters 2 and 3. Specifically, Chapter 2 tests CCAP as a moderator between team diversity and team outcomes, which implies that the causal relation between team diversity and team outcomes changes as a function of the moderator variable (CCAP). On the other hand, Chapter 3 concentrates on how ACAP mediates team diversity and team innovation, which implies that the causal relation between team diversity and team outcomes is explained by the mechanism of ACAP processes. By combining these models together and building a comprehensive model, we further increase the power to explain team innovation performance as we account for a larger variety of interrelated factors. Figure 1 summarizes the proposed conceptual models for the three studies.

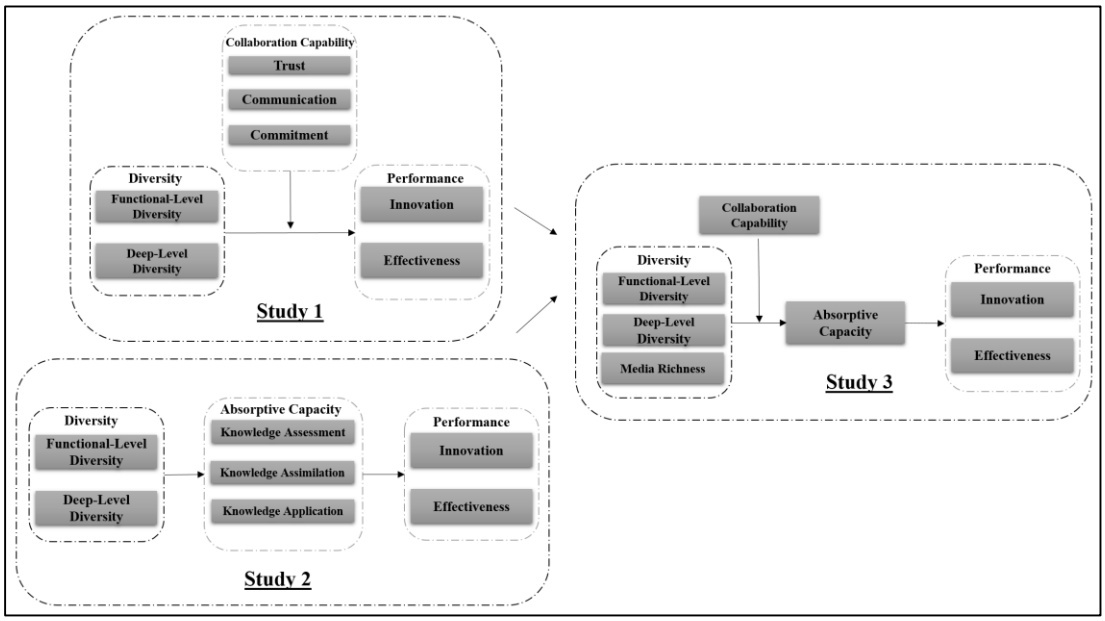


Figure 1 Research conceptual models

Background

Virtual teams have become an important method of knowledge creation for the innovation process within or among modern organizations. It is widely accepted that open innovation can be better realized by utilizing the virtual team environment (Furst, Blackburn, & Rosen, 2001). By using virtual teams, firms can efficiently combine the knowledge and skills of geographically dispersed team members.

Global market forces have reduced the role of the traditional sources of competitive advantage. They have also caused the emergence of new global trends that have introduced new competitors from different parts of the world. Currently, firms are operating in an extremely competitive and tumultuous global environment. Innovation and collaboration are critical to survival and success (Matthew & Sternberg, 2006). As this global competition intensifies and the pace of innovation accelerates, organizations are increasing their efforts to build global ventures. This is necessary to enhance their competitiveness and remain close to their targeted markets and customers. Managing these aspects of collaboration aimed at enhancing innovation is a way of preserving and expanding a firm's effectiveness. Developing innovative and useful products and services reduces costs and increases sales. However, innovation is meaningful only if new products or processes create value (Nonaka, 1994). For organizations to survive and sustain a competitive advantage, innovation must become a strategic and organizational imperative. The ability to swiftly and consistently advance solid new ideas is a top priority of today's organizations. Therefore, enhancing innovation is an essential business skill that eventually improves the growth of an organization.

In 2010, Booz & Company conducted their annual study of the world's 1,000 largest corporate research and development (R&D) spenders. This study revealed that "innovation can lead to higher performance, but the process isn't automatic." Also, innovation "does not necessarily require above average levels of investment or higher numbers of patents, since patents generally don't drive profits" (Jaruzelski & Dehoff, 2010). They found that the most prosperous companies supported an integrated collaborative process that encourages employees to think about next steps and possible solutions in order to create a maintainable competitive advantage. From this it may be concluded that successful organizations continually tap into new sources of knowledge, which is then integrated into the firm's strategic ability, in order to transform it into innovation (Nonaka, 1994).

The process of knowledge generation and innovation is embedded in the interaction of technological interrelations between various subsystems (groups, departments, and organizations). The linkages of a firm's subsystems have an important bearing on the "rate and direction of innovation" (Chesbrough, 1996; Gordon, Kaminski, Brouchous, & Schoenbachler, 1997). This interaction and collaboration play a critical part in articulating and increasing the rate of innovation. The fast-moving globalization trend challenges the collaborative working environment of an organization. Successful organizations should therefore focus on the collaboration performance of their networked subsystems, at both their internal boundaries (intra-functional teams) and external boundaries (customer, suppliers, competition, etc.). In a global and fragmented work environment, collaboration and innovation are often challenged by geographical

boundaries, time zones, and multicultural aspects. In light of these challenges, team-building efforts must transcend organizational boundaries.

Advances in telecommunication technologies are empowering firms to collaborate and communicate with business partners in new and economical ways. This dynamic process is driving the emergence of virtual teams. These are defined as teams that use "technology to work across locational, temporal, and relational limitations to achieve interdependent tasks" (Badrinarayanan & Arnett, 2008). Virtual teams allow organizations to pool their expertise by eliminating time and location barriers. Additionally, virtual teams provide exceptional levels of flexibility and responsiveness. Current organizations are investing heavily in virtual teams to improve their competitiveness and performance. However, virtual team research is still in its infancy. Substantial exploration is required to understand these new organizational systems (Badrinarayanan & Arnett, 2008).

Problem

There has been a significant body of research done on virtual teams; however, a clear and comprehensive understanding of the attributes that drive innovation in virtual teams does not exist. The literature that exists on this aspect is fragmented, and while it is challenging to provide a comprehensive view, it clearly shows that the traditional ACAP model has not yet been considered for virtual teams. While CCAP and practical challenges of managing ACAP have been identified as necessary components for successful collaboration and knowledge creation in various contexts, it has not yet been applied to virtual teams' success in fostering team innovation. Similarly, the influence of CCAP and ACAP on team innovation has not been fully studied in the theoretical

literature. Given how rapidly organizations are moving toward the use of virtual teams, there is a need to identify and develop the theoretical explanatory relationships between CCAP, ACAP, and team innovation in a virtual team environment.

The literature indicates that there is a lack of a unified understanding of the factors of collaboration that impact the innovative performance of virtual teams. To this point, researchers have studied fragmented factors of collaboration in their studies of virtual teams. For example, researchers gave a great deal of attention to the trust aspect of collaboration (Fan, Suo, Feng, & Liu, 2011; Rusman, Bruggen, Sloep, & Rob, 2010), noting that that trust plays a foundational role in virtual team collaboration. Further, they indicated that many failures of collaboration within virtual teams were attributable to the hampering of the process of establishing a foundation of interpersonal trust. Other researchers have focused on communication (Lee-Kelley & Sankey, 2008; Tong, Yang, & Teo, 2013), concentrating on the impact of communication media on team performance. The present study will investigate the CCAP multi-dimensional construct as it has been proposed by Blomqvist and Levy (2006), where they defined the vital factors to be trust, commitment and communication. However, whereas their study focused on a literature survey and conceptual analysis for knowledge creation in cross-functional teams, the proposed work will further explore and test CCAP within the virtual team environment. They proposed that these factors differentiate relationally oriented relationships from transactional relationships. Although transactional factors such as transaction cost, enabling technologies, and coordination are somewhat important, they are not sufficient for collaborative innovation, which is characterized by high risks and uncertainty (Blomqvist & Levy, 2006).

To further advance its contribution to the literature, the present study will also examine ACAP and its associated dimensions. Cohen and Levinthal (1990) described ACAP as the "ability of the firm to recognize the value of new external information, assimilate it, and apply it to commercial ends." As more companies are using virtual teams to foster innovation and increase their competitive advantage, it is imperative to study virtual teams through the lens of ACAP in a multi-dimensional construct (the ability to assess, assimilate, and apply knowledge). Without a multi-dimensional approach, a precise and accurate understanding of the ACAP construct cannot be developed, and the interdependencies among the dimensions remain unknown.

ACAP is an important construct because it not only enables organizations to utilize external knowledge, but also supports the accurate prediction of innovation (Cohen & Levinthal, 1994). Currently, the potential of virtual teams may be limited due to a limited understanding of how ACAP and CCAP influence team innovation. It is important to study virtual team collaboration with these independent factors because not all factors for innovation are created equal, and the relationships among the factors must be studied to determine their relative importance.

Research goals

This proposed research will study virtual teams from the perspectives of relational CCAP and ACAP in order to deal with the inherent challenges of the virtual team concept. While virtual teams are increasingly becoming the solution for globalization and increased competitive advantages, there are significant drawbacks to their use that need to be considered and further studied. Companies might deploy virtual teams to achieve specific goals, but they might not deploy the optimum strategies, processes, or

skills that support innovation. Working together and truly collaborating are two different things. As Keith Ferrazzi (CEO of Ferrazzi Greenlight) so eloquently (Ferrazzi, 2012) put it, "Collaborative activity is the secret sauce that enables teams to come up with innovative and creative products and solutions."

The main goal of this research is to design a virtual team collaboration model that drives team innovation. Over the last decades, organizational teams including research and development teams have become increasingly virtual; this is of vital importance to organizations. This research will extend the knowledge base of virtual team literature and assist organizations in understanding the critical relationships and factors that lead to optimal innovative performance in virtual teams. In order to achieve the main objective of this research, the following three studies were performed:

- The examination of the CCAP construct at the virtual team level: its definition, the interrelationships among its dimensions, its influence on team innovation, and its mediation relationship between team diversity and team innovation.
- The examination of the ACAP construct at the virtual team level: its definition, the interrelationships among its dimensions, its influence on team innovation, and its mediation relationship between team diversity and team innovation.
- The examination of the interdependencies among CCAP and ACAP dimensions: to design a framework that would assist organizations in understanding the interplay between team diversity, CCAP, ACAP, and team innovation in a virtual environment.

Establishing foundational insights into how principles of ACAP and CCAP translate from the traditional business environment to virtual teams can help organizations determine the appropriateness of virtual teams to their innovation needs and objectives. This research will analyze the multiple dimensions of CCAP and ACAP in order to identify and characterize any interdependencies among the dimensions. The

findings of this study will add new information related to virtual teams to the literature and provide a recipe for successful virtual team strategy and management.

The results of this research will examine and unpack the constructs of CCAP and ACAP in virtual team environments in order to maximize collaboration and also maximize the performance of virtual team innovation output by providing the strategy and insights that efficiently support virtual collaborative work. It will provide valuable insight to managers on the major and critical factors that contribute to the innovation outcomes of the virtual teams, enabling them to provide the appropriate training and skills to members of their virtual teams. It will also enable management to have the correct view on how to characterize and assess collaborative virtual teams.

Definitions and key terms

Virtual teams: "Teams whose members use technology to varying degrees in working across locational, temporal, and relational boundaries to accomplish an interdependent task" (L.L Martins, Gilson, & Maynard, 2004, p. 808).

Absorptive capacity (ACAP): Cohen and Levinthal (1990) described ACAP the as "ability of the firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends."

Collaboration capability (CCAP): Blomqvist and Levy (2006) described CCAP as the ability to "build and manage network relationships based on trust, communication and commitment."

Team diversity is defined as the degree of difference between team members. It can refer to either perceived or objective difference (Van Knippenberg, De Dreu, & Homan, 2004).

Deep-level diversity refers to team members' perceived differences with respect to non-visible underlying personal characteristics such as values, beliefs, and attitudes (D Harrison, Price, Gavin, & Florey, 2002).

Functional-level diversity is the degree to which team members differ in knowledge, skills, information, and expertise (Bunderson & Sutcliffe, 2002).

Media richness accounts for how task performance and communicative effectiveness can be affected by the following different communication media (in order of decreasing richness): (1) face-to-face, (2) telephone, (3) personal documents such as letters or memos, (4) impersonal written documents, and (5) numeric documents (Daft & Lengel, 1984).

Team innovation: Drazin et al. (1999) defined team innovation as the degree to which the team's processes are novel in the context of the team's objectives.

Defining teams

While the terms *teams* and *groups* are often used synonymously, distinguishable differences exist between the two terms (Lipnack & Stamps, 2000). Though teams are designed to have common objectives and goals, groups may share goals, but not necessarily objectives (Katzenbach & Smith, 1993). A team is characterized as "a group of two or more individuals who must interact cooperatively and adaptively in pursuit of shared valued objectives with clearly defined complementary roles and responsibilities[;] teamwork is much more important than the sum of the individuals" (Cannon-Bowers, Salas, & Converse, 1993, p. 220).

Teams are considered virtual when individuals work and communicate across time, space, cultures, or organizational boundaries using technological tools to overcome

temporal or geographical limitations (Hartog, D. N., Verburg, & Croon, 2012). A virtual team is defined as a "group of people who collaborate closely, even though they may be separated by space, time, and organizational barriers" (Lipnack & Stamps, 2000). Henry and Hartzler (1998) indicated that a virtual team usually consists of no more than 20 team members. Their geographical dispersal can significantly vary, and team members may be located in different parts of the globe. The concept of virtual teams can be extended to include members from different functional areas of organizations, and also include customers, suppliers and other business stake holders (Leenders, Engelen, & Kratzer, 2003).

History of virtual teams

Organizations began exploring virtual teams in the mid-1990s, including companies known for innovation such as Nokia, Sun Microsystems, Nike, and Apple. The development of virtual teams in these organizations stemmed from the demands imposed by globalization and the need to integrate their quality and human resources practices across their foreign operations (Lipnack & Stamps, 2000). For example, in the mid to late 1990s, Sun Microsystems implemented many successful virtual teams such as SunService's Live Call Transfer Team, SunExpress' Customer Order Cycle Team, and SunService's Two-Day Customer Quality Index Team (Sáenz, Aramburu, & Rivera, 2009). In these cases, Sun implemented inter-functional teams that were both internal and external to solve quality problems across the globe.

It was estimated that in 2004, there were more than 8.4 million people in the U.S. that were involved in virtual teams. By 2012, the Society for Human Resource Management (SHRM) indicated that 46% of organizations were using virtual teams. This

shows that organizations who want to stay competitive in the global market of the 21st century will need to adapt successfully to this new type of virtual working environment.

Summary

Team virtualization can offer considerable benefits to organizations of all sizes. The innovation process in traditional teams arises in a chosen physical space during designated working shifts. In contrast, in virtual teams, the innovation process has no time or place constraints and is facilitated by communication technology tools (Ojasalo, 2008). The use of virtual teams also means that relocating personnel is no longer required. Virtual teams with a flexible and configurable infrastructure can save costs and time, resulting in increased productivity (Anderson, McEwan, & Carletta, 2007). By having team members located across several time zones, the typical eight-hour workday expands to a full 24 hours in some virtual team settings, as team members in different parts of the globe can advance the projects within their respective workdays, providing consistent progress over the course of a full calendar day(Vaccaro, Veloso, & Brusoni, 2008). Virtual teams are valuable in generating information through improved access to experts who can expedite the exploration of creative and innovative solutions (Duarte, Deborah, & Tennant, 2011).

Virtual teams can have benefits over traditional face-to-face teams, especially in increasingly complex innovation environments, by leveraging knowledge and resources from various actors, increasing productivity and reducing relocation costs. These benefits are critical for innovation. Virtual teams also present intrinsic challenges, and if these challenges are not dealt with and managed well, the innovation process can be delayed or inhibited entirely. Therefore, the goal of this is research is to study virtual team

collaboration from the perspectives of CCAP and ACAP in order to deal with the inherent challenges of the virtual team concept. This study will extend the important research concept of CCAP and its criticality for knowledge creation into virtual team environments.

CHAPTER II

COLLABORATION CAPABILITY IN VIRTUAL TEAMS: EXAMINING THE INFLUENCE ON DIVERSITY AND INNOVATION

Introduction

Globalization has opened new possibilities for establishing and maintaining competitive advantage. As firms operate in competitive and tumultuous global markets, innovation and collaboration are critical to success (Matthew & Sternberg, 2006). Technology has advanced in ways that support the creation of teams of experts who are remotely located in relation to one another. Virtual teams are based on members collaborating from various geographical locations that may be in different time zones and countries. A report in 2011 from the research and advisory firm Gartner, Inc., projected that by 2015, about 75% of knowledge-based project work would be completed by distributed virtual teams, but that the complexity of virtual projects would elevate the level of risk associated with the technology (Gartner, 2011).

The creation of these teams provides unprecedented opportunities for collaboration, innovation, and corporate effectiveness (Hosseini & Chileshe, 2013), and the use of virtual teams also means that relocating personnel is no longer required. Virtual teams with a flexible and configurable infrastructure save costs and time, and often increase productivity (Anderson et al., 2007). By having team members located across several time zones, team members can advance the project within their respective

workdays, providing continual progress to a project (Vaccaro et al., 2008). Virtual teams are also noted as a means to increase diversity of knowledge resources by improving access to experts who contribute to the exploration of creative and innovative solutions (Duarte et al., 2011).

While virtual teams are increasingly becoming the solution for globalization and increased competitive advantages, significant challenges remain in managing collaboration within virtual teams. These challenges are due to cultural, technical, and experiential differences as well as difficulties related to developing trust and shared understanding among team members who are not within physical proximity. Such obstacles pose high risks and create uncertainty in the implementation of virtual teams, and if not appropriately managed, the virtual team may experience poor performance or even failure.

Although the diversity of knowledge created by involving members from diverse backgrounds and experiences creates a bundle of potentially valuable resources for the team, if team member diversity is not properly managed, such benefits may become liabilities. We suggest that, in order to enhance the beneficial effects of diversity on virtual team outcomes, the team must develop relationally oriented capabilities. In other words, to successfully integrate the heterogeneous knowledge resources present among team members, the virtual team must develop trust, communication, and commitment among those members. The capability of a team to build and manage relationships based on trust, communication, and commitment is noted as its collaboration capability (CCAP) by Blomqvist and Levy (2006).

The primary objective of this study is to investigate the role of CCAP within the virtual team. Specifically, we examine how CCAP positively moderates the influence of two types of diversity (deep level and functional level) on team innovation. Using a sample of virtual team members from a high-tech firm in Silicon Valley, we find that CCAP significantly influences the relationship between functional-level diversity and team innovation, while CCAP is found to not significantly influence the relationship between deep-level diversity and team innovation.

The findings of the present study offer numerous contributions to the existing research on virtual teams. First, this study offers empirical validation of the CCAP construct. CCAP was conceptually theorized by Blomqvist and Levy (2006) as a relationally oriented capability, and in this study, we apply CCAP within the context of the virtual team and empirically confirm the validity of the construct. Second, we examine the influence of CCAP within the virtual team, noting its beneficial effects for enhancing diversity-related outcomes. Third, this study examines two types of diversity (deep level and functional level), and notes that CCAP is beneficial in enhancing effects related to functional-level diversity, yet no effect was found with deep-level diversity. This finding suggests that CCAP is likely to be beneficial only when functional-level forms of diversity exist within the team, thus providing valuable insights for both researchers and managers.

Objective of the study

The primary objective of this study is to develop a virtual CCAP model that fosters knowledge creation and collaborative innovation. The following steps were used to accomplish this objective:

1. Extend and empirically examine the theoretical CCAP model that was proposed by Blomqvist and Levy (2006) to the domain of virtual collaboration. Confirmatory factor analysis was used to assess internal structure as well as convergent and discriminant evidence of validity.

2. Test the impact of team diversity on CCAP. Two dimensions of team diversity were examined at the input level. The first, deep-level diversity, involves individual characteristics, values, attitudes and preferences. Functional-level diversity, the second level, is diversity in functional and expertise backgrounds. These diversities among virtual team members can have implications for how the team members develop collaboration capabilities. It is therefore important to understand how the heterogeneity of the virtual team and the proposed collaboration model are linked.

Significance of this research

Blomqvist & Levy (2006) proposed the theoretical concept of CCAP (with the dimensions of trust, communication, and commitment) and argued that CCAP explains much of the success in knowledge creation and collaborative innovation. While Blomqvist & Levy did an extensive literature review in order to derive their CCAP dimensions theory, this study will aim to further test this construct in the virtual team environment and its impact on virtual team innovation. This study will adapt their concept to a virtual team model and empirically test the CCAP as defined by Blomqvist and Levy (2006). Empirically testing Blomqvist & Levy's CCAP model will provide a comprehensive groundwork for understanding collaboration in virtual teams. Therefore, the proposed research will make a theoretical and practical contribution to the understanding of CCAP in virtual teams.

This study will also examine the impact of team diversity on the proposed CCAP model and test the moderating role that CCAP can play in establishing innovation in virtual teams. Conducting this study will also help direct future research to focus on this important framework and gain better understanding of the complex relationships between

CCAP and innovation in virtual team environments. Finally, this study will reveal the practical challenges of managing successful virtual teams in organizations which can be useful to managers and virtual team members.

Literature review

Virtual teams and integrated collaborative processes

A requisite condition for the success of organizations is innovation. Innovation relates to the organizational capacity to participate and be involved in the introduction of new products, services, and ideas (Huang & Lin, 2011). The ability to innovate is among the most important dynamics that influence organizational success, and innovation is rapidly becoming increasingly vital to maintaining a competitive edge in the global marketplace regardless of the industry (Gorodnichenko et al., 2010).

In today's climate of globalization, innovation frequently involves teams that are physically located across the globe. These teams must continually communicate and coordinate with one another as they move forward on assigned projects and tasks. Given the difficulties associated with coordinating contributions from individuals who are not in close proximity, an efficient and integrated collaborative structure is critical to the completion of interdependent tasks and achievement of goals. The use of virtual teams is a common approach now pursued by many organizations seeking to bring together cross-functional teams from diverse locations and with individuals from varied backgrounds.

Virtual teams are becoming increasingly popular in the high-tech domain, and are generally described as functionally diverse and geographically dispersed. Virtual teams enable technology experts who are remotely located to collaborate and innovate, mainly by using technology to share information, communicate, and coordinate their efforts

(Lipnack & Stamps, 2000). Technology experts no longer have to work in the same physical space, but can instead engage in collaboration from any location around the world, at any moment in time. Virtual teams are valuable in generating new knowledge through improved access to experts who can expedite the exploration of creative and innovative solutions (Duarte & Snyder, 2011). The use of virtual teams also means that relocating personnel is no longer required. Virtual teams with a flexible and configurable infrastructure can save valuable resources, resulting in increased productivity (Anderson et al., 2007).

Factors that support CCAP

Factors that support the success of CCAP in networked organizations are linked to high levels of trust, commitment, and open and transparent communication (Blomqvist & Levy, 2006; Ulbrich, Anker, Luss, Huber, & Troitzsc, 2011). These factors are vital, because collaboration depends on the mutual adaptation of partners' behaviors in transferring knowledge (Bedwell et al., 2012). Blomqvist and Levy (2006) also identified the attributes of trust, communication, and commitment as critical prerequisites for CCAP.

Trust in virtual teams

Team trust has been defined as the level of confidence that is exercised among team members (Pinjani & Palvia, 2013). Trust has been viewed by scholars as a fundamental lubricant for a social system, since it opens up communication (Putnam, 2000). Trust has also been described as the glue that holds the links of virtual teams together (Lipnack & Stamps, 2000). Intra-team trust is one of the critical factors that

impact the performance of both face-to-face and virtual teams (Rusman et al., 2010). If there is a lack of trust, team members will not engage in effective collaboration activities. This could lead to serious problems, such as increased risk of miscommunication, poor decision-making, and inadequate flow of information (Rusman, van Bruggen, & Sloep, 2010). It is also been noted that teams with a high level of trust are more likely to have a steady and firm foundation of relationships, which results in a higher level of synergy and a reduction in cognitive conflict (Ensley, Pearson, & Amason, 2002).

Trust is a vital quality for the effective interaction of virtual teams. It involves every team member's willingness to be open, while allowing information to flow freely. Trust builds around the credibility and mutual goodwill of each team member; this engenders a general predictability of everyone's behavior (Ulbrich et al., 2011). Mutual trust brings about a number of benefits in working relationships, such as open communication, better cooperation, and a high level of decision-making (McKnight et al., 1995).

Trust in virtual teams can be very fragile, and it takes time to build. Team members' past experiences give rise to trust or distrust (Rusman et al., 2010). Trust has been noted as the needed threshold condition for successful collaboration (Blomqvist & Levy 2006). Integrity and honesty is crucial in building trust, especially in a virtual team environment when there is no face-to-face interaction. The absence of face-to-face interaction makes trust even more vital in virtual teams (Rusman et al., 2010). Members depend on each other to complete tasks successfully and on time. Without trust, things will not get done as efficiently.

Greenberg et al. (2007) indicated that trust can be developed in two ways: one is called cognitive trust, which is based on team member integrity and ability; the second way is called affective trust, which is based on social interaction and emotional ties that have been developed over time. They also indicated that "a trustworthy person is honest, able, and caring" (Greenberg, Greenberg, & Antonucci, 2007). Trust, therefore, is a critical factor in achieving high-level CCAP, where high-level trust supports the ability of the group to dynamically adapt to change and position themselves strategically (Furumo & Pearson, 2006). Trust becomes the important pillar upon which virtual team members create high-level collaboration in order to optimize effectiveness.

Communication in virtual teams

Team communication has been studied since the 1960s, and there is large body of literature characterizing the importance of internal communication; however, an exploration into virtual collaboration is more recent and still developing (Badir, Büchel, & Tucci, 2012; Piekkari & Tietze, 2011). This is because communication in virtual teams is affected by time zones, space, and cultural differences (Reed & Knight, 2010). Reed and Knight (2010) state that poor communication can negatively impact the sufficiency of knowledge transfer, posing risks for team performance.

Poor communication results in deterioration of the effectiveness of the team in building relationships and promoting efficient team coordination (Montoya, Massey, Hung, Caisy, & Crisp, 2009). Poor and infrequent communication has been shown to be costly in terms of wasted time and resources, and frequently results in confusion and uncertainties that weaken the cohesion among the team members (Reed & Knight, 2010). In order for the organization to reap the benefits of virtual team structures, organizational

leadership must help to build online relationships and effectively manage the complexity of this online communication as team members navigate space, time, and cultural barriers, where direct interface and supervision is often minimal.

Quality communication is essential for innovation in virtual teams. Innovation is not seen as a solo creative endeavor taken on by one talented individual; rather, innovation is supported through the communication process among people (Offenbeek & Koopman, 1996). In order to meet the demand of innovation, media richness and intensity is crucial in facilitating the proper communication environment for innovation (Badir et al., 2012). Media richness theory (MRT) states that task performance and communicative effectiveness can be affected by the different communication media characterized by the five hierarchies: face-to-face, video conference, phone calls, email exchange, paper, and reports (Daft & Lengel, 1984) . According to this theory, media richness is classified by its ability to provide rapid feedback and convey personal behavior, the richness of the information that can be transferred, and its ability to convey social cues such as body language cues, emotional signs, expression of opinion and natural language. MRT argues that the face-to-face medium is the richest form and the most effective medium for the instantaneous observations of various signs of body language, facial expressions, and tone of voice, which is effective in reducing ambiguity especially in knowledge-intensive projects (Daft & Lengel, 1984). Figure 2 shows the conceptual view of MRT and a media richness hierarchy with respect to media richness and communicative effectiveness. It has been suggested that, if a medium is chosen that is lower than the appropriate richness required by the task, a decrease in overall performance and task quality will result (Montoya et al., 2009).

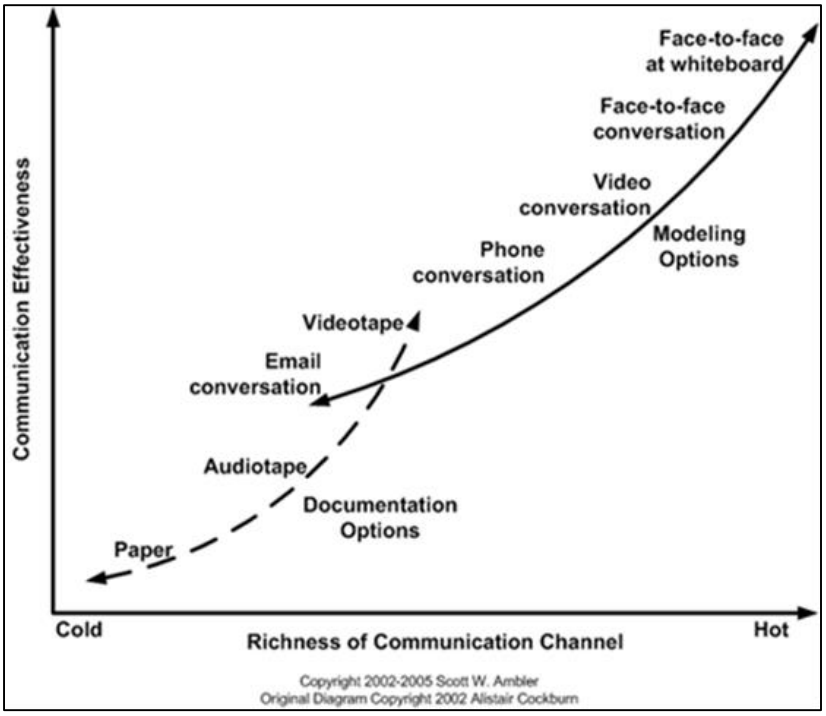


Figure 2 Media richness theory: Types of communication

Intensity of communication is another attribute of the multi-dimensional aspect of communication (Badir et al., 2012). Intensity of communication is referred to as the frequency of interaction required to gather information, brainstorm, and analyze for sufficient knowledge transfer among team members (Badir et al., 2012). Gerwin and Ferris (2004) found a positive correlation between intensity of communication and trust, where the lower the trust, the lower the intensity of communication. High levels of communication intensity are essential among innovation-driven networks, because higher social interactions between members will more likely produce better, stronger ties within the team (Oke & Idiagbon-Oke, 2010). The proper threshold of the intensity level is therefore dependent on the complexity, the uncertainty, and the interdependency of the tasks (Badir et al., 2012). From the literature, we see that these two qualities of

communication (degree of media richness and intensity level) can be crucial contributors to the success of collaboration and efficient performance in the environment of highly uncertain and complex tasks.

Commitment in virtual teams

Meyer and Allen (1991) described three types of commitment: affective (desire to belong), normative (feeling obligation to stay), and continuance (awareness of cost of leaving). The type of commitment that is beneficial to teams is the affective commitment; this was indicated in a study that showed that affective commitment exhibited a strong positive correlation with team performance (Meyer & Herscovitch, 2002). Meyer and Herscovitch (2002, p.301) described commitment as "a force that binds an individual to a course of action of relevance to one or more targets." This psychological force has a large effect on the behavior of the team members and their quality of collaboration (Chang, Chi, Chen, & Deng, 2012).

The degree of commitment among team members has a major impact on the established relationships of loyalty and dedication among team members (Chang, Chi, Chen, & Deng, 2012). It is also been noted that committed team members are essentially satisfied, and they develop constructive interactions with other team members (Mathieu & Zajac, 1990). The constructive interaction that stems from a high level of commitment can cultivate knowledge sharing among members of the team (Huang & Lin, 2011). When knowledge is shared and transferred to other team members, it then adds value and has a direct positive impact on the innovative capability of the firm (Sáenz et al., 2009).

Geographical proximity will influence how virtual team members' behavior impacts team goals, values, and norms (Bishop & Scott, 2000), especially if the team

members feel isolated and left alone (Workman, Kahnweiler, & Bommer, 2003). One way to eliminate the sense of loneliness is to strengthen the social bonds of the team, which has been shown to have a positive impact on affective commitment (Cater & Zabkar, 2009). Further, it has been shown that members with strong affective commitment to the team are more apprehensive about the performance and the fate of the team; this, in turn, produces favorable collaborative behavior (Kang, Lee, Lee, & Choi, 2007). However, it is inherently more difficult to do this in virtual teams, where members have to rely entirely on technology and media to reinforce social bonds. To develop and sustain affective commitment, the organization must supply suitable media for the environment.

Team diversity

Diversity is defined as the degree to which there are differences between people within a team (Van Knippenberg et al., 2004). Researchers (Harrison et al., 2002; Bunderson & Sutcliffe, 2002; Milliken & Martins, 1996) have defined diversity on three levels: surface, deep, and functional. The first, surface-level diversity, reflects differences such as age, sex, and race, which are easy to measure. The second, deep-level diversity, refers to the differences in personal characteristics such as values, beliefs, and attitudes that are communicated through extended, personalized interaction and information gathering (Milliken & Martins, 1996). The third level of diversity, functional-level diversity, is the degree to which team members differ in knowledge, skills, information, and expertise.

A large body of research produced over the past few decades has examined the complex relationship between team diversity and team performance (Tekleab & Quigley,

2014a). Conclusions drawn from this research indicate that team diversity can affect performance in both positive and negative ways. Some researchers have indicated that team diversity can act as a double-edged sword, yielding positive effects in some contexts and negative effects in others (Milliken & Martins, 1996).

Two major theoretical perspectives have emerged in the literature that examines the positive and negative implications of diversity: the social categorization perspective and the information perspective. The social categorization perspective argues that team members tend to create social categories (in-group and out-group) based on similarities and differences among them (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). In-group members tend to communicate more frequently and trust each other more than the out-group members. These natural tendencies occur due to the fact that in-group members share the same worldviews and perceptions (Moynihan et al., 2006). Fostering these types of diversity and biases could cause variations and uncertainties in the relationships within the virtual team, eventually disturbing the CCAP and innovative performance of the team.

The second theoretical perspective is the information perspective, which argues that teams with diversity outperform homogeneous teams because heterogeneous teams possess larger pools of informational resources (Milliken & Martins, 1996). These diverse resources include wider ranges of relevant knowledge, skills, and abilities that are distinct. These non-redundant resources provide an advantage to such teams in enabling them to make higher-quality decisions and arrive at more creative and innovative solutions (van Knippenberg, van Ginkel, & Homan, 2013). From this information perspective, researchers therefore claim that team diversity has a positive effect on the

team performance, an effect produced by the collaborations of diverse team members (Chae, Seo, & Lee, 2014).

Review of studies that evaluated factors that affect innovation in a virtual team environment

The literature review identified 16 relevant studies as shown in Table 1, that were published from 2006 to 2014 in a context of innovation and creativity in a virtual team environment. Of these studies, six evaluated effective communications in innovation, two evaluated trust and none were found that studied commitment in the context of innovation in a virtual team environment. Only two of the sixteen studies included both communication and trust.

Review of studies that evaluated CCAP factors in a virtual team environment

The literature review in Table 2 identified 13 relevant studies that were published from 2006 to 2014 in a context of collaboration capability. Of these studies, six evaluated effective communications in innovation, two evaluated trust and none were found that studied commitment in the context of innovation in a virtual team environment. Only two of the of studies included both communication and trust.

Review of studies that evaluated components of factors that build CCAP

The rest of the literature review in Table 3 evaluated studies that addressed a number of factors that affect the components of CCAP in virtual team environments. Two of these nine studies evaluated communication and five evaluated trust as an output of CCAP. None of the studies evaluated the commitment or the combination of all the vital elements of CCAP on innovation in virtual teams.

Table 1 Studies that evaluated team innovation in virtual teams

Author	Title	Factors	Output
Cormican et al., 2006	Virtual team environment for collaborative research projects.	Communication, knowledge sharing and learning between members	R&D development
Sorli, Stokic, Mendikoa, & Armijo, 2007	Advanced IC tools for maximizing virtual team creativity and Innovation in Manufacturing environments	Information and communication technologies.	Virtual team creativity and innovation.
Tran 2007	Innovations in Virtual Team Training using the CASE Method	The use of the CASE teaching method as a mean to improve virtual teams' performance	Innovation
Hambley et al. 2007	Virtual team leadership: The effects of leadership style and communication medium on team interaction styles and outcomes	Leadership styles, communication media.	Team outcomes (creativity), team interaction styles
Jan de et al. 2008	Conditions for innovation behavior of virtual team members: a 'high-road' for internationally dispersed virtual teams	Information and communication technologies, coordination mechanism, task dependencies	Innovative behavior
Amberg et al. 2008	From virtual teams to online communities: fostering group Based collaboration for innovation and knowledge Management	Trust, privacy, transparency, information and communication technology	Open innovation
Ebrahim et al. 2009	Innovation and R&D activities in virtual team	Virtual environments	R&D activities
Wang & Noe 2010	Research on stability of knowledge transfer in virtual technology innovation team	Stability and continuity of knowledge transfer	Innovative tasks
Bjorn & Ngwenyaman 2010	Technology alignment: A new area in virtual team research	Technology-use practices and collaborative practices	Technology-alignment

Table 1 (Continued)

Author	Title	Factors	Output
Gressgård 2011	Virtual team collaboration and innovation in organization	Information and communication technologies	Organizations' innovation capabilities
Xue & Luo 2011	Trust, performance and innovation research in virtual team	Character, trust, contextual performance, task performance	Team innovation
Wi et al. 2011	Virtual organization for open innovation: Semantic web based inter-organizational team formation	Team Assessment (Know-What, Know-How, Know-Who), team formation social network ontology model.	Open innovation
Chamakiotis et al. 2013	Factors influencing creativity in virtual design teams	Communication, engagement, organizational skills, education- and experience-related knowledge, geographical dispersion.	Creativity
Chang 2011	New organizational designs for promoting creativity: A case study of virtual teams with anonymity and structured interactions	Gender and national origin, social status, personality, communications styles, work experience, engineering disciplines	Creativity performance
Bergener & Majchrzak 2012	Media choice - influencing factor in virtual team innovation processes	Communication media	Innovation processes
Martinez Moreno et al. 2012	The role of self-guided training in the relationship between task conflict and innovation in virtual teams	Task conflict, self-guided training	Team innovation

Table 2 Studies that evaluated team attributes in virtual teams

Author	Title	Factors	Output
Cormican et al., 2006	Virtual team environment for collaborative research projects.	Communication, knowledge sharing and learning between members.	R&D development
Lin, Standing, & Liu, 2008	A model to develop effective virtual teams	Social dimensional factors, communication, trust, cohesion	Team coordination, performance, satisfaction
Shachaf, 2008	Cultural diversity and information and communication technology impacts on global virtual teams: An exploratory study	Cultural diversity and communication	Team effectiveness
Reed & Knight 2010	To study the differences in communication between traditional project teams and those that operate virtually and impact on project risk.	Communication and knowledge transfer	Project risk
Ko et al. 2011	Analytic collaboration in virtual innovation projects	Adequacy of consensus, technological support and social work contexts	Cross-functional collaboration
Clear & MacDonell 2011	Understanding technology use in global virtual teams: Research methodologies and methods	IT, leadership, experience and social interaction	Decision outcomes (Efficiency, quality, consensus, commitment)
Ferreira et al. 2012	Perception of virtual team's performance: A multinational exercise	Language, culture and time zone	Team performance
Horwitz & Santillan 2012	Knowledge sharing in global virtual team collaboration: applications of CE and ThinkLets	Collaboration engineering (CE) and ThinkLets	knowledge-sharing behavior

Table 2 (Continued)

Author	Title	Factors	Output
Saafein & Shaykhian 2013	Factors affecting virtual team performance in telecommunication support environment	Communication tools, cohesion and collaboration, leadership, trust, the location of team members and team size	Virtual team performance
Pinjani & Palvia 2013	Trust and knowledge sharing in diverse global virtual teams	Diversity, mutual trust, and knowledge sharing	Virtual team performance, effectiveness and member satisfaction
Tong et al. 2013	Spontaneous virtual teams: Improving organizational performance through information and communication technology	Coordination and communication	Team performance
Peñarroja et al. 2013	The effects of virtuality level on task-related collaborative behaviors: The mediating role of team trust	Trust, virtuality level	Virtual team coordination, cooperation and team information
Hardin et al. 2013	Participative goal setting in self-directed global virtual teams: The role of virtual team efficacy in goal setting effectiveness and performance	Goal commitment	Team performance
Pendharkar 2013	Genetic learning of virtual team member preferences	Team member preferences from past actions	Team coordination
Duran & Popescu 2014	The challenge of multicultural communication in virtual teams	Cultural diversity	Team collaboration

Table 3 Studies that evaluated team attributes in virtual teams

Author	Title	Factors	Output
Lee-Kelley & Sankey 2008	Global virtual teams for value creation and project success: A case study	Time zone and cultural differences	Communication and team relations
Rusman et al. 2009	From pattern to practice: Evaluation of a design pattern fostering trust in virtual teams	Quality of work contribution, responsiveness and communication styles.	Trust
Chen & Chen 2009	Advanced multi-phase trust evaluation model for collaboration between coworkers in dynamic virtual project teams.	Cooperative relations	Calculating trust between workers
Bryant et al. 2009	The effects of reward structure, media richness and gender on virtual teams	Reward structure, media richness and gender	Team satisfaction and social loafing
Rusman, et al. 2010	Fostering trust in virtual project teams: Towards a design framework grounded in a Trust Worthiness Antecedents (TWAN) schema	Communality, ability, benevolence, internalized norms, accountability.	Trusting behavior and formation
Fan et al. 2011	Trust estimation in a virtual team: A decision support method	Reputation, collaboration	Trust Level
Daim et al. 2012	Exploring the communication breakdown in global virtual teams	Trust, interpersonal relations, cultural differences, leadership and technology	Communication breakdowns
Olson & Olson 2012	Virtual team trust: task, communication and sequence	Task interdependence, communication medium, and sequence of conditions	Trust

Table 3 (Continued)

Author	Title	Factors	Output
Luse et al. 2013	Personality and cognitive style as predictors of preference for working in virtual teams	Personality and cognitive style	Preference for working in virtual teams
Dhiraj 2013	Examining the formation of swift trust within a scientific global virtual team	Interactions between team members	Trust
Al-Ani et al. 2014	Facilitating contagion trust through tools in global systems engineering teams	Software tools types	Trust

Research model and hypotheses

Given the complex nature of the virtual team environment, this study proposes that diverse virtual team innovation is strongly associated with CCAP. Team collaboration determines and signals whether the team member is engaging in activities that generate new knowledge and innovation (Blomqvist & Levy, 2006). Therefore, this study suggests that virtual team's innovation outcome, as a dependent variable, will increase with the development of CCAP (in terms of trust, communication and commitment), which is also affected by team diversity. From the input-process-output viewpoint, the research framework is represented by Figure 3. Team diversity is the independent variable; CCAP is the moderator variable and team outcome is the dependent variable.

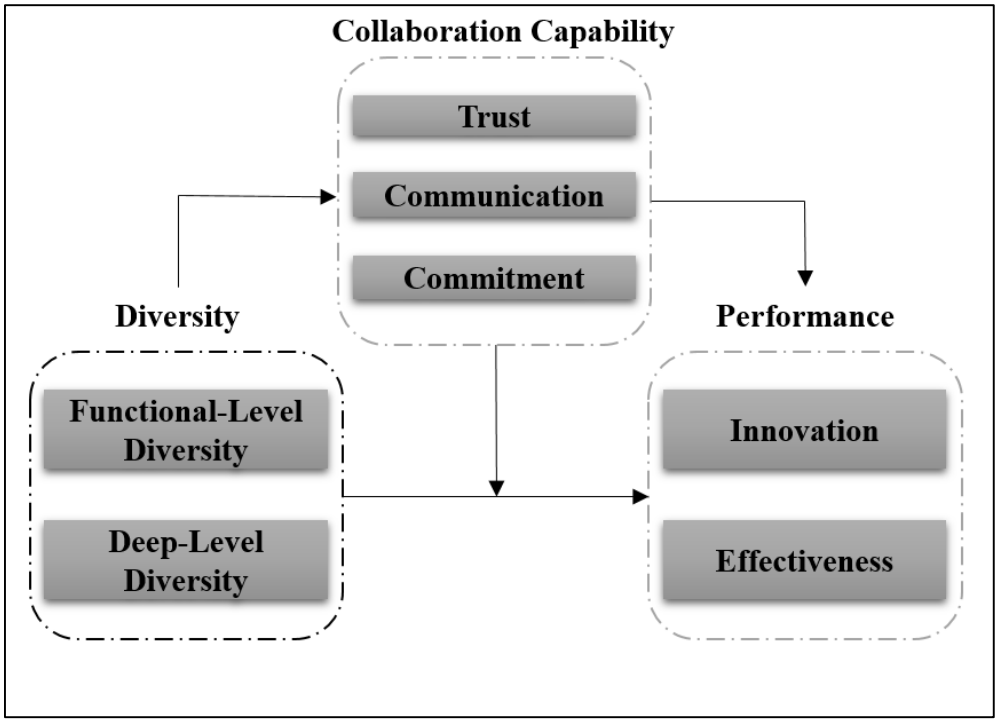


Figure 3 CCAP conceptual research model

The collaborative form of interaction is necessary if diverse teams are to secure advancement during innovation processes (Nissen, Evald, & Clarke, 2014). Bloomqvist and levy (2006) identified CCAP with high levels of trust, communication and commitment; that is, depending on the level of these dimensions, collaboration can promote or discourage innovation processes. This is similar to the concept of moderation relationship. A moderator interacts with a predictor variable such that the influence of the predictor on the outcome varies depending on the level of the moderator (Baron & Kenny, 1986). Using this definition, CCAP would interact with team diversity such that the impact of team diversity on team performance would vary depending on the level of CCAP perceived by the virtual team; team outcome is strongest when CCAP is high and weakest when CCAP is low.

The sub objective of this study is to examine the possible moderating effect of the degree of CCAP interaction on the team outcome relationship. In practice, virtual teams vary on the amount of CCAP. Initially teams start with specific level of collaboration, but from team to team, this level may range from low collaboration to a high level of collaboration. This study attempts to add to the emerging theoretical and empirical research on teams by including the degree of CCAP, which we believe is an important variable for team performance. The following are the three major research questions and associated hypotheses:

1. What is the effect of team diversity on CCAP dimensions in virtual teams?
2. Is there a positive relationship between each of the CCAP dimensions (trust, communication and commitment) and team outcome (innovation and effectiveness)?
3. Does CCAP behave as a higher-order factor that underlies the three dimensions (trust, communication, commitment)?
4. Does CCAP moderate the relationship between team diversity and team outcome?

Researchers on team diversity have long argued that widening the range of expertise of the team can result in higher team innovation (Bantel & Susan, 1981). Diverse teams can also respond quickly to implementing various types of organizational change (Bowers, Pharmer, & Salas, 2000), and respond more aggressively to competitive threats (Hambrick, 1996). On the other hand, virtual teams that are composed of various global specialists may be unable to fully harvest the benefits of functional-level diversity due to the poor, or lack of, CCAP among them. Prior research suggested that team heterogeneity can result in less effective emotional and relational performance (Phillips & Loyd, 2006). This study suggests that diversity is likely to affect the collaboration

relationship among virtual team members during team processes. The impact of diversity can cause variations in their values, attitudes that may lead to increase in conflict and decrease in trust, less communication and a low level of team commitment. Thus,

- Hypothesis 1.1a: Functional-level diversity will be negatively associated with trust.
- Hypothesis 1.1b: Functional-level diversity will be negatively associated with communication.
- Hypothesis 1.1c: Functional-level diversity will be negatively associated with commitment.
- Hypotheses 1.2a: Deep-level diversity will be negatively associated with trust.
- Hypotheses 1.2b: Deep-level diversity will be negatively associated with communication.
- Hypotheses 1.2c: Deep-level diversity will be negatively associated with commitment.

In order to strengthen the relationship between team functional-level diversity and team outcome, CCAP can act as the moderator for a higher level of team outcome. Blomqvist and Levy's model (2006) argues that CCAP for knowledge creation and innovation is a multi-facet concept that can be described through three critical relational dimensions (trust, communication, and commitment). This theoretical model states that team communication is needed for trust to emerge, and communication can also improve the level of trust. Like trust and communication, trust and commitment are also inter-related. This leads to the following hypothesis.

- Hypothesis 2.1. Trust will be positively associated with team innovation.
- Hypothesis 2.2. Communication will be positively associated with team innovation

- Hypothesis 2.3. Commitment will be positively associated with team innovation.
- Hypothesis 2.4. Trust will be positively associated with team effectiveness.
- Hypothesis 2.5. Communication will be positively associated with team effectiveness.
- Hypothesis 2.6. Commitment will be positively associated with team effectiveness.

Moderating role of collaboration capability

Researchers on team diversity have long argued that broadening the range of expertise of the team results in enhanced team innovation (Bantel & Susan, 1981). Accordingly, numerous studies find a relationship between diversity and innovation within a team (Gibson & Gibbs, 2006; Ostergaard, Timmermans, & Kristinsson, 2011). When deep-level diversity exists, members within a team have heterogeneous personalities, values, and attitudes (David Harrison, Price, & Bell, 1998; Jackson & Joshi, 2004). The diversity of values and similar deep-level factors are shown to positively influence performance in global innovation teams, suggesting that such diversity provides the team with diverse perspectives beneficial for problem-solving and innovation (Winkler & Bouncken, 2011). Additionally, functional-diversity in teams—demonstrated by the varied skills and expertise among members—provides access to a broad array of knowledge, and such knowledge resources essential to innovation-oriented tasks. Studies of teams and organizations generally confirm the significant relationship between functional-level diversity and innovation outcomes (Yap, Chai, & Lemaire, 2005).

Although diverse teams are better able to respond to various types of change (Bowers et al., 2000) and competitive threats (Hambrick, 1996), virtual teams with deep

and functional-level diversity may be unable to fully harvest the benefits of diverse knowledge resources if the trust, communication, and commitment among members is lacking. Bloomqvist and Levy (2006) note that CCAP is formed by trust, communication, and commitment; that is, depending on the level of such factors, the CCAP within the team may promote or discourage the exchange of knowledge, which thereby effects innovation success. Without a proper exchange of ideas and a variety of perspectives of how to solve innovation-related issues, achieving innovation-related success is hindered. Thus, collaboration is an integral factor if diverse teams are to secure advancement during innovation processes (Nissen et al., 2014).

Given the complex nature of the virtual team environment, we posit that the success of diverse virtual team innovation is strongly associated with CCAP. When virtual teams are characterized by deep-level diversity, a variety of values, beliefs, and attitudes may undermine innovation efforts if team members are not guided by trust, communication, and commitment. Thus, when virtual teams with deep-level diversity have a refined CCAP, we suggest that members work together more collaboratively, thereby enhancing team innovation outcomes. Similarly, when virtual teams are composed of functional-level diversity, and a variety of knowledge, skills, and abilities exist among team members, we suggest that when collaboration among members is based on trust, communication, and commitment, innovation-related outcomes are enhanced.

- Hypothesis 3a: CCAP will moderate the relationship between deep-level diversity and innovation, such that innovation is strongest when CCAP is high and weakest when CCAP is low.
- Hypothesis 3b: CCAP will moderate the relationship between functional-level diversity and innovation, such that innovation is strongest when CCAP is high and weakest when CCAP is low.

Each of the three dimensions of CCAP have been reviewed and shown in the literature to have conceptual independence and empirically based discriminant validity (Meyer & Allen, 1991; Pinjani & Palvia, 2013; Pirola-Merlo, Härtel, Mann, & Hirst, 2002). Building upon the theoretical conception of Blomqvist and Levy (2006), this study proposes that there might be also a common underlying link empirically that runs between the dimensions that connects them together into a higher-order core factor. The conceptual frameworks and the nature of multidimensional latent construct have been in the psychology and social science literature for quite some times. For example, Luthans, Avolio, Avey, and Norman (2007) have developed a higher order multi-dimensional construct called Psychological Capital (PsyCap) that underlies four distinct dimensions (hope, optimism, resilience, and self-efficacy). They demonstrated that higher order construct such PsyCap can relate to external variables much stronger than each individual construct's bivariate relationships. Luthans et al. (2007) also referred to other researchers in the organizational behavioral literature that investigate and developed models at a higher level of abstraction. For example, Luthans et al. (2007) referred to empowerment, which is multi-dimensional latent construct that is composed of meaning, competence, self-determination and impact (Spreitzer, 1995), also to transformational leadership which is composed of charisma, individual consideration, intellectual stimulation, and motivation (Murphy & Ensher, 2008). Based on this fundamental concept of higher level of abstraction modeling, a fourth hypothesis in this study is the following:

- Hypothesis 4: CCAP is a three-dimensional construct, consisting of trust, communication, and commitment.

Measures

Deep-level diversity

Following team diversity researchers (e.g., Pinjani & Palvia, 2013; Martins et al., 2003; Harrison et al., 2002), we used a 9-item scale adapted from Martins et al. (2003), which measures the perceived differences with respect to non-visible underlying personal characteristics such as values, beliefs, and attitudes. A sample item is "Members of the team are similar in terms of their personal values."

Functional-level diversity

We used a three-item scale adapted from (Kirkman, Rosen, Tesluk, & Gibson, 2004) that measures the degree to which team members differ in their functional background and expertise. A sample item is "Members of the team are similar in terms of their functional expertise."

CCAP

Blomqvist and Levy (2006) define CCAP as the ability to build and manage network relationships based on trust, communication, and commitment. Each dimension of CCAP was measured independently using existing validated scales from the literature. For team trust, we used a four-item measurement scale adapted from Pinjani and Palvia (2013). A sample item is "Team members can rely on fellow team members." For team commitment, we used a four-item scale adapted from (Han & Harms, 2010). A sample item is "Team members feel a strong sense of belonging to their team." For team communication, we used six-item scale adapted from (Worley, Bailey, Thompson,

Joseph, & Williams, 1999). A sample item is “If we have a decision to make, everyone is involved in making it.”

Innovation

We used a three-item scale adapted from (Vera & Crossan, 2005) that measures innovation at the team level. A sample of this measure is “The team is highly innovative.”

Team effectiveness

We used a nine-item measurement scale adapted from (Pinjani & Palvia 2013). A sample item is “In the past, the team has been effective in reaching its goals”.

Control variables

In this study, we are interested in analyzing team diversity, CCAP, team innovation and team effectiveness, but other factor could be argued to have an effect on the performance, therefore this study will use the following control variables.

Team size

Previous research established that team size can have an impact on team performance (Haleblian & Finkelstein, 1993; D Harrison et al., 2002), with an increase numbers of the team size, the psychological distance can increase (Pearce & Herbik, 2004). It is important in our study to control for team size because in larger virtual teams it may be harder to develop collaboration and this may influence team outcomes.

Team tenure

The length of the team existence is likely to influence team outcomes (Barsade, Ward, Turner, & Sonnenfeld, 2000). The longer the team members interact with each other they may develop higher level of collaboration.

Degree of dispersion

The degree of dispersion represents the extent to which a team is virtual (Staples & Webster, 2008). O'Leary and Cummings (2007) argued that team outcomes are differentially associated to the dimension of dispersion. O'Leary and Cummings (2007) suggested the below dispersion indices:

- *Isolation:* Percent of team members with no other team members at their site. Low values of index indicate low levels of isolation.
- *Imbalance:* Equals standard Deviation $(n_i, n_j, \ldots n_k)/N$, where k = the total number of sites represented in the team, n_i = the number of team members in the i^{th} site, n_j = the number of team members in the j^{th} site, and N = total number of team members across all sites.

Research methodology

A survey was conducted to test the hypothesized relationship and the CCAP model. This approach was appropriate for this study given the objective was to empirically confirm the CCAP measure and test the proposed hypotheses about virtual teams. In addition, this approach is in synthesis with prior work that examined virtual teams and multi-dimensional construct validation. The sample of this study was collected from a global engineering department of a high-tech firm in Silicon Valley, California, which consists of 375 design and software engineers (42 teams) in multiple locations across Asia, Europe and the United States. The respondents were asked to rate each

statement of the composite survey based on their knowledge, experience, and understanding of each item using a seven-point Likert scale.

Ethical clearance and institutional permission from the participating company was obtained prior to conducting the research; however, the institution where this research was conducted did not permit the collection of specific demographic data citing the need to protect employee privacy. Employees in the global engineering department were asked to complete the questionnaire by a representative of the Human Resources department of the organization. The survey was voluntary and individual anonymity was guaranteed (citing the academic nature of the study). To enhance participation, participants were offered the opportunity to enter a raffle for a gift.

A total of 166 respondents completed the questionnaire, yielding a response rate of 42.27 percent. Of the 166 collected responses, 36 responses were incomplete and were removed from the final analysis. Therefore, a total of 130 responses were used for the analysis. Four of the 130 completed responses only had one piece of data missing, and these values were then coded into SPSS as missing data.

Although specific demographic information was not collected from the respondents due to Human Resource department restrictions, data on educational background of the respondents was permitted. Of the participants responding to the questionnaire, 27% had a doctoral degree, 37% had a Master's degree, 33% had a Bachelor's degree, and 3% had an Associate's degree.

Quantitative data analysis

The four major categories for quantitative research are descriptive, correlational, quasi-experimental and experimental study designs (Creswell, 2008). Based on the

objectives of this research, a multivariate correlation design is appropriate. It will determine to what degree the team diversity is associated with CCAP and how CCAP is associated with team innovation. This was accomplished by calculating the correlation coefficient and determining the strength and direction among the variables of interest. Below is a brief introduction to the methods that were used in this analysis with further details provided in later sections.

First, a Pearson correlation-based approach was used to explore potential relationships between variables were considered to assess the magnitude and direction of the movement of one variable when the other is changed. It is important to note that these correlation measures cannot be interpreted as a cause and effect relationship but only indicate a degree of correlation and association of the variables with one another. Any inferences about a cause-and-effect association must be based on the judgment of the analyst and the expert (Taylor, 1990).

To evaluate the model proposed in Figure 3, a hierarchical multiple regression analysis with a moderator variable was performed as it allows both hypothesis testing and effect analysis via a rigorous statistical framework. Multiple regression analysis is a statistical technique used to study multivariate relationships between explanatory variables. The advantage of using multiple regression analysis permits the researcher to simultaneously investigate the relationship and predict the outcomes between several variables (Cohen, Cohen, West, & Aiken, 2003). Hierarchical multiple regression analysis using Baron and Kenney's (1986) approach was utilized to accept or reject the hypotheses in relation to the relationships among the variables. The regression analysis

will test the magnitude of the effect of team diversity on innovative capability while at the same time accounting for team processes using a moderator variable

In addition to the steps provided above, the following will also be evaluated for model performance in order to ensure the accuracy and strength of the model:

- Multiple linear regressions is based upon the premise of four key assumptions: A) linearity, B) statistical independence between the error terms, C) Homoscedasticity (constant variance in the residuals) and D) normality of the error distribution.

- To test the linearity assumption a plot of the residuals vs. predicted values was created. A horizontal line with an approximately constant variance is expected if this assumption is correct. If this assumption is not correct, various non-linear transformations of the variables was performed.

- To test statistical independence, a plot of the residual autocorrelation was created. A check was performed where the majority of the residual autocorrelations fell within the 95% confidence interval around zero. A Durbin-Watson was also performed to evaluate the correlation between residuals

- Homoscedasticity can be evaluated by considering the histogram of the regression standardized residuals to ensure normality. Finally, an exploration of the skewness and kurtosis values for all the variables were also evaluated for normality.

Assuming that all the assumptions are met, we will then evaluate this model using an F-test and an R^2 statistic to determine that the model is in fact statistically significant and to evaluate what percentage of the variability in innovative capability is explained by the CCAP and team diversity.

Correlational hypothesis testing

As each of these hypotheses represent the relationship between two variables, the testing of these hypothesis will all follow the same outline. Prior to the statistical analysis, the Likert data was normalized by computing the median. Then a correlation

coefficient on the normalized values of these two variables were computed to identify the direction and magnitude of the association. Next, a statistical test will then be performed to identify if the correlation is statistically significant. Specifically, for any two variables A and B, we will test two hypotheses versus one another:

- H_o: A and B are not significantly correlated, versus
- H_a: A and B are significantly correlated.

A p-value along with a conclusion of the test based upon the 5% significance level will then be used. For example, in the case of Hypothesis 2.1, where we are testing if trust is positively associated with team innovation, a Pearson correlation coefficient was calculated between the two variables, and a one-tailed hypothesis test (as we are only testing for increase) was performed. The classification of Pearson correlation values was assessed based on Cohen's classification (Cohen et al., 2003) of correlation Table 4, which is widely used and cited publication.

Table 4 Cohen's correlation classification

r	Classification
±0.50	Considered Strong
±0.30	Considered Moderate
±0.10	Considered Weak

Moderator hypothesis testing

Next, an analysis of Hypothesis 2.3 was rigorously undertaken to evaluate if CCAP will moderate the relationship between team diversity and team innovation. As we need to specifically account for the moderator variable, a multiple linear regression approach needs to be employed. This approach is explained and then described in terms

of this specific analysis below. A moderator (interaction) variable can be a quantitative variable that influences the strength or/and the direction of the relationship between an independent variable and a dependent variable (Rose, Holmbeck, Coakley, & Franks, 2004). The moderation relationship can be represented as a multi regression model such that

$$Y = A + B_1X + B_2M + B_3X * M + e \quad (1)$$

Where A is the regression intercept, B_1 is the regression coefficient for the independent variable X, B_2 is the regression coefficient for the moderator, and B_3 is the regression coefficient for the product term X*M, which is the moderation effect. Figure 4 illustrates the statistical relationship. In the diagram, the dependent variable Y is predicted by three variables: X, M, and X*M. The hypotheses of a moderator relationship is supported if the coefficient B_3 of the product term (X*M) is significant.

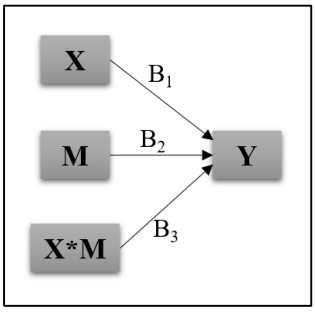


Figure 4 Basic moderation model

Frazier et al. (2004) provided the below steps approach to test for the effects of moderator variables. The below steps were used to test hypotheses 3 and 4:

1. *Centering variables*: This step is necessary in order to avoid the effect of multi-collinearity. Centering is accomplished by subtracting the sample mean from each moderator variable.

2. *Create a cross-product term*: These product terms are created to represent the interaction between the predictor and the moderator variable. These product term are simply the multiplication of the predictor and moderator variables using the centered variables.

3. *Structuring the Equation*: After the cross-product term has been created, the next step is to include the variables and centered variables that are contained in the interaction terms should be included in the model.

4. *Interpreting the Results*: The statistical significance of the moderator effect is tested with the multiple degree of freedom F test rendering stepwise change for the step by which the multiple product terms are entered.

5. *Scatter Plot (slope) analysis*: The simple slope analysis is used to depict the effect of a moderation effect with a scatter plot.

CCAP higher order construct hypotheses testing

Given the forth objective of this study is to test the higher order theoretical CCAP model, the below analyses methods are framed around testing the CCAP model. There are two phases in the analyses. The first phase is to evaluate the subscale structure of the instrument using estimation of internal consistency reliability. The second phase is to test the hypotheses, and establish reliability and construct validity of the model. The data analyses will include descriptive statistics and correlations, internal consistency reliability, Item-to-total correlations, confirmatory factor analysis (CFA), and discriminant validity.

Descriptive statistics

Descriptive statistics was computed for initial data analysis. Mean, standard deviation, skewness, and kurtosis of each of the variables were inspected. A common method to test for normality is to run descriptive statistics to get skewness and kurtosis. Skewness is the tilt in distribution, or more precisely, the lack of symmetry. The range for

skew should be within ± 2 for the data to be normally distributed. Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution. Positive kurtosis indicates heavy tails and peakedness relative to the normal distribution, whereas negative kurtosis indicates light tails and flatness.

Internal consistency reliability

The instrument is reliable if it shows consistent scores for the repeated measurement, which referred to the consistency measures. To check the internal consistency reliability of the instruments of the dimensions of CCAP, the Cronbach's α was used, which is the most common measure for internal consistency. The Cronbach's α coefficient can vary from 0 to 1. In general, if the Cronbachs α is greater than 0.7, the instrument is considered reliable, but 0.5 - 0.6 could be accepted for an exploratory study (Nunnally & Bernstein 1994). Cronbach's alpha is widely understood to indirectly indicate the extent to which a set of items measures a single one-dimensional latent construct, which can be thought of as the percent of variable in an experimental variable that is accounted for by true scores on the underlying latent construct.

Item-to-total correlations

Item analysis was conducted and each of the constructs in CCAP (trust, commitment, and communication) examined. An item-total correlation is performed to test if any item in the questionnaire scale is inconsistent with the averaged behavior of others, and therefore it will be eliminated. If the correlation is low, it means that the item is not measuring the same construct that the rest of the items are trying to measure. This step is performed prior to determining the factors that represent the underlying latent

construct. It is widely accepted and recommended in the literature that an item be removed or further analyzed if the item-to-corrected total correlations is 0.3 or below (De Vaus 2008).

Confirmatory factor analysis

Confirmatory Factor Analysis (CFA) is a theory driven multiple regression method that reveals which variables will load together into a higher factor. CFA is a member of structural equation models (SEM) that provides a method for testing a variety of hypotheses about a set of measured variables including higher-order variables. CFA allows researchers to evaluate the extent to which measurement hypotheses are consistent with empirical respondent scale data. CFA enables theory testing and development in a measurement context (Brown 2006). This technique offers the researcher a viable method for evaluating the validity of higher order constructs. For Hypothesis 4, conformity factor analysis was conducted to examine the construct validity of CCAP and to determine if the underlying three dimensions of CCAP fit into a higher order model. A CFA model using maximum likelihood estimation was performed on the data using IBM Amos software in order to confirm the proposed CCAP factor multi-dimensional structure.

With CFA, a proper fitting model is identified by the comparative, proportion of variance accounted and parsimony fit indices provided by the software package. The following indices were examined to assess how well the model matches the observed data:

1. Root Mean Square Error of Approximation (RMSEA): This index is related to the residuals in the model that estimates the lack of fit in a model compared to the saturated model. RMSEA values range from 0 to 1 with a smaller RMSEA value indicating better model fit, values of less than .06 indicate a good fitting model (Hu & Bentler 1999), whereas, a value of 0.08 or less is often considered acceptable (Browne & Cudeck 1992).

2. Comparative Fit Index (CFI): is equal to the discrepancy function that assesses fit using a non-central chi square distribution. CFI values range from 0 to 1 with a larger value indicating a better model fit. Acceptable model fit is indicated by a CFI value of 0.9 or greater (Hu & Bentler 1999).

3. Normed Fit Index (NFI): Also known as, the Bentler-Bonett normed fit index (1980) was developed to evaluate the estimated model by comparing chi-square values of the model to that of the data. A value greater than 0.9 is considered to be a good fitting model.

4. Goodness of Fit (GOF): is a measure of fit index between the hypothesized model and the observed covariance matrix. A value greater than 0.9 is considered to be a good fitting model.

5. Standardized Root Mean Square Residual (SRMR): is a fit index based on the difference between the saturated covariance matrix and the CFA model covariance matrix. A value of 0.08 or less is considered to be a good fitting model.

Discriminant validity

Discriminant validity is "the degree to which measures of distinct concepts differ" (Bagozzi & Phillips, 1982), that is, measures of different constructs should share little variance. With respect to this study, discriminant validity would be tested to validate that the three CCAP dimensions (trust, communication, and commitment), although highly related, are empirically distinct constructs. To test and evaluate the discriminant validity of the construct, Anderson and Gerbing (1998) suggested modifying the unconstrained free model with the correlations among the construct dimensions set to be 1.0 and in this case the model would be considered the constrained model. If the Chi-square difference

between the two models is significant, the dimensions of the construct are significantly different and should not be merged into one dimension.

Data analysis

This section details the analysis of data collected through the online field survey. The survey constructs were assessed to insure that they are reliable and they measure their respective constructs in order to be used to test the research hypotheses. Based on the research model each construct consisted of multiple measurement items. The questionnaire scales psychometric properties assessing them at two levels: item level and construct level.

Data preparation

After the survey was conducted, the following steps were taken to prepare the data for hypotheses testing. First, all the data was exported from the Survey Monkey site into IBM SPSS statistical software V22. SPSS is an incorporated collection of quantitative analysis software that can perform statistical analysis tasks such as generation of descriptive statistics, bivariate analysis, multiple dimensional scaling and reduction, regression analysis, factor analysis and many more capabilities.

After the survey was administered and collected, several steps were taken to prepare the data for hypothesis testing. First, all data was initially gathered into a master SPSS worksheet. Initial review of the data showed a total of 166 responses were collected. Of the 166 collected responses there were 22 responses that didn't fully participate in the survey because they only completed the consent section, also an additional 14 responses showed inconsistencies in their responses and were removed

from the final analysis. Therefore, a total of 130 usable responses were used for the analysis, which is above our initial goal of 120 responses. Four out of the 130 responses had one piece of data missing, these missing values were then coded into SPSS as missing data. The completed set of data were coded using their original scales, for example, the data employing a seven-point Likert scale were coded using the following scale: (1) strongly disagree, (2) disagree, (3) somewhat disagree, (4) neither disagree nor agree, (5) somewhat agree, (6) agree, and (7) strongly agree.

Media usage

This section provides the results on the usage of virtual media by the virtual teams with the frequency responses for the various communication media as shown in Table 5. A high percent of the responses 60.9% shows no face-to-face interaction or interactions that occur less than once a month. This is a true characteristic of virtual teams that rely on virtual technologies. This is consistent with recent research that the virtual team members have less face-to-face interaction requiring that they rely on the use of different techniques for communication and forming relationships (Haines, 2014). A high percent 91.9% of respondents use emails in their team communication on a weekly or daily basis. Emails are the most popular means of communication due to the ease of usage and the control of communication between the sender and the recipient (W. D. Harvey, McHugh, Paiz, & Ventrella, 2004). Instant Messaging is a popular application for communication with team members due to its ease of use and the instant communication response between the sender and the receiver. A total of 68.3% of responses used instant messaging on a weekly or daily basis. Telephone calls are also popular means of communication in virtual teams, a total of 74.4% of responses indicate telephone calls are

used on weekly or daily bases. Only total of 14.5% of responses uses video conference communication on a weekly or daily basis. This could be due to the lack of meeting rooms enabled for video conferences or people in general might not feel comfortable being seen on cameras and therefore they avoid video conferences.

Table 5 Frequency of media usage

	Media Usage (%)					
Occurrence	F2F	Email	IM	TeleCalls	TeleConf	VideoConf
Never	36.7	5.6	23.8	11.2	17.8	58.9
Less than once a month	24.2	1.6	4.0	5.6	4.7	18.5
Once a month	4.7	0.8	4.0	8.8	4.7	8.1
Once a week	6.3	2.4	5.6	30.4	34.9	10.5
A few times a week	14.8	29.0	32.5	32.8	27.9	0.8
Daily	13.3	60.5	30.2	11.2	10.1	3.2

Note. $N = 130$.

Descriptive statistics at the item level

The descriptive statistics of all the survey items are reported in Table 6 and include values for minimum, maximum, mean, standard deviation, skewness and kurtosis. The range for skew should be within ± 2 for the data to be approximately normally distributed (Lewis-Beck et al. 2007). The results in Table 6 indicates that all the kurtosis and skewness statistics for all the items are well within the acceptable range ±2, indicating that the items are approximately normally distributed for all the questionnaires.

Descriptive statistics at the construct level

Construct level data was computed by taking the median on all the items belonging to that construct. Table 7 shows the descriptive statistics for the various constructs used in this study. Given that the range of skewness and kurtosis are within +/- 2, this establishes the normality specification for the construct level.

Table 6 Descriptive statistics at item level

	Item	Min	Max	*M*	*SD*	Skewness	Kurtosis
Functional Diversity	DiversityFunc1	1.0	7.0	3.60	1.65	0.08	-1.28
	DiversityFunc2	1.0	7.0	4.46	1.63	-0.54	-0.78
	DiversityFunc3	1.0	7.0	4.22	1.62	-0.24	-1.15
Deep-Level Diversity	DiversityDeep1	1.0	7.0	3.35	1.58	0.28	-0.98
	DiversityDeep2	1.0	7.0	4.04	1.51	-0.29	-0.81
	DiversityDeep3	1.0	7.0	4.65	1.66	-0.72	-0.43
	DiversityDeep4	1.0	7.0	5.11	1.43	-1.12	0.94
	DiversityDeep5	1.0	7.0	5.43	1.21	-1.06	1.30
	DiversityDeep6	2.0	7.0	5.77	1.13	-1.11	1.11
	DiversityDeep7	1.0	7.0	5.44	1.36	-1.27	1.54
	DiversityDeep8	1.0	7.0	5.37	1.37	-1.02	0.82
	DiversityDeep9	2.0	7.0	5.72	1.02	-0.84	0.68
Communication	CCAP_Comm1	1.0	7.0	4.69	1.61	-0.49	-0.73
	CCAP_Comm2	1.0	7.0	4.35	1.46	-0.19	-0.69
	CCAP_Comm3	1.0	7.0	4.27	1.52	-0.33	-0.53
	CCAP_Comm4	1.0	7.0	5.10	1.41	-1.08	1.01
	CCAP_Comm5	1.0	7.0	4.83	1.50	-0.79	0.24
	CCAP_Comm6	1.0	7.0	5.33	1.32	-0.96	0.78
Trust	CCAP_Trust1	1.0	7.0	5.20	1.31	-0.80	0.30
	CCAP_Trust2	2.0	7.0	5.75	1.04	-1.06	1.15
	CCAP_Trust3	1.0	7.0	5.58	1.13	-1.21	1.83
	CCAP_Trust4	2.0	7.0	5.64	1.08	-0.81	0.53
Commitment	CCAP_Commit1	1.0	7.0	4.52	1.26	-0.20	-0.07
	CCAP_Commit2	2.0	7.0	4.76	1.25	-0.25	-0.44
	CCAP_Commit3	2.0	7.0	4.71	1.21	-0.31	-0.07
	CCAP_Commit4	1.0	7.0	4.61	1.34	-0.46	-0.13
Effectiveness	Team_Effectiveness1	2.0	7.0	5.36	1.15	-0.93	0.64
	Team_Effectiveness2	2.0	7.0	5.42	1.03	-0.97	1.05
	Team_Effectiveness3	2.0	7.0	5.34	1.15	-0.67	0.18
	Team_Effectiveness4	2.0	7.0	5.57	1.08	-1.07	1.27
	Team_Effectiveness5	2.0	7.0	5.34	1.21	-0.77	0.32
	Team_Effectiveness6	1.0	7.0	5.36	1.14	-1.08	1.82
	Team_Effectiveness7	1.0	7.0	5.36	1.25	-1.15	1.41
	Team_Effectiveness8	1.0	7.0	4.80	1.48	-0.83	0.39
	Team_Effectiveness9	1.0	7.0	5.16	1.24	-0.78	0.76
Innovation	Team Innovation1	1.0	5.0	3.54	0.94	-0.72	0.44
	Team Innovation2	1.0	5.0	3.41	1.08	-0.36	-0.55
	Team Innovation3	1.0	5.0	3.41	1.04	-0.31	-0.48

Note. $N = 130$.

Table 7 Descriptive statistics at construct level

Construct	Min	Max	*Mdn*	*SD*	Skewness	Kurtosis
Functional Diversity	1.0	7.0	3.0	1.58	0.37	-1.05
Deep-Level Diversity	1.0	7.0	2.0	1.17	1.24	1.94
Trust	2.0	7.0	6.0	1.02	-0.87	0.79
Commitment	2.0	7.0	5.0	1.17	-0.17	-0.10
Communication	1.0	7.0	5.0	1.37	-0.73	0.17
Effectiveness	2.0	7.0	6.0	1.05	-0.85	0.87
Innovation	1.0	5.0	4.0	0.99	-0.36	-0.35

Note. $N = 130$.

Validity of the scales

The notion of validity was articulated by Kelly (1927) who stated that a scale is valid if it measures what it claims to measure. Cronbach's α is commonly used to establish internal consistency construct validity (Nunnally & Bernstein, 1994). Cronbach's α is widely understood to indirectly indicate the extent to which a set of items measures a single one-dimensional latent construct, which can be thought of as the percent of variability in an experimental variable that is accounted for by true scores on the underlying latent construct.

Other important statistics are the Cronbach's Alpha If Item Deleted and the Corrected Item-Total Correlation. Cronbach's Alpha If Item Deleted is important because it estimates Cronbach's alpha if a given item was deleted. On the other hand, if any item deleted would increase the overall Cronbach's Alpha, then this item would be flagged for further consideration if it should be removed from the analysis. The Corrected Item-Total Correlation is performed to test if any item in the questionnaire scale is inconsistent with the averaged behavior of others. If so, then the item will be eliminated. If the correlation is low, it means that the item is not measuring the same construct as the rest of the items are trying to measure. This step is performed prior to determining the factors that

represent the underlying latent construct. It is widely accepted and recommended in the literature that an item be removed or further analyzed if the item-to-corrected total correlation is 0.3 or below (De Vaus, 2008). After analyzing the results from Table 8, it is evident that all the items and their respective construct meet the specifications of Scale Cronbach's Alpha, Cronbach's Alpha if Item Deleted and Corrected Item-Total Correlation.

Hypotheses 1.1a–1.1c: Functional-level diversity and CCAP dimensions

The alternative hypotheses 1.1a – 1.1c state that functional-level diversity will have a negative relationship with the CCAP dimensions in virtual teams. These hypotheses were evaluated and tested using Pearson's correlation coefficients. The set of hypotheses between functional-level diversity and the CCAP dimensions were analyzed as represented in Figure 5. The results of these hypotheses are discussed in the below sections, in addition Table 9 depicts these correlations along with their statistical *p* values of significance.

Hypothesis 1.1a: Functional-level diversity will be negatively associated with trust

Pearson product-moment correlation coefficient shows there is insufficient evidence ($r(130) = -0.01$, $P>0.05$) to support the alternative hypothesis that there is a negative association between functional-level diversity ($M=3.86$, $SD = 1.59$) and trust ($M=5.59$, $SD=1.02$). A lower level of trust is not associated with a higher level of functional-level diversity.

Table 8 Reliabilities data item and construct level

Scale	Item	Corrected Item-Total Correlation	α If Item Deleted	Scale α
Functional Diversity	DiversityFunc1	0.56	0.76	0.78
	DiversityFunc2	0.60	0.72	
	DiversityFunc3	0.69	0.62	
Deep-Level Diversity	DiversityDeep1	0.42	0.82	0.83
	DiversityDeep2	0.55	0.80	
	DiversityDeep3	0.63	0.79	
	DiversityDeep4	0.66	0.79	
	DiversityDeep5	0.53	0.81	
	DiversityDeep6	0.43	0.82	
	DiversityDeep7	0.62	0.80	
	DiversityDeep8	0.42	0.82	
	DiversityDeep9	0.51	0.81	
Communication	CCAP_Comm1	0.64	0.86	0.88
	CCAP_Comm2	0.61	0.87	
	CCAP_Comm3	0.67	0.86	
	CCAP_Comm4	0.72	0.85	
	CCAP_Comm5	0.85	0.83	
	CCAP_Comm6	0.62	0.87	
Commitment	CCAP_Commit1	0.73	0.91	0.91
	CCAP_Commit2	0.85	0.87	
	CCAP_Commit3	0.80	0.89	
	CCAP_Commit4	0.82	0.88	
Trust	CCAP_Trust1	0.71	0.83	0.86
	CCAP_Trust2	0.69	0.83	
	CCAP_Trust3	0.68	0.84	
	CCAP_Trust4	0.78	0.80	
Effectiveness	Team_Effectiveness1	0.68	0.92	
	Team_Effectiveness2	0.79	0.92	
	Team_Effectiveness3	0.71	0.92	
	Team_Effectiveness4	0.81	0.91	
	Team_Effectiveness5	0.78	0.92	0.93
	Team_Effectiveness6	0.86	0.91	
	Team_Effectiveness7	0.71	0.92	
	Team_Effectiveness8	0.61	0.93	
	Team_Effectiveness9	0.73	0.92	
Innovation	Team_Innovation1	0.78	0.85	0.89
	Team_Innovation2	0.79	0.85	
	Team_Innovation3	0.80	0.83	

Note. $N = 130$.

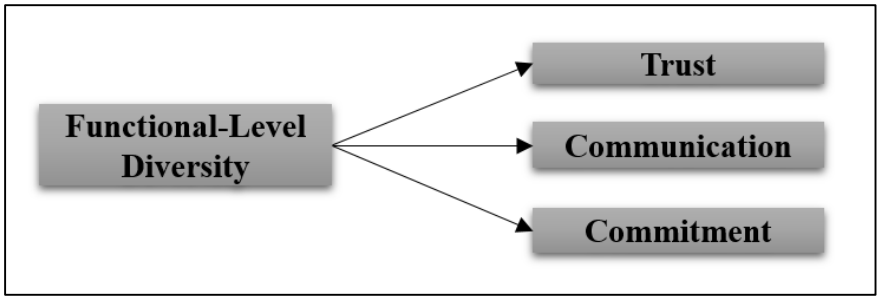


Figure 5 Functional-level diversity and CCAP correlations

Table 9 Functional-level diversity Pearson correlation coefficients

		1	2	3	4
1. Functional-Level Diversity	*r*	—	-0.01	-0.03	-0.09
	Sig. (1-tailed)		0.48	0.35	0.15
2. Trust	*r*		—	0.66**	0.57**
	Sig. (1-tailed)			0.00	0.00
3. Communication	*r*			—	0.57**
	Sig. (1-tailed)				0.00
4. Commitment	*r*				—
	Sig. (1-tailed)				

Note. $N = 130$.
**Correlation is significant at the .01 level (1-tailed).

Hypothesis 1.1b: Functional-level diversity will be negatively associated with communication

Pearson product-moment correlation coefficient shows there is insufficient evidence ($r(130) = -0.03$, $P>0.05$) to support the alternative hypothesis that there is a negative association between functional-level diversity (M=3.86, SD=1.59) and communication (M=4.66, SD=1.17). A lower level of communication is not associated with a higher level of functional-level diversity.

Hypothesis 1.1c Functional-level diversity will be negatively associated with commitment

Pearson product-moment correlation coefficient shows there is insufficient evidence ($r(130) = -0.09$, $P>0.05$) to support the alternative hypothesis that there is a negative association between functional-level diversity ($M=3.86$, $SD=1.59$) and commitment ($M=4.80$, $SD=1.37$). A lower level of commitment is not associated with a higher level of team functional-level diversity.

Hypotheses 1.2a-1.2c: Deep-level diversity and CCAP dimensions

The alternative hypotheses 1.2a – 1.2c state that deep-level diversity will have a negative relationship with the CCAP dimensions in virtual teams. These hypotheses were evaluated and tested using Pearson's correlation coefficients. The set of hypotheses between deep-level diversity and the CCAP dimensions were analyzed as represented in Figure 6. In addition, Table 10 depicts these correlations along with their statistical p values of significance.

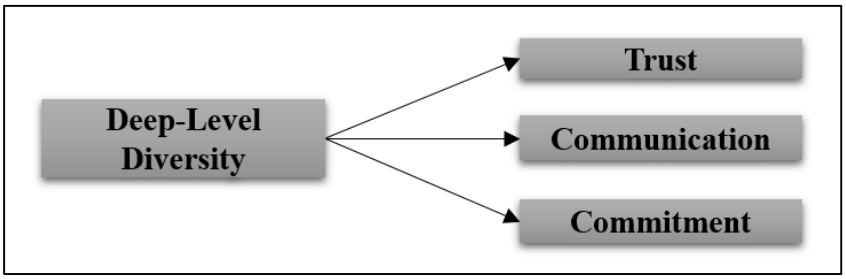


Figure 6 Deep-level diversity correlations

Table 10 Deep-level diversity correlations

		1	2	3	4
1. Deep-Level Diversity	*r*	—	-0.40**	-0.48**	-0.32**
	Sig. (1-tailed)		0.00	0.00	0.00
2. Trust	*r*		—	0.66**	0.57**
	Sig. (1-tailed)			0.00	0.00
3. Communication	*r*			—	0.57**
	Sig. (1-tailed)				0.00
4. Commitment	*r*				—
	Sig. (1-tailed)				

Note. $N = 130$.
**Correlation is significant at the .01 level (1-tailed).

Hypothesis 1.2a Deep-level diversity will be negatively associated with trust

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = -0.40$, $p < 0.01$) to support the alternative hypothesis that there is a moderate, negative association between deep-level diversity (M=2.72, SD=1.16) and trust (M=5.59, SD=1.02). A lower level of trust is associated with a higher level of deep-level diversity.

Hypothesis 1.2b Deep-level diversity will be negatively associated with communication

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = -0.48$, $p<0.01$) to support the alternative hypothesis that there is a moderate, negative association between deep-level diversity (M=2.72, SD=1.16) and communication (M=4.66, SD=1.17) . A lower level of communication is associated with a higher level of deep-level diversity.

Hypothesis 1.2b Deep-level diversity will be negatively associated with commitment

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = -0.32$, $p<0.01$) to support the alternative hypothesis that there is a moderate, negative association between deep-level diversity (M=2.72, SD=1.16) and commitment (M=4.80, SD=1.37). A lower level of commitment is associated with a higher level of deep-level diversity.

Hypotheses 2.1-2.6: CCAP dimensions and team outcomes

The alternative hypotheses 2.1 – 2.6 state that CCAP dimensions will have positive association with team outcomes (effectiveness and innovation). These hypotheses were evaluated and tested using Pearson's correlation coefficients. Table 11 depicts these correlations along with their *p* values of significance.

Table 11 CCAP dimensions correlations

		1	2	3	4	5
1. Trust	*r*	—	0.58**	0.57**	0.46**	0.57**
	Sig. (1-tailed)		0.00	0.00	0.00	0.00
2. Commitment	*r*		—	0.34**	0.42**	0.44**
	Sig. (1-tailed)			0.00	0.00	0.00
3. Communication	*r*			—	0.51**	0.42**
	Sig. (1-tailed)				0.00	0.00
4. Innovation	*r*				—	0.46**
	Sig. (1-tailed)					0.00
5. Effectiveness	*r*					—
	Sig. (1-tailed)					

Note. $N = 130$.
**Correlation is significant at the .01 level (1-tailed).

Hypothesis 2.1. Trust will be positively associated with team innovation

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.46$, $p<0.01$) to support the alternative hypothesis that there is a moderate positive association between trust (M=5.59, SD = 1.02) and innovation (M=3.42, SD=0.99). A higher level of trust is associated with a higher level of innovation.

Hypothesis 2.2. Communication will be positively associated with team innovation

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.51$, $p<0.01$) to support the alternative hypothesis that there is a strong positive association between communication (M = 4.66, SD=1.17) and innovation (M=3.42, SD = 0.99). A higher level of communication is associated with a higher level of innovation.

Hypothesis 2.3. Commitment will be positively associated with team innovation

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.42$, $p<0.01$) to support the alternative hypothesis that there is a moderate positive association between commitment (M=4.80, SD=1.37) and innovation (M=3.42, SD=0.99). A higher level of commitment is associated with a higher level of innovation.

Hypothesis 2.4. Trust will be positively associated with team effectiveness

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.57$, $p<0.01$) to support the alternative hypothesis that there is a moderate

positive association between trust (M=5.59, SD = 1.02) and effectiveness (M=5.41, SD=1.05). A higher level of trust is associated with a higher level of effectiveness.

Hypothesis 2.5. Communication will be positively associated with team effectiveness

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.42$, $p<0.01$) to support the alternative hypothesis that there is a strong positive association between communication (M = 4.66, SD=1.17) and effectiveness (M=5.41, SD=1.05) A higher level of communication is associated with a higher level of effectiveness.

Hypothesis 2.6. Commitment will be positively associated with team effectiveness

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.44$, $p<0.01$) to support the alternative hypothesis that there is a moderate positive association between commitment (M=4.80, SD=1.37) and effectiveness (M=5.41, SD=1.05). A higher level of commitment is associated with a higher level of effectiveness.

Hypotheses 3a and 3b: CCAP as a moderator variable

The alternative hypothesis 3a states that CCAP will moderate the relationship between deep-level diversity and innovation, such that innovation is strongest when CCAP is high and weakest when CCAP is low. Also alternative hypothesis 3b states that CCAP will moderate the relationship between functional-level diversity and innovation, such that innovation is strongest when CCAP is high and weakest when CCAP is low. An analysis of the alternative hypotheses 3a and 3b were conducted to evaluate if CCAP will

moderate the relationship between team diversity (deep-level diversity, functional-level diversity) and innovation. As we need to specifically account for the moderator variable, the hierarchical moderated regression analysis (HMRA) approach, as described by Baron and Kenney (1986), was employed. The moderation hypotheses were tested individually by using a sequence of regressions for each intermediate run, as well as for the final dependent run. The researcher controls the sequence of entry of the IVs in the regression model analysis. The predictors are entered into the analysis in a sequence based on predicted importance, where new predictors are entered last so that their distinctive influence can be determined. For this study, the process starts by individually entering the control variables in the regression initially, then the predictor variables, the moderator variable and the interaction term.

Frazier et al. (2004) provided an approach to test for the effects of moderator variables. These steps were used to test the moderation hypothesis.

1. *Center variables:* This step is necessary in order to avoid the effect of multi-collinearity. Centering is accomplished by subtracting the sample mean from each moderator variable.

2. *Create a cross-product term:* These product terms are created to represent the interaction between the predictor and the moderator variable. These product terms are simply the multiplication of the predictor and moderator variables using the centered variables.

3. *Structure the Equation:* After the cross-product term has been created, the variables and centered variables that are contained in the interaction terms should be included in the model.

4. *Interpret the Results:* The statistical significance of the moderator effect is tested with the multiple degree of freedom F-test rendering stepwise change for the step by which the multiple product terms are entered.

Results for hypothesis 3a

The results of the hierarchical regression model are presented in Table 12. In step 1, control variables were entered into the regression model. In step 2, the main effects for deep-level diversity and CCAP were entered into the second stage of the regression model, and in the third step, the interaction effect for CCAP and deep-level diversity was entered into the regression equation.

Results of the HRM revealed that the control variables in Model 1 of Table 12 are not statistically significant ($F = 0.503$, $P > 0.05$) and they only explain 2.2% of the total variance. In Model 2 in the HRM, the two main effect variables (deep-level diversity, CCAP) were examined and they are significant ($P < 0.05$) and explain 21% of the variance in the innovation output. In Model 3, the interaction term (Deep-level diversity X CCAP) was examined, however, the results of their interaction term ($\beta = -0.011$, $P > 0.05$) did not show significance. Based on this data, moderation cannot be supported because the interaction term of the moderation analysis was not significant. Therefore, the alternative hypothesis 3a is not supported.

Results for hypothesis 3b

The result of the hierarchical regression model for H3b is presented in Table 13. In step 1, control variables were entered into the regression equation. In step 2, the main effects for functional-level diversity and CCAP were entered into the second stage of the regression model, and in the third step, the interaction effect for CCAP and functional-level diversity was entered into the regression equation.

Table 12 Moderation analysis: Deep-level diversity, CCAP, innovation

DV: Innovation	β	*F*(Model)	*R*	R^2	ΔR^2
		Model 1: Control Variables			
Imbalance Index	-0.00	0.50	0.15	0.02	0.02
Team Tenure	-0.03				
Isolation Index	0.13				
Team Size	-0.10				
		Model 2: Main Effects			
Deep-Level Diversity	-0.17**	4.38**	0.48	0.23	0.21
CCAP	0.06**				
		Model 3: Interactions			
Deep-Level Diversity X CCAP	-0.01	3.74	0.48	0.23	0.00

Note. Unstandardized β reported. $N = 130$.
**$p < .01$.

Table 13 Moderation analysis: Functional-level diversity, CCAP, innovation

DV: Innovation	β	*F*(Model)	*R*	R^2	ΔR^2
		Model 1: Control Variables			
Imbalance Index	-0.00	0.50	0.15	0.02	0.02
Team Tenure	-0.03				
Isolation Index	0.13				
Team Size	-0.10				
		Model 2: Main Effects			
Functional-Level Diversity	0.09**	4.38**	0.48	0.23	0.21
CCAP	0.16**				
		Model 3: Interactions			
Functional-Level Diversity X CCAP	-0.05**	5.75**	0.57	0.32	0.07

Note. Unstandardized β reported. $N = 130$.
**$p < .01$.

Results of the HRM revealed that the control variables in Model 1 of Table 13 are not statistically significant (F = 0.50, P> 0.05) and only explained 2.2% of the total variance. In Model 2 in the HRM, the two main effect variables (functional diversity,

CCAP) were examined and they are positive and significant ($P < 0.05$) explaining 22.7% of the variance in the innovation output. In Model 3, the interaction term (functional-level diversity X CCAP) was examined, and the result of their interaction term ($\beta = 0.05$, $P < 0.01$) is positive and significant. Based on these results the alternative hypothesis 3b is supported.

Assumption testing

Prior to the conduct of the statistical regression analysis for the hypotheses tests, the data were screened and cleaned to evaluate the sample distribution. An exploration of the skewness and kurtosis values for all the variables were evaluated for normality as shown in Table 6, linearity and regression residuals were also evaluated as shown in Appendix C.

Cook's distance was also evaluated in SPSS. The maximum Cook's distance for the sample was less than 1 (0.47), which suggested there were no outlier cases that impacted the model. The Durbin-Watson test value was less than 2 (1.93), an indication that the residuals were uncorrelated (Field, 2013). Variance inflation factor (VIF) and collinearity statistical tolerance were used to assess multicollinearity of the predictor variables. VIF indicates the degree to which the standard errors are inflated due to the levels of collinearity, VIF values of 10 or greater are often cited as indicative of problematic collinearity (Field, 2013). The second test for multicollinearity uses collinearity statistical tolerance, which is the percentage of variance in the independent variable that is not accounted for by the other independents variables, tolerances values of 0.20 or less are cited as problematic (Field, 2013). The results of these two test indicates that the variance inflation factor values for all predictors within the model are well below

10 (1.07) and the tolerance values are well above 0.2 (0.94), which are good indicators that there is no multicollinearity present in the models.

Hypothesis 4: Confirmatory factor analysis–CCAP

The main goal of a CFA is to determine the capability of a predefined theoretical model to fit an observed set of empirical data (Brown, 2006). Blomqvist and Levy (2006) describe CCAP as a socially complex phenomenon composed of three interrelated dimensions (trust, communication, and commitment). The primary purpose of this CFA model is to explain and analyze the interrelated relationships simultaneously between the set of first order latent variables (trust, communication, and commitment) and a second order latent variable (CCAP).

In structural equation modeling, the latent variables are theoretical constructs that can only be determined to exist as a combination of other measurable variables. Latent variables are variables that cannot be directly observed but can account for the covariance among a larger set of observed variables or manifest variables (Byrne, 1998). Furthermore, latent variables can be either exogenous, "independent," or endogenous, "dependent," variables. An endogenous variable is a factor in the causal model whose value is determined by the state of other variables in the model. On the other hand, an exogenous variable is a factor in the causal model whose value is independent of the state of other variables in the model. The endogenous variables are differentiated graphically from the exogenous variables by having directed arrows pointing towards them, while exogenous variables don't have any straight, single headed arrow pointing at them (Brown, 2006).

Figure 7 is a hypothesized second-order model for CCAP. In this model, there is one second-order factor (CCAP) and three first-order factors (trust, communication, and commitment). Each first-order factor is represented by observed variables (questionnaire items) plus residual variables for each observed variable. There are also second-order path coefficients between the first-order latent variable and the second-order latent variable and first-order path coefficients between observed variables and the first order latent variables.

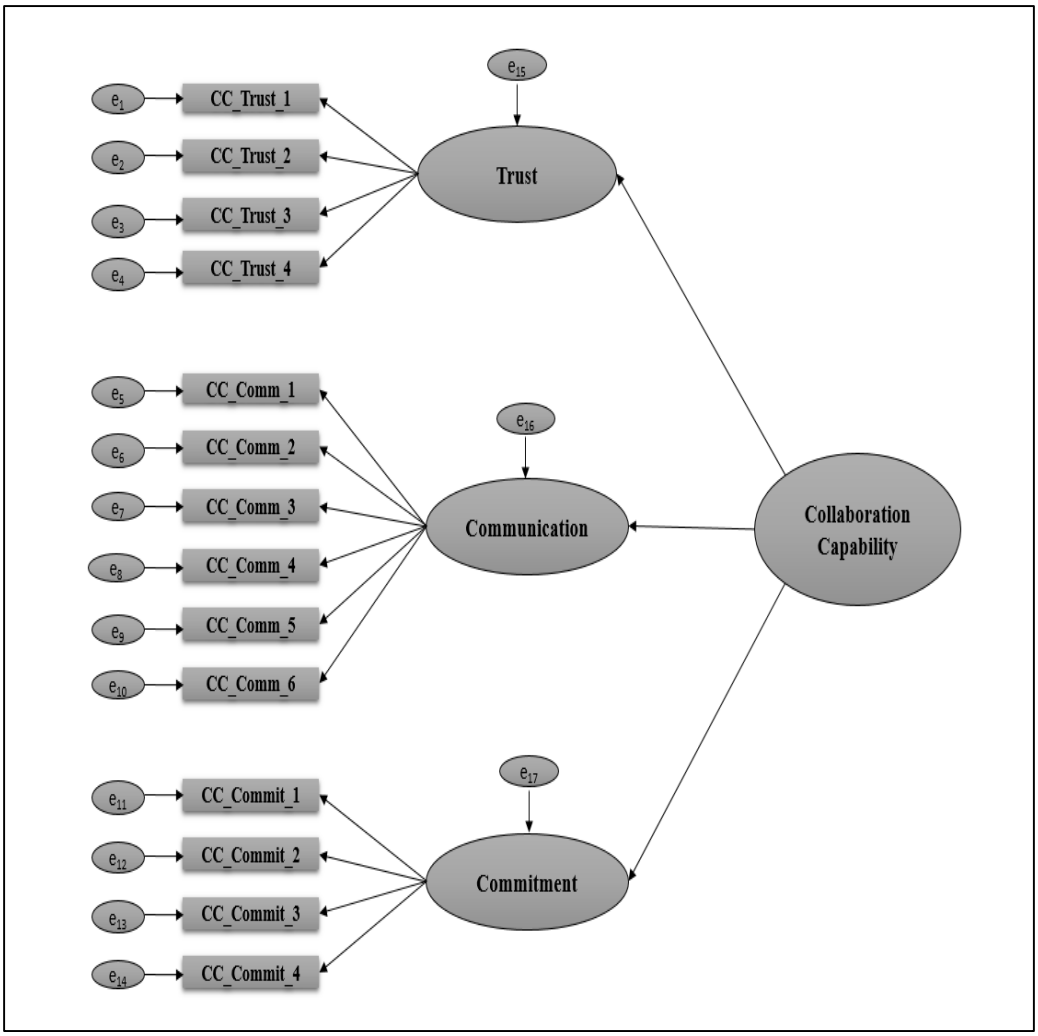


Figure 7 CCAP second-order model

Residuals for the endogenous variables are the measurement error that needs to be identified for endogenous variables (i.e. observed variable) in the model (Brown, 2006). Therefore, as shown in Figure 7, residual variables (e1 to e13) are assigned to the observed variables. Parameter estimates include the second-order factor loadings (γ) (Communication, Commitment, trust) and first-order factor loadings (Comm1, Comm2, Comm3, Comm4, Comm5, Commit1, Commit2, Commit3, Commit4, Trust1, Trust2, Trust3, Trust4).

Assessing the fit between model and data with goodness-of-fit indices

In this section, the empirical results are examined using confirmatory factor analysis (CFA). The CFA technique allows analyzing models with latent variables, which yields correlations and regression coefficients among the latent construct (Brown, 2006). Fit statistics are used to test the CFA model for an overall goodness of fit. The fit indexes are used to evaluate the residuals that result from fitting of a model to the empirical data (Brown, 2006). The overall fit of the CFA measurement model in this study was evaluated using the IBM AMOS V22 software and the results examined for the following indices that are recommend by (Brown, 2006): chi-square (χ^2), χ^2/df, CFI, NFI, RMSEA and SRMR.

Chi-square (χ^2)

Chi-square evaluates the difference between the observed and the expected covariance matrices with low values being an indication of a better fit (Brown, 2006). In conjunction with the Chi-square index is a measure of the ratio of χ^2 to the degrees of freedom of the model where a value of less than 2 is considered as an adequate fit.

The Comparative Fit Index (CFI) is equal to the discrepancy function that assesses fit using a non-central Chi-square distribution. CFI values range from 0 to 1 with a larger value indicating a better model fit. Acceptable model fit is indicated by a CFI value of 0.9 or greater (Hu & Bentler, 1999).

Root mean square error of approximation

Root mean square error of approximation (RMSEA) is an index related to the residuals in the model that estimates the lack of fit in a model compared to the saturated model. RMSEA values range from 0 to 1 with a smaller RMSEA value indicating better model fit, values of less than 0.06 indicate a good fitting model (Hu & Bentler, 1999), whereas, a value of 0.08 or less is often considered acceptable (Browne & Cudeck, 1992). *Normed Fit Index (NFI)* also known as the Bentler-Bonett normed fit index (1980) was developed to evaluate the estimated model by comparing Chi-square values of the model to that of the data. A value greater than 0.9 is considered a good fitting model.

Goodness of fit

Goodness of fit (GOF) is a measure of fit index between the hypothesized model and the observed covariance matrix. A value greater than 0.9 is considered a good fitting model.

Standardized root mean square residual

Standardized Root Mean Square Residual (SRMR) is a fit index based on the difference between the saturated covariance matrix and the CFA model covariance matrix. A value of 0.08 or less is considered a good fitting model.

Table 14 shows a summary of fit indices for the hypothesized model and Figure 8 provides a visual representation of the CCAP model. The proposed second-order model showed good fit $\chi^2/df=1.56$, *CFI= 0.970, IFI=0.971, RMSEA=0.06 and SMSR=0.06.* The values of CFI greater than 0.90 and a ratio of chi-square to the degrees of freedom less than 2 is an indication of an acceptable model fit (Kline, 2005). Based on the result of the CFA, the theorized model of CCAP is considered to be a good representation of the data and hence supporting hypothesis 4: CCAP is a three dimensional construct, consisting of trust, communication, and commitment.

Table 14 Summary of fit indices of CCAP model

CFA	χ2	df	χ^2/df <2	CFI >0.90	NFI >0.90	IFI >0.90	RMSEA <0.08	SMSR <0.08
3-Dimensional CCAP Model	98.74	63.0	1.56	0.97	0.92	0.97	0.06	0.06

Note. $N = 130$.

Convergent validity

Convergent validity is the degree to which the items in a factor agree in their measurement of that factor. Convergent validity is specified by significant factor loadings of each of the measures on an appropriate scale (Anderson & Gerbing, 1998). Hair et al. (2010) recommends that all factor loadings should have a value greater than 0.50 to be statistically significant. As shown in Table 15, all factor loadings for the observed variables were statistically significant at $p < 0.05$. This data provides supporting evidence of the convergent validity of all the items, which effectively measure the same construct.

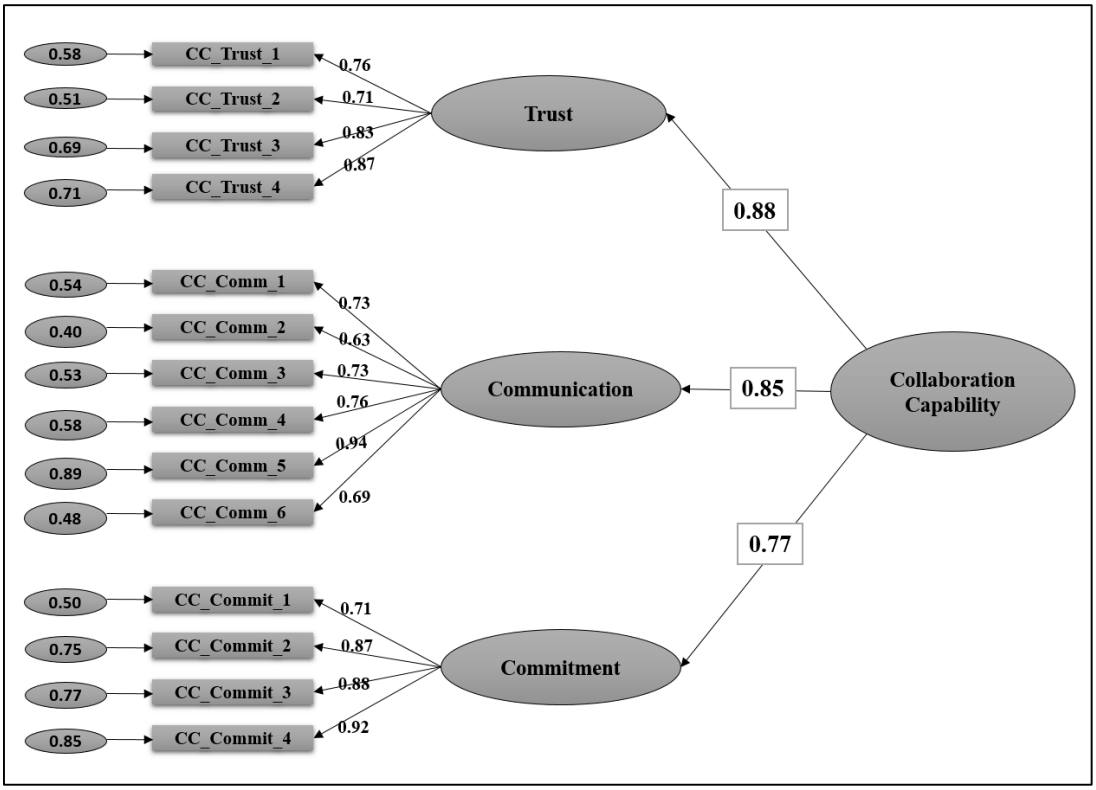


Figure 8 CCAP conceptual model and standardized loadings

Table 15 Factor loadings

Construct	Item	Factor Loading
Communication	CCAP_Comm1	0.73*
	CCAP_Comm2	0.65*
	CCAP_Comm3	0.73*
	CCAP_Comm4	0.76*
	CCAP_Comm5	0.92*
	CCAP_Comm6	0.64
Commitment	CCAP_Commit1	0.76*
	CCAP_Commit2	0.90*
	CCAP_Commit3	0.84*
	CCAP_Commit4	0.89*
Trust	CCAP_Trust1	0.76*
	CCAP_Trust2	0.70*
	CCAP_Trust3	0.83*
	CCAP_Trust4	0.88*

Note. $N = 130$.
*$p < .05$.

Discriminant validity

An important objective of this analysis is to verify the multi-dimensional nature of CCAP by testing discriminant validity. To test and evaluate the discriminant validity of the CCAP construct, discriminant validity among the CCAP dimensions was tested in two ways. First, Anderson & Gerbing (1988) suggested modifying the unconstrained free model with the correlations among the construct dimensions set to 1.0 (in this case, the model would be considered a constrained model), and then compare goodness of fit statistics of the constrained vs. the unconstrained model. Second, the CFA was modified by comparing the hypothesized CCAP model with a single dimensional model that combines communication, trust and commitment into one factor. If the construct shows good discriminant validity, then single dimensional model and the unconstrained free model should show poorer fit.

The fit statistics for these models are shown in Table 16, the results reveal that the theorized three-dimensional CCAP model has a better fit than both the one-dimensional and constrained models. Each time, compared to the unconstrained three-dimensional model (M1), the data reveals that the constrained model and the one-dimensional model consistently fit the data significantly worse than the unconstrained model, providing support for the discriminant validity of each subscale of the CCAP. This result establishes discriminant validity and supports alternative hypothesis 4 that CCAP is a higher-order core factor and underlies the three sub-dimensions (trust, communication, and commitment).

Table 16 Discriminant validity test

CFA	$\chi 2$	df	$\chi 2$/df <2.0	CFI >0.90	NFI >0.90	IFI >0.90	RMSEA <0.08	SMSR <0.08
			Model 1					
3-Dimensional	98.7	63.0	1.56	0.97	0.92	0.97	0.06	0.06
			Model 2					
3-Dimensional Constrained	109.6	66.0	1.66	0.96	0.92	0.97	0.07	0.07
			Model 3					
1-Dimensional	208.9	66.0	3.16	0.88	0.84	0.88	0.13	0.09

Note. $N = 130$.

Discussion and implications

One contribution of the present study is the empirical validation of CCAP as a higher-order factor with three dimensions (trust, communication, and commitment). Reliability indicators, factor loadings, and convergent validity revealed that all the indicators are related to the underlying constructs they were designed to measure. Discriminant validity of the construct demonstrated that the three distinct dimensions exist in the CCAP model. The evidence of reliability and validity provides support for the CCAP model, as well as information about the usefulness of the CCAP construct. This work represents a step toward the validation of the CCAP theory, first proposed by Blomqvist and Levy (2006), by offering a psychometrically valid scale for the study of CCAP within a virtual context. Our findings suggest that the three manifestations of CCAP dimensions of trust, communication, and commitment are valid indicators of an underlying CCAP within a virtual team. This empirical analysis allows for more fine-

grained research on CCAP and the ability to analyze CCAP dimensions in concert with one another, supporting further research opportunities in this field.

Following the empirical validation of the CCAP construct, the hypotheses were examined to determine the influence of CCAP on the relationship between team diversity (deep-level and functional-level diversity) and team innovation. The results indicated that there is no moderation effect of CCAP on the relationship between deep-level diversity and team innovation. It was evident from the data that a high percent (91.9%) used email as the preferred technological medium for communication and interaction with each other, and 60% of the team members had no face-to-face interaction. The email dependency and the lack of face-to-face interaction could be strong contributors to the lack of moderation and interaction between deep-level diversity and CCAP. This lack of interactive reasoning due to high email dependency can be further justified based on an argument put forth by Harrison et al. (1998), positing that team members detect and identify the personalities and the non-visible underlying characteristics of their teammates through interactions and through observing their verbal and non-verbal behavior. For this particular study, if the virtual teammates had communicated more frequently through a richer medium, then CCAP may have had a more significant influence on the relationship between deep-level diversity and innovation outcomes. Another possibility for the lack of moderation is that deep-level traits are not necessarily factors that are exchanged among virtual teammates since these traits are not easily detected and exchanged in a virtual environment. To do so, an extended period of time is likely necessary for these perceived differences to surface and be significant contributors to the behavior of the team.

On the other hand, the moderation effect of CCAP on the relationship between functional-level diversity and team innovation was determined to be statistically significant. This is a notable finding of this research, given that a primary purpose for forming virtual teams is to pool core competencies from experts of various technical and functional backgrounds (Hertel, Deter, & Konradt, 2006). This research finds that CCAP plays a significant moderating role in the virtual team environment and in relation building, which facilitates higher levels of team innovation. Highly collaborative virtual team members use their complementary and collective knowledge to achieve higher levels of innovation. In virtual teams that depict high functional-level diversity, having CCAP is likely to enhance innovation outcomes.

The findings of the present study have valuable implications for how researchers and managers address the benefits of functional-level diversity and the challenges of deep-level diversity in virtual teams. The results of this investigation call for more detailed attention to deep-level diversity in order to examine how to offset the potentially negative effects on the team's collaboration process. Although this finding was not significant, it is a potentially important influence of which managers should be aware. Offsetting the negative effect may be done through training for team members to facilitate collaboration building and to detect and resolve conflicts immediately as they arise. Conflict in virtual teams negatively impacts team-member perceptions and the desire to remain with the team (Tekleab & Quigley, 2014b), and should therefore be addressed immediately. Virtual team managers can achieve higher innovative performance through creating an environment of collaboration in terms of trust, communication, and commitment among the team members. A highly collaborative

environment in a diverse virtual team can be a key activator of knowledge creation which is a critical enabler for innovation (Blomqvist & Levy, 2006; Esterhuizen, Schutte, & du Toit, 2012).

The present study also indicates that team innovation in global and virtual environments is complex, and leaders have the ongoing challenge of improving collaboration infrastructure among virtual teams. This can be done by building trust among team members, providing the appropriate tools of communication, and continuing to motivate team members to share knowledge and resolve communication issues. Team leaders are also encouraged to ensure commitment to the task and common goals, which align the team with desired performance outcomes.

Virtual team leaders also have the responsibility to monitor the team's CCAP. Virtual teams tasked with technology development and innovation are expected to collaborate with each other rigorously. Therefore, our CCAP model and framework will aid virtual team leaders in assessing and monitoring their teams' CCAP. By monitoring this capability, leaders may proactively take the action necessary to enhance collaboration among virtual team members for improved innovation performance. This model also demonstrates a practical and comprehensive way to measure teams' collaboration capability. A key aspect of this scale is that managers can use the CCAP model as a comparative measure of teams, which can give their firms an important competitive advantage by allowing them to measure and manage virtual team collaboration.

Limitations and future research

Although the findings of the present study contribute to the advancement of virtual team research, these findings should be interpreted with respect to the study's

limitations. First, the sample was drawn from a single organization, which limits the generalization of the findings. Future researchers are encouraged to examine CCAP in alternate contexts and industries to further validate the measurements and relationships attributed to team phenomena.

Second, the non-probability sampling approach used in this study poses a potential limitation. Random sampling was not an option since this study involved a specific sample within one organization. The organization in which the study was conducted did not permit the collection of respondent age, gender, and similar demographic data. Therefore, future researchers are encouraged to explore the demographic contexts in which CCAP is optimal and under what conditions CCAP is restricted.

A third potential limitation is common method variance (CMV). Podsakoff, MacKenzie, Lee, and Podsakoff (2003) indicate that survey-based research has the possibility of having a CMV bias in situations where a study relies on self-reporting measures. In this study, CMV could arise, given one respondent reporting for all observed measures. We attempted to minimize the bias and encourage honest responses by assuring the participants that the survey would be anonymous. Researchers that have studied this methodological issue have concluded that, even if CMV bias exists in the observed correlations, it is not necessarily sufficient to challenge the theoretical interoperation of the relationships (Doty & Glick, 1998). They further indicated that, although CMV bias should be avoided to the extent that this is possible, it is not likely to be large enough to invalidate the theoretical interpretations and research conclusions (Doty & Glick, 1998). The presence of CMV was evaluated in this study using Harman's

single-factor method (Podsakoff et al., 2003). Through the use of this method, no single factor emerged accounting for more than 50% of the overall variance, suggesting that CMV did not have a significant effect.

Fourth, to limit the influence of non-response bias, the sample was divided into two groups consisting of early and late respondents (Armstrong & Overton, 1977) at the date midpoint between the first and the last respondent. Differences in the groups (Group 1 = early respondents and Group 2 = late respondents) were analyzed for all the variables. Statistical significance was estimated, and no significant differences existed for all the variables, suggesting no non-response bias.

Last, this study used the correlation-method design, which requires caution when interpreting correlations and relationships. Casual inferences must be treated with caution when using these types of correlation studies. Although the results are consistent with prior research and with our hypothesized model, extending our casual inference should be done with caution.

Looking ahead, this study suggests a number of implications for future research, many of which were previously noted. Additionally, future researchers are encouraged to extend the current study to determine whether similar results and relationships might be achieved at various industries that rely on virtual teams, such as software companies. Testing this model in different work environments would address its generalizability. Another challenge for future research is to identify factors that facilitate deep-level diversity on team performance. Future research should attempt to disentangle the effects of deep-level diversity on virtual teams. For example, how familiar do virtual team

members need to be with one another in order to outweigh the negative effect of deep-level diversity?

Conclusion

The present study has addressed the many issues that are important to globally distributed virtual teams. The purpose of our research was to understand CCAP in virtual teams and to show how team diversity among team members can impact team trust, communication, and commitment. This study finds that virtual teams with deep-level diversity tend not to converge around collaboration that results in innovative ideas. Deep-level diversity provides minimal benefit to innovation in virtual teams.

This study has implications for managing virtual team diversity in global organizations that researchers and mangers should consider. The conventional wisdom in organizations assumes diversity is beneficial to teams because it brings various perspectives to the table to solve complex problems. Although this is true for functional-level diversity, our research shows that deep-level diversity should not be ignored, but instead given more attention in order to minimize its negative impact. Furthermore, this research was conducted with a quantitative approach in order to validate the theoretical construct of CCAP and the reliability and validity of its scale through confirmatory factor analysis.

In conclusion, the extensive assessment of the construct validity of CCAP is a major strength of the study; the construct of CCAP is important for the performance and quality of virtual teams. This study establishes empirical evidence of the construct validity and psychometrics of the CCAP. CCAP is a multi-dimensional construct, and a

team's trust, communication and commitment have significant impact on team innovation and effective performance. Table 17 summarizes the hypotheses results of this chapter.

Table 17 Summary of Hypotheses Results

	Alternative Hypothesis	Results
1.1a	Functional-level diversity will be negatively associated with trust.	Not Supported
1.1b	Functional-level diversity will be negatively associated with communication.	Not Supported
1.1c	Functional-level diversity will be negatively associated with commitment.	Not Supported
1.2a	Deep-level diversity will be negatively associated with trust.	Supported
1.2b	Deep-level diversity will be negatively associated with communication.	Supported
1.2c	Deep-level diversity will be negatively associated with commitment.	Supported
2.1	Trust will be positively associated with team innovation.	Supported
2.2	Communication will be positively associated with team innovation.	Supported
2.3	Commitment will be positively associated with team innovation.	Supported

CHAPTER III

ABSORPTIVE CAPACITY IN VIRTUAL TEAMS: EXAMINING THE INFLUENCE ON DIVERSITY AND INNOVATION

Introduction

Globalization has opened new possibilities for establishing and maintaining competitive advantage. As firms operate in competitive and tumultuous global markets, innovation and collaboration are critical to success (Matthew & Sternberg, 2006). Technology has advanced in ways that support collaboration among a team of experts who are remotely located in relation to one another. Virtual teams, consisting of members collaborating from various geographical locations and who may be in different time zones and countries, are becoming more common in practice. A report in 2011 from Gartner, Inc., projected that by 2015, about 75% of knowledge-based project work would be completed by distributed virtual teams; however, the complexity of virtual projects would elevate the level of risk associated with the virtual team (Gartner, 2011).

The proliferation of virtual teams provides unprecedented opportunities for innovation and corporate effectiveness (Hosseini & Chileshe, 2013), and the use of virtual teams also means that relocating personnel is no longer required. Virtual teams with a flexible and configurable infrastructure save costs and time, and often increase productivity (Anderson et al., 2007). By having team members located across several time zones, team members can advance the project within their respective workdays,

providing continual progress to a project (Vaccaro et al., 2008). Virtual teams are also noted as a means to increase diversity of knowledge resources by improving access to experts who contribute to the exploration of creative solutions.

As virtual teams are increasingly used in a hypercompetitive business environment to collaborate with suppliers, technology providers, or competitors to access external knowledge, the need to understand how teams obtain and use knowledge resources becomes paramount. The ability to recognize, assimilate, and apply valuable external knowledge to commercial ends is known as absorptive capacity (ACAP) (Cohen & Levinthal, 1990). Over the last twenty-five years, ACAP has attracted a significant amount of attention in the literature, given its noted relationship with firm-level outcomes, including measures of financial performance and innovation (Daspit & D'Souza, 2013; Tsai, 2001; Volberda, Foss, & Lyles, 2010). Scholars have also applied ACAP to the team-level, finding similar positive implications for team outcomes (Leal-Rodríguez, Roldán, Ariza-Montes, & Leal-Millán, 2014; Nemanich et al., 2010; Tiwana & Mclean, 2005). Although ACAP is examined for its role in enhancing team-level outcomes, few studies examine the influence of ACAP in a virtual team environment.

For a team to effectively identify new, valuable knowledge that warrants acquisition, the firm must be able to first recognize the value of the external knowledge. Therefore, the scope of prior related knowledge existing within the team is essential to the team successfully identifying and acquiring worthwhile knowledge resources. Given that diversity of internal knowledge resources is essential to the ACAP of the virtual team, we attempt to understand the breadth of internal knowledge resources by

investigating how two types of diversity, deep level and functional level, relate to the team's ACAP.

Functional-level diversity, or the degree to which team members vary in knowledge, skills, and expertise, offers insight into the cognitive resource variation present within the virtual team. Deep-level diversity consists of individual values, beliefs, and attitudes, which also affect the scope of knowledge resources present among team members. Both types of diversity, we suggest, are valuable to virtual teams as enablers of prior knowledge, which support the assessment, assimilation, and application of new external knowledge conceptualized by the team's ACAP.

The first objective of this investigation is to validate the ACAP construct at the virtual team level, and second, to investigate the relationships between diversity, ACAP, and team innovation outcomes. Specifically, we examine how ACAP positively mediates the relationship between diversity (both deep-level and functional-level diversity) and team innovation. Using a sample of virtual team members from a high-tech firm in the Silicon Valley, we find that ACAP both fully and partially mediates the diversity-outcome relationship, depending on the type of diversity examined. Also, we find that functional-level diversity relates positively to ACAP, while deep-level diversity is negatively related to ACAP, suggesting that varied types of diversity affect ACAP and associated outcomes discriminately.

The findings of the present study offer numerous contributions to the existing research on virtual teams. First, this study offers empirical validation of the ACAP multi-dimensional construct at the virtual team level. In this study, we apply ACAP within the context of the virtual team and empirically confirm the validity of the construct. Second,

we examine the influence of ACAP within the virtual team, noting the mediating effects on the diversity-outcomes relationship. Third, this study examines two types of diversity (deep level and functional level) and finds that each type of diversity has a varied effect on ACAP and associated outcomes. Overall, the findings suggest that ACAP is a pivotal source of innovation success in virtual teams, where teams with well-developed ACAP are more likely to realize superior innovation outcomes.

Objectives of the study

The main objective of this study is based on these research questions: How does ACAP influence and affect virtual team innovation and team effectiveness? What is the influence of team diversity on ACAP? These research questions were addressed by:

1. Exploring the multi-dimensionality of ACAP in a virtual team environment. Confirmatory factor analysis was used to assess internal structure as well as convergent and discriminant evidence of validity.
2. Analyzing the effect of ACAP on a virtual team's performance.
3. Testing the impact of team diversity on ACAP. The two dimensions of team diversity (deep level and functional level) were examined at the input level. These diversities among virtual team members can have implications on how the team members develop ACAP. It is therefore important to understand how the heterogeneity of the virtual team and the proposed ACAP are linked.

Significance of the study

The present study will make new contributions to the literature. Its key contribution is in developing an ACAP view of virtual team innovation. Previous research has not fully explored the role of ACAP in virtual teams and how it can act as a tool to enable virtual teams to achieve their innovation goals. We will address this by analyzing the effect of ACAP on virtual team innovation. We will demonstrate that a

team's innovation output is achieved through its ACAP. The second key contribution lies in demonstrating that the diverse attributes of virtual teams do not produce innovation by themselves; they do so by enhancing ACAP skills at the virtual team level. ACAP enables innovation by finding unique associations between complementary ideas and knowledge held by the various members of a virtual team. Therefore, this study will explore ACAP as a mediator between team diversity and team innovation.

Literature Review

A requisite condition for the success of organizations is innovation. Innovation relates to the organizational capacity to participate and be involved in the introduction of new products, services, and ideas (Huang & Lin, 2011). The ability to innovate is among the most important dynamics that influence organizational success, and innovation is rapidly becoming increasingly vital to maintaining a competitive edge in the global marketplace regardless of the industry (Gorodnichenko et al., 2010).

In today's climate of globalization, innovation frequently involves teams that are physically located across the globe. These teams must continually communicate and coordinate with one another as they move forward on assigned projects and tasks. Given the difficulties associated with coordinating contributions from individuals who are not in close proximity, an efficient and integrated collaborative structure is critical to the completion of interdependent tasks and achievement of goals. The use of virtual teams is a common approach now pursued by many organizations seeking to bring together cross-functional teams from diverse locations and with individuals from varied backgrounds.

Virtual teams are becoming increasingly popular in the high-tech domain, and are generally described as functionally diverse and geographically dispersed. Virtual teams

enable technology experts who are remotely located to collaborate and innovate, mainly by using technology to share information, communicate, and coordinate their efforts (Lipnack & Stamps, 2000). Technology experts no longer have to work in the same physical space, but can instead engage in collaboration from any location around the world, at any moment in time. Virtual teams are valuable in generating new knowledge through improved access to experts who can expedite the exploration of creative and innovative solutions (Duarte & Snyder, 2011). The use of virtual teams also means that relocating personnel is no longer required. Virtual teams with a flexible and configurable infrastructure can save valuable resources, resulting in increased productivity (Anderson et al., 2007).

Team diversity

Diversity is defined as the degree to which there are differences between people within a team (Van Knippenberg et al., 2004). Researchers (Harrison et al., 2002; Bunderson & Sutcliffe, 2002; Milliken & Martins, 1996) have defined diversity on three levels: surface, deep, and functional. The first, surface-level diversity reflects differences such as age, sex, and race, which are easy to measure. The second, deep-level diversity, refers to the differences in personal characteristics such as values, beliefs, and attitudes that are communicated through extended, personalized interaction and information gathering (Milliken & Martins, 1996). The third level of diversity, functional-level diversity, is the degree to which team members differ in knowledge, skills, information, and expertise.

A large body of research produced over the past few decades includes a great number of studies that examine the complex relationship between team diversity and

team performance (Tekleab & Quigley, 2014a). Conclusions drawn from this previous research indicate that team diversity can affect performance in both positive and negative ways. Some researchers have indicated that team diversity can act as a double-edged sword, yielding positive effects in some contexts and negative effects in others (Milliken & Martins, 1996).

Two major theoretical perspectives have emerged in the literature that examines the positive and negative implications of diversity: the social categorization perspective and the information perspective. The social categorization perspective argues that team members tend to create social categories (in-group and out-group) based on similarities and differences among them (Turner et al., 1987). In-group members tend to communicate more frequently and trust each other more than the out-group members. These natural tendencies occur due to the fact that in-group members share the same worldviews and perceptions (Moynihan et al., 2006). Fostering these types of diversity and biases could cause variations and uncertainties in the relationships within the virtual team, eventually disturbing the CCAP and innovative performance of the team.

The second theoretical perspective is the information perspective, which argues that teams with diversity outperform homogeneous teams because heterogeneous teams possess larger pools of informational resources (Milliken & Martins, 1996). These diverse resources include wider ranges of relevant knowledge, skills, and abilities that are distinct. These non-redundant resources provide an advantage to such teams in enabling them to make higher-quality decisions and arrive at more creative and innovative solutions (van Knippenberg et al., 2013). From this information perspective, researchers

therefore claim that team diversity has a positive effect on team performance, an effect produced by the collaborations of diverse team members (Chae et al., 2014).

Absorptive capacity

External sources of knowledge are critical to innovation output and in predicting future technological advances of a firm (Lee-Kelley & Sankey, 2008; Murovec & Prodan, 2009; Nemanich et al., 2010). In recent years, firms have begun moving away from relying exclusively on the generation of knowledge within the firm. Today, many are collaborating with partners that complement their knowledge resources, especially in the knowledge intensive sectors characterized by knowledge-intensive firms. In general, knowledge-intensive firms provide creative and innovative solutions to complex problems; examples of such firms include computer and electronics design and manufacturing companies, engineering firms, and research centers (Escribano, Fosfuri, & Tribó, 2009).

Many firms recognize the importance of external knowledge to innovation and no longer depend on internal knowledge generation alone. Cohen and Levinthal (1990) refer to the absorption and application of new external knowledge for commercial purposes as ACAP. In order to assess, assimilate, and apply new knowledge, firms should have an existing (internal) knowledge base on which to build the new, external knowledge. By having diverse internal knowledge resources within the firm, the organization possesses the internal prior knowledge necessary to recognize new, valuable external opportunities. Thus, the scope of prior related knowledge is a driver of the firm's ability to appropriately leverage ACAP capabilities (Zahra & George, 2002; Volberda et al., 2010).

ACAP is also conceptualized within the context of the team, and the present study extends such insights to the context of the virtual team. As virtual teams are increasingly used in a hypercompetitive business environment to collaborate with suppliers, technology providers, or competitors to access external knowledge, the ability of the virtual team to utilize its diverse internal resources to potentially enhance the team's ACAP becomes a source of advantage. Therefore, this study investigates how two types of internal team diversity relate to the ACAP dimensions of knowledge assessment, knowledge assimilation, and knowledge application.

Knowledge assessment

In today's rapidly-advancing field of information technology, the flow of information has increased rapidly, and the pressure now is on teams to process immense amounts of information reasonably and logically. In this fluid environment, ACAP is revealed in the ability of the receivers to discover new knowledge and assess the value and importance of knowledge transmitted to them (Gebauer, Worch, & Truffer, 2012). In the context of team-level work, this capability is demonstrated by the ability "to easily comprehend new technological developments in their field well enough to accurately assess the potential usefulness of those developments for their own work and for the industry" (Nemanich et al., 2005, p. 21).

It is important to note that knowledge management literature has classified knowledge into two dimensions: explicit and tacit knowledge. Explicit knowledge is the type of knowledge that can be easily identified, communicated, retrieved, and codified (documents, reports, etc.), while tacit knowledge is the collection of knowledge that a person possesses from ideas, thinking patterns, beliefs, and schemata that are deeply

embedded within the individual. Tacit knowledge was introduced by Polanyi (1966) with the assertion that "we can know more than we can tell" (p.4). Tacit knowledge has a crucial effect on the realization of innovation in companies (Fang, Fang, Chou, Yang, & Tsai, 2011), and has long been regarded as a recipe for competitive advantage .(Spender, Edmondson, & Moingeon, 1996)

From a knowledge management perspective, the processes and practices that cultivate knowledge assessment capability are related to the cognition element of an individual's thinking patterns, knowledge structure, and their ability to recognize and judge new knowledge. It is also related to the background and professional experience of an individual, which defines the quality and quantity of one's tacit knowledge base. Nonaka (1994) posited that socialization plays a crucial part in building tacit knowledge; he referred to this as the spiral of knowledge creation model. In collaborative virtual team environments, the valuation capability of tacit knowledge is critical and strongly dependent on the individual's cognitive and experience level and how those levels are challenged by virtual interaction and the inherent complexities of codifying tacit knowledge (Jabar, I, & H, 2010).

Knowledge assimilation

The assimilation of new, external knowledge is the next fundamental step in ACAP. This is the means by which teams gain the benefits of collaboration and the extension of the innovation boundary through knowledge diffusion. Assimilation as a cognitive process has been characterized as an integral part of knowledge transfer and knowledge sharing (Nemanich et al., 2005). Szulanski (2000) defined knowledge transfer "as a process not a one-time act" and as a process "in which an organization recreates a

complex, causally ambiguous set of routines in new settings and keeps it functioning" (p. 5). The difficulty is that knowledge transfer is highly dependent on the complexity of the knowledge and its tacitness; as the complexity level increases, stronger intimate relations are required between the collaborating members in order to ease the knowledge transfer process and make it a success (Uygur, 2013).

The other integral part of assimilating knowledge is the level of knowledge sharing among the team. It is not enough for one team member to hold the new, external knowledge; it needs to be distributed in an efficient manner so that it can be easily shared and understood by other team members (Rosen, Furst, & Blackburn, 2007). Prior researchers have identified the importance of intranet-based infrastructure and the implementation of mechanisms for sharing and distributing knowledge and expertise among team members (Rosen et al., 2007). These mechanisms include electronic bulletin boards, discussion forums, instant messaging, and the creation of dedicated team web pages (Rosen et al., 2007). Recent research has also been striving to further understand the complicated roles that culture and social issues play in knowledge sharing among team members (Wang & Noe, 2010). Trust has been identified as a major factor that influences knowledge sharing and is a factor that can lessen the negative influence of supposed costs on knowledge sharing (Wang & Noe, 2010). As the processes of knowledge transfer and knowledge sharing are exercised efficiently, the assimilation level of the team increases as it integrates new valuable external knowledge with existing knowledge.

Knowledge application

Cohen and Levinthal (1989, 1990) did not give specific definitions for the ACAP dimensions. Later theorists, such as (Alavi & Tiwana, 2002), argued that knowledge application is the key to knowledge integration, which they define as "the synthesis of individuals' specialized knowledge into situation-specific systemic knowledge" (p. 1030). Alavi and Tiwana also put emphasis on the point that knowledge integration is a key component of knowledge application, and that "the value of individual and organizational knowledge resides primarily in its application, an activity that we view as the crux of knowledge management" (p. 1031). The reason for that is that knowledge application enables an organization to sense, interpret, and respond to new opportunities and challenges (Alavi & Tiwana, 2002). Although a firm's infrastructure provides the "bones," it is the team's capacity level of knowledge integration that provides the "flesh and blood" (Van Den Bosch, Volberda, & De Boer, 1999).

The team's ability to integrate diverse arrays of knowledge depends on its social and cognitive processes, which shape the team's ability to combine diverse knowledge; the team has to overcome numerous compositional, team, and background barriers to successfully generate innovative knowledge (Salazar, Lant, Fiore, & Salas, 2012). Therefore, the process of integrating external know-how can be rather difficult to accomplish, and many organizations do not perform well at this process, even with the smartest and brightest experts (Hage, Jordan, Mote, & Whitestone, 2008). The process of knowledge integration is not static, but rather dynamic; it requires team members to engage in ongoing mutual readjustments and behavioral action (Gardner, Fong, & Huang, 2010). Successful knowledge integration requires the development of a dynamic and

systematic approach that supports the consistent integration and coordination of member knowledge throughout the duration of team interaction (Gardner et al., 2010).

There are specific challenges to knowledge application and integration in virtual team environments because knowledge is distributed and socially shared (Alavi & Tiwana, 2002). Knowledge integration requires coordination that accommodates differences in time, proximity, and configuration, across various units and communities. Unless these activities are managed well and facilitated by rich and iterative communication collaborations, the goal of achieving high performance will suffer, and knowledge utilization will be limited (Kotlarsky, Fenema, & Willcocks, 2008).

Virtual teams are becoming a desirable way to access and incorporate knowledge in collaborative networks, yet the literature review reveals that ACAP in virtual teams has received little research attention. In this study, we will deepen understanding of the innovative processes within virtual teams by analyzing the interrelationships between team diversity, ACAP, and team innovation.

Other studies

Table 18 summarizes published studies that have evaluated factors that affect innovation and creativity in a virtual team environment. The sources of data used within this review came from publication from areas of management, information technology, psychology and sociology. An examination and analysis of these studies shows that many of them deal with the topic of innovation and creativity, yet there is no discussion associated with the ACAP construct. Since we were not able to find any available research on this specific topic, we conclude that there is a gap in the literature in terms of extending and validation ACAP construct into the virtual team environment.

Table 18 Studies that evaluated team innovation in virtual teams

Author	Title	Factors	Output
Cormican et al., 2006	Virtual team environment for collaborative research projects.	Communication, knowledge sharing and learning between members	R&D development
Sorli, Stokic, Mendikoa, & Armijo, 2007	Advanced IC tools for maximizing virtual team creativity and innovation in manufacturing environments	Information and communication technologies.	Virtual team creativity and innovation.
Tran 2007	Innovations in virtual team training using the CASE Method	The use of the CASE teaching method as a mean to improve virtual teams' performance	Innovation
Hambley et al. 2007	Virtual team leadership: The effects of leadership style and communication medium on team interaction styles and outcomes	Leadership styles, communication media.	Team outcomes (creativity), team interaction styles
Jan de et al. 2008	Conditions for innovation behavior of virtual team members: a 'high-road' for internationally dispersed virtual teams	Information and communication technologies, coordination mechanism, task dependencies	Innovative behavior
Amberg et al. 2008	From virtual teams to online communities: fostering group based collaboration for innovation and knowledge management	Trust, privacy, transparency, information and communication technology	Open innovation
Ebrahim et al. 2009	Innovation and R&D activities in virtual team	Virtual environments	R&D activities
Wang & Noe 2010	Research on stability of knowledge transfer in virtual technology innovation team	Stability and continuity of knowledge transfer	Innovative tasks

Table 18 (Continued)

Author	Title	Factors	Output
Bjorn & Ngwenyaman 2010	Technology alignment: a new area in virtual team research	Technology-use practices and collaborative practices	Technology-alignment
Gressgård 2011	Virtual team collaboration and innovation in organization	Information and communication technologies	Organizations' innovation capabilities
Xue & Luo 2011	Trust, performance and innovation research in virtual team	Character, trust, contextual performance, task performance	Team innovation
Wi et al. 2011	Virtual organization for open innovation: semantic web based inter-organizational team formation	Team Assessment (Know-What, Know-How, Know-Who), team formation social network ontology model.	Open innovation
Chamakiotis et al. 2013	Factors influencing creativity in virtual design teams	Communication, engagement, organizational skills, education and experience related knowledge, geographical dispersion.	Creativity
Chang 2011	New organizational designs for promoting creativity: A case study of virtual teams with anonymity and structured interactions	Gender and national origin, social status, personality, communications styles, work experience, engineering disciplines	Creativity performance
Bergener & Majchrzak 2012	Media choice - influencing factor in virtual team innovation processes	Communication media	Innovation processes
Martinez Moreno et al. 2012	The role of self-guided training in the relationship between task conflict and innovation in virtual teams	Task conflict, self-guided training	Team innovation

Given the sparse literature that evaluated factors affecting innovation in a virtual team environment, additional literature was reviewed comprising eleven published studies that focus on attributes affecting overall team performance. This literature is summarized in Table 19. None of the studies evaluated the combination of all the vital elements of ACAP on innovation in virtual teams.

Table 19 Studies that evaluated team attributes in virtual teams

Author	Title	Factors	Output
Cormican et al., 2006	Virtual team environment for collaborative research projects.	Communication, knowledge sharing and learning between members.	R&D development
Lin, Standing, & Liu, 2008	A model to develop effective virtual teams	Social dimensional factors, communication, trust, cohesion	Team coordination, performance, satisfaction
Shachaf, 2008	Cultural diversity and information and communication technology impacts on global virtual teams: An exploratory study	Cultural diversity and communication	Team effectiveness
Reed & Knight 2010	To study the differences in communication between traditional project teams and those that operate virtually and impact on project risk.	Communication and knowledge transfer	Project risk
Saafein & Shaykhian 2013	Factors affecting virtual team performance in telecommunication support environment	Communication tools, cohesion and collaboration, leadership, trust, the location of team members and team size	Virtual Team Performance
Pinjani & Palvia 2013	Trust and knowledge sharing in diverse global virtual teams	diversity, mutual trust, and knowledge sharing	Virtual Team Performance, Effectiveness and member satisfaction

Table 19 (Continued)

Author	Title	Factors	Output
Tong et al. 2013	Spontaneous virtual teams: Improving organizational performance through information and communication technology	Coordination and communication	Team Performance
Peñarroja et al. 2013	The effects of virtuality level on task-related collaborative behaviors: The mediating role of team trust	Trust, Virtuality Level	Virtual Team Coordination, cooperation and team information
Hardin et al. 2013	Participative Goal Setting in Self-Directed Global Virtual Teams: The Role of Virtual Team Efficacy in Goal Setting Effectiveness and Performance	Goal Commitment	Team performance
Pendharkar 2013	Genetic learning of virtual team member preferences	Team member preferences from past actions	Team Coordination
Duran & Popescu 2014	The Challenge of Communication	Cultural diversity	Team Collaboration

Research model and hypotheses

Given the complex nature of the virtual team environment, the present study proposes that the success of diverse virtual team innovation is strongly associated with ACAP. This empirical model is based on the theoretical model of Cohen and Levinthal (1994), where knowledge assessment, knowledge assimilation, and knowledge application are the three dimensions of ACAP.

Team ACAP level determines and signals whether the team members will be engaging in activities that harvest new knowledge and innovation. Therefore, this study

suggests that a virtual team's innovation outcome, as a dependent variable, will increase with the development of ACAP (in terms of knowledge assessment, knowledge assimilation, and knowledge application), which is also affected by team diversity. From the Input-Process-Output viewpoint, the research framework is represented as shown in Figure 9. Specifically, team diversity is the input variable; ACAP is the mediator variable, and team innovation is the dependent variable.

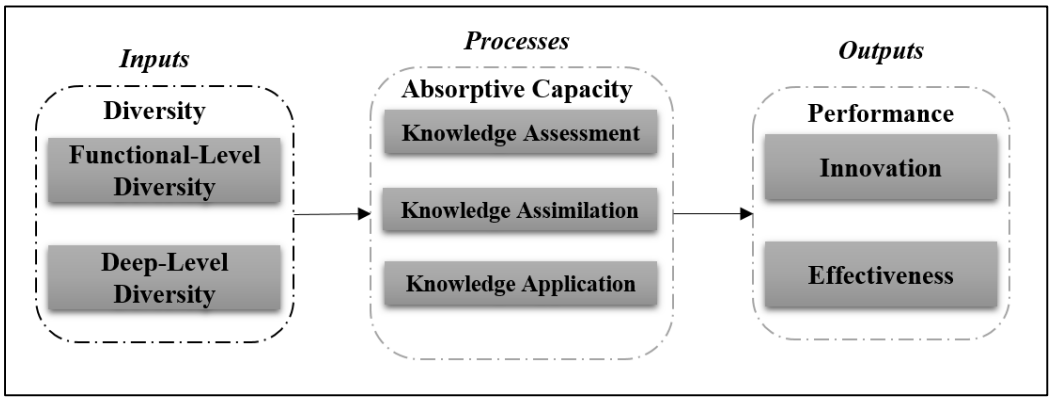


Figure 9 ACAP in virtual teams research model

The ability to assess and value new, external knowledge has a positive effect on assimilation of new, external knowledge (Huber, 1991; Nemanich et al., 2005). This prior knowledge is accumulated over time through past experiences and learning, and is used to guide behavior, make predictions, and acquire new knowledge (Ebrahim et al., 2009). The first two dimensions of ACAP result in cognitive learning, where new, external knowledge is transferred into the group knowledge stocks (Nemanich et al., 2005). The ability to assess and assimilate new, external knowledge are inputs to the process of

applying knowledge through design or experimentations (Nemanich et al., 2005). This leads to the following set of hypotheses:

- Hypothesis 1.1a: Functional-level diversity will be positively associated with knowledge assessment.
- Hypothesis 1.1b: Functional-level diversity will be positively associated with knowledge assimilation.
- Hypothesis 1.1c: Functional-level diversity will be positively associated with knowledge application.
- Hypothesis 1.2a: Deep-level diversity will be negatively associated with knowledge assessment.
- Hypothesis 1.2b: Deep-level diversity will be negatively associated with knowledge assimilation.
- Hypothesis 1.2c: Deep-level diversity will be negatively associated with knowledge application.

A diverse team's expertise enhances the potential for creativity and innovation, but diversity by itself does not lead to higher levels of innovation output (Tiwana & Mclean, 2005). Prior research has also shown that a positive relationship exists between ACAP and innovation effectiveness outcomes (Nemanich et al., 2010; Zahra & George, 2002). In order to achieve effective team innovation outcomes, we postulate that ACAP's process of knowledge assessment, knowledge assimilation, and knowledge application is the mechanism to achieve team innovation. Therefore, we hypothesize that:

- Hypothesis 2.1. Knowledge assessment will be positively associated with team innovation.
- Hypothesis 2.2. Knowledge assimilation will be positively associated with team innovation.
- Hypothesis 2.3. Knowledge application will be positively associated with team innovation.

- Hypothesis 2.4. Knowledge assessment will be positively associated with team effectiveness.
- Hypothesis 2.5. Knowledge assimilation will be positively associated with team effectiveness.
- Hypothesis 2.6. Knowledge application will be positively associated with team effectiveness.

Building upon the theoretical conception of Cohen and Levinthal (1990), this study adapts to the virtual team environment the three-dimensional ACAP model that was originally proposed by Cohen and Levinthal (1990), recommended by (Todorova & Durisin, 2007), and validated in a field study at the team level by Cadiz, Griffith, & Sawyer (2009). This three-dimensional model of ACAP has been considered because it incorporates the manifestation of the core processes that a virtual team would go through to transform new, external knowledge into operational knowledge that leads to effective outcomes of team innovation.

The present study aims to validate, in a virtual team environment, that there is a common underlying link that runs between knowledge assessment, knowledge assimilation, and knowledge application, a link that connects them together into a higher-order core factor called ACAP. Based on this fundamental concept of a higher level of abstract modeling, this study hypothesizes the following:

- Hypothesis 3: ACAP is a three-dimensional construct consisting of knowledge assessment, knowledge assimilation, and knowledge application.

Mediating role of absorptive capacity

Although diverse teams are noted to respond better to various types of change (Bowers et al., 2000) and competitive threats (Hambrick, 1996), understanding of how diversity enables teams to do so remains limited. Researchers report that the integration

of team diversity is the common element in high performing teams (Maznevski, 1994; Nederveen Pieterse, Van Knippenberg, & Van Ginkel, 2011). Leonard-Barton (1992) finds that the diversity of teams creates divergent thinking and is essential to prevent core capabilities from developing into core rigidities. Maznevski (1994) argues that diversity is a necessary but insufficient driver of team innovation outcomes, suggesting that team diversity leads to higher performance only when team members create novel linkages between the disparate ideas, perspectives, and knowledge held by individual team members. We build on this perspective and suggest that diversity creates value for the virtual team through relationships with absorptive capacity.

Without a refined ACAP in the virtual team, the team's ability to transform its diverse knowledge into innovative value is lacking. In order for the team to successfully examine the environment, it must possess the capacity to understand the environmental landscape and recognize the presence of new, potentially valuable knowledge. Possession of prior knowledge and experience enables the team to readily identify external knowledge worth acquiring (Zahra & George, 2002). We suggest, however, that having sufficient diversity within the team is not sufficient to deliver desired outcomes; rather, a means of leveraging the diverse knowledge and creating value is necessary to enable the team to perform. To this end, we suggest that ACAP is the mechanism that enables the team to create value from intra-team diversity and deliver innovation-related outcomes.

ACAP is a capability that must occur with efficiency in order to generate competitive innovation and is noted in prior studies for its value-creating role as a mediator driving outcomes (Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011; Liao, Wu, Hu, & Tsuei, 2009). In the context of virtual teams, the present study suggests

that the diversity of functional knowledge and expertise among members broadens the scope of knowledge resources accessible to the team and enhances the capability of the team to assess, assimilate, and apply new knowledge in pursuit of innovation outcomes. Similarly, this study suggests that deep-level diversity among team members provides access to a greater array of potentially complementary knowledge resources, enhancing the team's capability to assess the external environment, assimilate, and apply new knowledge.

Given the complex nature of the virtual team environment, the innovation success of the virtual team is characterized by the central, value-creating role of the team's ACAP. In the absence of a refined ACAP, diverse knowledge resources in the team are unlikely to provide valuable innovation returns in the context of a dynamic environment. However, the virtual team that appropriately leverages deep-level and functional-level diversity through the capability of ACAP is more likely to experience desired innovation outcomes, given the value-creating benefits of ACAP. When virtual teams with deep-level and functional-level diversity have a refined ACAP, this study suggests that members will have greater advantages in their innovation efforts, which will lead to creative solutions, thereby enhancing team innovation outcomes. Thus, this study also suggests that deep-level and functional-level diversity relate to innovation outcomes, and both relationships are mediated by ACAP.

- Hypothesis 4a: The relationship between deep-level diversity and virtual team innovation outcomes is mediated by ACAP.
- Hypothesis 4b: The relationship between functional-level diversity and virtual team innovation outcomes is mediated by ACAP.

Measures

Deep-level diversity

Following team diversity researchers (e.g., Pinjani & Palvia, 2013; Martins et al., 2003; Harrison et al., 2002), we used a 9-item scale adapted from Martins et al. (2003), which measures the perceived differences with respect to non-visible underlying personal characteristics such as values, beliefs, and attitudes. A sample item is "Members of the team are similar in terms of their personal values."

Functional-level diversity

We used a three-item scale adapted from (Kirkman et al., 2004) that measures the degree to which team members differ in their functional background and expertise. A sample item is "Members of the team are similar in terms of their functional expertise."

ACAP

We used the multi-dimensional construct developed by Cadiz, Griffith, and Sawyer (2009) that measures ACAP at the team level. A sample item is "We know enough about the technology we use to determine what new information is credible and trustworthy."

Innovation

We used a three-item scale adapted from (Vera & Crossan, 2005) that measures innovation at the team level. A sample of this measure is "The team is highly innovative."

Team effectiveness

We used a nine-item measurement scale adapted from (Pinjani & Palvia 2013). A sample item is “In the past, the team has been effective in reaching its goals”.

Control variables

In this study, we are interested in analyzing team diversity, CCAP, team innovation and team effectiveness, but other factor could be argued to have an effect on the performance, therefore this study will use the following control variables.

Team size

Previous research established that team size can have an impact on team performance (Haleblian & Finkelstein, 1993; D Harrison et al., 2002), with an increase numbers of the team size, the psychological distance can increase (Pearce & Herbik, 2004). It is important in our study to control for team size because in larger virtual teams it may be harder to develop collaboration and this may influence team outcomes.

Team tenure

The length of the team existence is likely to influence team outcomes (Barsade et al., 2000). The longer the team members interact with each other they may develop higher level of collaboration.

Degree of dispersion

The degree of dispersion represents the extent to which a team is virtual (Staples & Webster, 2008). O’Leary and Cummings (2007) argued that team outcomes are differentially associated to the dimension of dispersion. O’Leary and Cummings (2007) suggested the below dispersion indices:

- *Isolation:* Percent of team members with no other team members at their site. Low values of index indicate low levels of isolation.

- *Imbalance:* Equals standard Deviation ($n_i, n_j, \ldots n_k$)/N, where k = the total number of sites represented in the team, n_i = the number of team members in the i^{th} site, n_j = the number of team members in the j^{th} site, and N = total number of team members across all sites.

Research methodology

A survey was conducted to test the hypothesized relationship and the ACAP model. This approach was appropriate for this study given the objective was to empirically confirm the ACAP measure at the virtual team level and test the proposed hypotheses about virtual teams. In addition, this approach is in synthesis with prior work that examined virtual teams and multi-dimensional construct validation. The sample of this study was collected from a global engineering department of a high-tech firm in Silicon Valley, California, which consists of 375 design and software engineers (42 teams) in multiple locations across Asia, Europe and the United States. The respondents were asked to rate each statement of the composite survey based on their knowledge, experience, and understanding of each item using a seven-point Likert scale.

Ethical clearance and institutional permission from the participating company was obtained prior to conducting the research; however, the institution where this research was conducted did not permit the collection of specific demographic data citing the need to protect employee privacy. Employees in the global engineering department were asked to complete the questionnaire by a representative of the Human Resources department of the organization. The survey was voluntary and individual anonymity was guaranteed (citing the academic nature of the study). To enhance participation, participants were offered the opportunity to enter a raffle for a gift.

A total of 166 respondents completed the questionnaire, yielding a response rate of 42.27 percent. Of the 166 collected responses, 36 responses were incomplete and were removed from the final analysis. Therefore, a total of 130 responses were used for the analysis. Four of the 130 completed responses only had one piece of data missing, and these values were then coded into SPSS as missing data.

Although specific demographic information was not collected from the respondents due to Human Resource department restrictions, data on educational background of the respondents was permitted. Of the participants responding to the questionnaire, 27% had a doctoral degree, 37% had a Master's degree, 33% had a Bachelor's degree, and 3% had an Associate's degree.

Quantitative data analysis

The four major categories for quantitative research are descriptive, correlational, quasi-experimental and experimental study designs (Creswell, 2008). Based on the objectives of this research, a multivariate correlation design is appropriate. It will determine to what degree the team diversity is associated with ACAP and how ACAP is associated with team innovation. This was accomplished by calculating the correlation coefficient and determining the strength and direction among the variables of interest. Below is a brief introduction to the methods that were used in this analysis with further details provided in later sections.

First, a Pearson correlation-based approach was used to explore potential relationships between variables and to assess the magnitude and direction of the movement of one variable when the other is changed. It is important to note that these correlation measures cannot be interpreted as a cause and effect relationship but only

indicate a degree of correlation and association of the variables with one another. “Any conclusions about a cause-and-effect relationship must be based on the judgment of the analyst” (Taylor, 1990).

To evaluate the model proposed in Figure 9, a multiple regression analysis with a moderator variable was performed as it allows both hypothesis testing and effect analysis via a rigorous statistical framework. Multiple regression analysis is a statistical technique used to study multivariate relationships between explanatory variables. The advantage of using multiple regression analysis permits the researcher to simultaneously investigate the relationship and predict the outcomes between several variables (Cohen et al. 2003). Hierarchical multiple regression analysis using Baron & Kenney’s (1986) approach was utilized to accept or reject the hypotheses in relation to the relationships among the variables. The regression analysis will test the magnitude of the effect of team diversity on innovative capability while at the same time accounting for team processes using a moderator variable

In addition to the steps provided above, the following will also be evaluated for model performance in order to ensure the accuracy and strength of the model:

- Multiple linear regressions is based upon the premise of four key assumptions: A) linearity, B) statistical independence between the error terms, C) Homoscedasticity (constant variance in the residuals) and D) normality of the error distribution.

- To test the linearity assumption a plot of the residuals vs. predicted values were created. A horizontal line with an approximately constant variance is expected if this assumption is correct. If this assumption is not correct, various non-linear transformations of the variables will be performed.

- To test statistical independence, a plot of the residual autocorrelation was created. A check was performed that the majority of the residual autocorrelations fall within the 95% confidence interval around zero. A Durbin-Watson test can also be performed to evaluate the correlation between residuals

- Homoscedasticity can be evaluated by considering the histogram of the regression standardized residuals to ensure normality. Finally, an exploration of the skewness and kurtosis values for all the variables were evaluated for normality.

Assuming that all the assumptions are met, we will then evaluate this model using an F-test and an R^2 statistic to determine that the model is in fact statistically significant and to evaluate what percentage of the variability in innovative capability is explained by the ACAP and team diversity.

Correlational hypothesis testing

As each of these hypotheses represent the relationship between two variables, the testing of these hypothesis will all follow the same outline. Prior to the statistical analysis, the Likert data was normalized by computing the median. Then a correlation coefficient on the normalized values of these two variables was computed to identify the direction and magnitude of the association. Next, a statistical test will then be performed to identify if the correlation is statistically significant. Specifically, for any two variables A and B, we will test two hypotheses versus one another:

- H_o: A and B are not significantly correlated, versus

- H_a: A and B are significantly correlated.

A p-value along with a conclusion of the test based upon the 5% significance level will then be used. A Pearson correlation coefficient was calculated between the two variables, and a one-tailed hypothesis test (as we are only testing for increase or decrease)

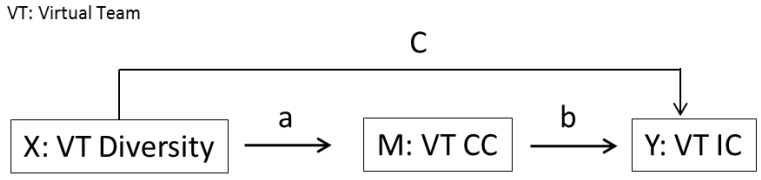
was performed. The classification of Pearson correlation values were assessed based on Cohen's classification (J. Cohen et al., 2003) of correlation Table 20.

Table 20 Cohen's correlation classification

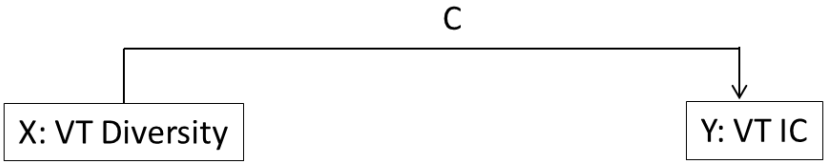
r	Classification
±0.50	Considered Strong
±0.30	Considered Moderate
±0.10	Considered Weak

Mediator hypothesis testing

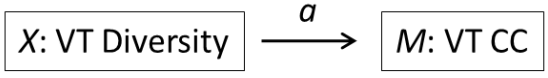
We begin by outlining the process of testing that ACAP is in fact a full mediator variable via the three-step process shown below. The relationships can be depicted in the following way and described in the following four steps.



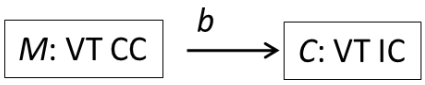
Step 1: Preform a simple regression analysis with X predicting Y to test for path "C" alone, $Y = B_0 + B_1 X + e$.



Step 2: Preform a simple regression analysis with X predicting M to test for path "a" alone, $M = B_0 + B_1 X + e$.



Step 3: Preform a simple regression analysis with M predicting Y to test for path "b" alone, $Y = B_0 + B_1 M + e$.



Step 4: Preform a multiple regression analysis with X and M predicting Y with "C" as the direct effect, $Y = B_0 + B_1 M + B_2 X + e$.

Step 1-3 are conducted to establish the existence of relationships among the variables. If the relationships are significant, then M can act as a mediator to C. This can be tested and supported in Step 4. If X is not significant when M is controlled, then the finding will support full mediation. If X is still significant when M is controlled, then the finding will support partial mediation. Baron and Kenney's (1986) also indicated that a mediator variable function follows these two conditions. Variations in levels of the independent variable (IV) significantly account for variations in the mediator. Assuming that the model passes the steps described above, we would then be able to confirm that ACAP is in fact a mediator variable.

ACAP higher order construct hypotheses testing

Given the forth objective of this study is to test the higher order theoretical ACAP model, the below analyses methods are framed around testing the ACAP model. There are two phases in the analyses. The first phase is to evaluate the subscale structure of the instrument using estimation of internal consistency reliability. The second phase is to test the hypotheses, and establish reliability and construct validity of the model. The data analyses will include descriptive statistics and correlations, internal consistency

reliability, item-to-total correlations, confirmatory factor analysis (CFA), and discriminant validity.

Descriptive statistics

Descriptive statistics was computed for initial data analysis. Mean, standard deviation, skewness, and kurtosis of each of the variables were inspected. A common method to test for normality is to run descriptive statistics to get skewness and kurtosis. Skewness is the tilt in distribution, or more precisely, the lack of symmetry. The range for skew should be within ± 2 for the data to be normally distributed. Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution. Positive kurtosis indicates heavy tails and peakedness relative to the normal distribution, whereas negative kurtosis indicates light tails and flatness.

Internal consistency reliability

The instrument is reliable if it shows consistent scores for the repeated measurement, which referred to the consistency measures. To check the internal consistency reliability of the instruments of the dimensions of CCAP, the Cronbach's α was used, which is the most common measure for internal consistency. The Cronbach's α coefficient can vary from 0 to 1. In general, if the Cronbachs α is greater than 0.7, the instrument is considered reliable, but values of 0.5 - 0.6 could be accepted for an exploratory study (Nunnally & Bernstein, 1994). Cronbach's alpha is widely understood to indirectly indicate the extent to which a set of items measures a single one-dimensional latent construct, which can be thought of as the percent of variable in an experimental variable that is accounted for by true scores on the underlying latent construct.

Item-to-total correlations

Item analysis was conducted and each of the constructs in ACAP (knowledge assessment, knowledge assimilation, and knowledge application) examined. An item-total correlation was performed to test if any item in the questionnaire scale is inconsistent with the averaged behavior of others, and therefore it will be eliminated. If the correlation is low, it means that the item is not measuring the same construct that the rest of the items are trying to measure. This step was performed prior to determining the factors that represent the underlying latent construct. It is widely accepted and recommended in the literature that an item be removed or further analyzed if the item-to-corrected total correlations is 0.3 or below (De Vaus, 2008).

Confirmatory factor analysis

Confirmatory Factor Analysis (CFA) is a theory driven multiple regression method that reveals which variables will load together into a higher factor. CFA is a member of structural equation models (SEM) that provides a method for testing a variety of hypotheses about a set of measured variables including higher-order variables. CFA allows researchers to evaluate the extent to which measurement hypotheses are consistent with empirical respondent scale data. CFA enables theory testing and development in a measurement context (Brown, 2006). This technique offer the researcher a viable method for evaluating the validity of higher order constructs. For Hypothesis 4, conformity factor analysis was conducted to examine the construct validity of ACAP and to determine if the underlying three dimensions of ACAP fit into a higher order model. A CFA model using maximum likelihood estimation was performed on the data using the IBM Amos software in order to confirm the proposed ACAP factor multi-dimensional

structure. With CFA, a proper fitting model is identified by the comparative, proportion of variance accounted and parsimony fit indices provided by the software package. The following indices were examined to assess how well the model matches the observed data:

1. Root Mean Square Error of Approximation (RMSEA) is related to the residuals in the model that estimates the lack of fit in a model compared to the saturated model. RMSEA values range from 0 to 1 with a smaller RMSEA value indicating better model fit, values of less than .06 indicate a good fitting model (Hu & Bentler, 1999), whereas, a value of .08 or less is often considered acceptable (Browne & Cudeck, 1992).

2. Comparative Fit Index (CFI) is equal to the discrepancy function that assesses fit using a non-central chi square distribution. CFI values range from 0 to 1 with a larger value indicating a better model fit. Acceptable model fit is indicated by a CFI value of .9 or greater (Hu & Bentler, 1999).

3. Normed Fit Index (NFI) also known as the Bentler-Bonett normed fit index (1980) was developed to evaluate the estimated model by comparing chi-square values of the model to that of the data. A value greater than .9 is considered a good fitting model.

4. Goodness of Fit (GOF) is a measure of fit index between the hypothesized model and the observed covariance matrix. A value greater than 0.9 is considered a good fitting model.

5. Standardized Root Mean Square Residual (SRMR) is a fit index based on the difference between the saturated covariance matrix and the CFA model covariance matrix. A value of .08 or less is considered a good fitting model.

Discriminant validity

Discriminant validity is "the degree to which measures of distinct concepts differ" (Bagozzi & Phillips, 1982), that is, measures of different constructs should share little variance. With respect to this study, discriminant validity would be tested to validate that the three ACAP dimensions (knowledge assessment, knowledge assimilation, and knowledge application), although highly related, are empirically distinct constructs. To

test and evaluate the discriminant validity of the construct, Anderson and Gerbing (1998) suggested modifying the unconstrained free model with the correlations among the construct dimensions set to be 1.0 and in this case the model would be considered the constrained model. If the Chi-square difference between the two models is significant, the dimensions of the construct are significantly different and should not be merged into one dimension.

Data Analysis

This section details the analysis of data collected through the online field survey. The survey constructs were assessed to insure that they are reliable and they measure their respective constructs in order to be used to test the research hypotheses. Based on the research model each construct consisted of multiple measurement items. The questionnaire scales psychometric properties assessing them at two levels: item level and construct level.

Data preparation

After the survey was conducted, the following steps were taken to prepare the data for hypotheses testing. First, all the data was exported from the Survey Monkey site into IBM SPSS statistical software V22. SPSS is an incorporated collection of quantitative analysis software that can perform statistical analysis tasks such as generation of descriptive statistics, bivariate analysis, multiple dimensional scaling and reduction, regression analysis, factor analysis and many more capabilities.

After the survey was administered and collected, several steps were taken to prepare the data for hypothesis testing. First, all data was initially gathered into a master

SPSS worksheet. Initial review of the data showed a total of 166 responses were collected. Of the 166 collected responses there were 22 responses that didn't fully participate in the survey because they only completed the consent section, also an additional 14 responses showed inconsistencies in their responses and were removed from the final analysis. Therefore, a total of 130 usable responses were used for the analysis, which is above our initial goal of 120 responses. Four out of the 130 responses had one piece of data missing, these missing values were then coded into SPSS as missing data. The completed set of data were coded using their original scales, for example, the data employing a seven-point Likert scale were coded using the following scale: (1) strongly disagree, (2) disagree, (3) somewhat disagree, (4) neither disagree nor agree, (5) somewhat agree, (6) agree, and (7) strongly agree.

Media usage

This section provides the results on the usage of virtual media by the virtual teams with the frequency responses for the various communication media as shown in Table 21. A high percent of the responses 60.9% shows no face-to-face interaction or interactions that occur less than once a month. This is a true characteristic of virtual teams that rely on virtual technologies. This is consistent with recent research that the virtual team members have less face-to-face interaction requiring that they rely on the use of different techniques for communication and forming relationships (Haines, 2014). A high percent 91.9% of respondents use emails in their team communication on a weekly or daily basis. Emails are the most popular means of communication due to the ease of usage and the control of communication between the sender and the recipient (W. D. Harvey et al., 2004). Instant Messaging is a popular application for communication with team

members due to its ease of use and the instant communication response between the sender and the receiver. A total of 68.3% of responses used instant messaging on a weekly or daily basis. Telephone calls are also popular means of communication in virtual teams, a total of 74.4% of responses indicate telephone calls are used on weekly or daily bases. Only total of 14.5% of responses uses video conference communication on a weekly or daily basis. This could be due to the lack of meeting rooms enabled for video conferences or people in general might not feel comfortable being seen on cameras and therefore they avoid video conferences.

Table 21 Frequency of media usage

	Media Usage (%)					
Occurrence	F2F	Email	IM	TeleCalls	TeleConf	VideoConf
Never	36.7	5.6	23.8	11.2	17.8	58.9
Less than once a month	24.2	1.6	4.0	5.6	4.7	18.5
Once a month	4.7	0.8	4.0	8.8	4.7	8.1
Once a week	6.3	2.4	5.6	30.4	34.9	10.5
A few times a week	14.8	29.0	32.5	32.8	27.9	0.8
Daily	13.3	60.5	30.2	11.2	10.1	3.2

Note. $N = 130$.

Descriptive statistics at the item level

The descriptive statistics of all the survey items are reported in Table 22 and include values for minimum, maximum, mean, standard deviation, skewness and kurtosis. The range for skew should be within ± 2 for the data to be approximately normally distributed (Lewis-Beck, Bryman, & Liao, 2007). The results in Table 22 indicates that all the kurtosis and skewness statistics for all the items are well within the acceptable range ±2, indicating that the items are approximately normally distributed for all the questionnaires.

Table 22 Descriptive statistics at item level

	Item	Min	Max	*M*	*SD*	Skewness	Kurtosis
Functional-Level Diversity	DiversityFunc1	1.0	7.0	3.59	1.65	0.08	-1.28
	DiversityFunc2	1.0	7.0	4.45	1.63	-0.54	-0.78
	DiversityFunc3	1.0	7.0	4.22	1.62	-0.24	-1.15
Deep-Level Diversity	DiversityDeep1	1.0	7.0	3.35	1.58	0.28	-0.98
	DiversityDeep2	1.0	7.0	4.04	1.51	-0.29	-0.81
	DiversityDeep3	1.0	7.0	4.65	1.66	-0.72	-0.43
	DiversityDeep4	1.0	7.0	5.11	1.43	-1.12	0.94
	DiversityDeep5	1.0	7.0	5.43	1.21	-1.06	1.30
	DiversityDeep6	2.0	7.0	5.77	1.13	-1.11	1.11
	DiversityDeep7	1.0	7.0	5.44	1.36	-1.27	1.54
	DiversityDeep8	1.0	7.0	5.37	1.37	-1.02	0.82
	DiversityDeep9	2.0	7.0	5.72	1.02	-0.84	0.68
Knowledge Assessment	ACAP_Asses1	2.0	7.0	5.37	0.94	0.95	0.42
	ACAP_Asses2	1.0	7.0	4.86	1.35	-0.12	0.42
	ACAP_Asses3	2.0	7.0	5.34	1.23	0.39	0.42
Knowledge Assimilation	ACAP_Assim1	1.0	7.0	5.35	1.29	0.64	0.42
	ACAP_Assim2	1.0	7.0	5.10	1.30	0.30	0.42
	ACAP_Assim3	1.0	7.0	5.01	1.34	0.04	0.42
Knowledge Application	ACAP_Apply1	1.0	7.0	4.89	1.26	-0.11	0.42
	ACAP_Apply2	1.0	7.0	4.63	1.41	0.04	0.42
	ACAP_Apply3	2.0	7.0	5.11	1.35	0.55	0.42
Effectiveness	Team_Effectiveness1	2.0	7.0	5.36	1.15	-0.93	0.64
	Team_Effectiveness2	2.0	7.0	5.42	1.03	-0.97	1.05
	Team_Effectiveness3	2.0	7.0	5.34	1.15	-0.67	0.18
	Team_Effectiveness4	2.0	7.0	5.57	1.08	-1.07	1.27
	Team_Effectiveness5	2.0	7.0	5.34	1.21	-0.77	0.32
	Team_Effectiveness6	1.0	7.0	5.36	1.14	-1.08	1.82
	Team_Effectiveness7	1.0	7.0	5.36	1.25	-1.15	1.41
	Team_Effectiveness8	1.0	7.0	4.80	1.48	-0.83	0.39
	Team_Effectiveness9	1.0	7.0	5.16	1.24	-0.78	0.76
Innovation	Team Innovation1	1.0	5.0	3.54	0.94	-0.72	0.44
	Team Innovation2	1.0	5.0	3.41	1.08	-0.36	-0.55
	Team Innovation3	1.0	5.0	3.41	1.04	-0.31	-0.48

Note. $N = 130$.

Descriptive statistics at the construct level

Construct level data was computed by taking the median on all the items belonging to that construct. Table 23 shows the descriptive statistics for the various constructs used in this study. Given that the range of skewness and kurtosis are within ±2, this establishes the normality specification for the construct level.

Table 23 Descriptive statistics at construct level

Construct	Min	Max	*Mdn*	*SD*	Skewness	Kurtosis
Functional-Level Diversity	1.0	7.0	3.0	1.57	0.36	-1.05
Deep-Level Diversity	1.0	7.0	2.0	1.16	1.23	1.93
Knowledge Assessment	1.0	7.0	5.0	1.01	-1.35	2.09
Knowledge Assimilation	1.0	7.0	6.0	1.16	-1.03	1.11
Knowledge Application	1.0	7.0	5.0	1.37	-0.07	0.18
Team Effectiveness	2.0	7.0	6.0	1.04	-0.84	0.87
Team Innovation	1.0	5.0	4.0	0.98	-0.36	-0.35

Note. $N = 130$.

Validity of the scales

The notion of validity was articulated by Kelly (1927) who stated that a scale is valid if it measures what it claims to measure. Cronbach's α is commonly used to establish internal consistency construct validity (Nunnally & Bernstein, 1994). Cronbach's α is widely understood to indirectly indicate the extent to which a set of items measures a single one-dimensional latent construct, which can be thought of as the percent of variability in an experimental variable that is accounted for by true scores on the underlying latent construct.

Other important statistics are the Cronbach's Alpha If Item Deleted and the Corrected Item-Total Correlation. Cronbach's Alpha If Item Deleted is important because it estimates Cronbach's alpha if a given item was deleted. On the other hand, if any item

deleted would increase the overall Cronbach's Alpha, then this item would be flagged for further consideration if it should be removed from the analysis. The Corrected Item-Total Correlation is performed to test if any item in the questionnaire scale is inconsistent with the averaged behavior of others. If so, then the item will be eliminated. If the correlation is low, it means that the item is not measuring the same construct as the rest of the items are trying to measure. This step is performed prior to determining the factors that represent the underlying latent construct. It is widely accepted and recommended in the literature that an item be removed or further analyzed if the item-to-corrected total correlation is 0.3 or below (De Vaus 2008). After analyzing the results from Table 24, it is evident that all the items and their respective construct meet the specifications of Scale Cronbach's Alpha, Cronbach's Alpha if Item Deleted and Corrected Item-Total Correlation.

Hypotheses 1.1a–1.1c: Functional-level diversity and ACAP dimensions

The alternative hypotheses 1.1a – 1.1c states that functional level diversity will have a positive relationship with the ACAP dimensions in virtual teams. These hypotheses were evaluated and tested using Pearson's correlation coefficients. The set of hypotheses between functional level diversity and the ACAP dimensions were analyzed as represented in Figure 10. In addition, Table 25 depicts these correlations along with their statistical p values of significance.

Table 24 Reliabilities data item and construct level

Scale	Item	Corrected Item-Total Correlation	α If Item Deleted	Scale α
Functional Diversity	DiversityFunc1	0.56	0.76	0.78
	DiversityFunc2	0.60	0.71	
	DiversityFunc3	0.69	0.62	
Deep-Level Diversity	DiversityDeep1	0.42	0.82	0.83
	DiversityDeep2	0.55	0.80	
	DiversityDeep3	0.63	0.79	
	DiversityDeep4	0.66	0.79	
	DiversityDeep5	0.53	0.81	
	DiversityDeep6	0.43	0.82	
	DiversityDeep7	0.62	0.80	
	DiversityDeep8	0.42	0.82	
	DiversityDeep9	0.51	0.81	
Knowledge Assessment	ACAP_Assess1	0.45	0.80	0.75
	ACAP_Assess2	0.64	0.60	
	ACAP_Assess3	0.68	0.55	
Knowledge Assimilation	ACAP_Assim1	0.55	0.71	0.75
	ACAP_Assim2	0.65	0.60	
	ACAP_Assim3	0.80	0.71	
Knowledge Application	ACAP_Apply1	0.66	0.72	0.81
	ACAP_Apply2	0.73	0.65	
	ACAP_Apply3	0.57	0.81	
Effectiveness	Team_Effectiveness1	0.68	0.92	0.93
	Team_Effectiveness2	0.79	0.92	
	Team_Effectiveness3	0.71	0.92	
	Team_Effectiveness4	0.81	0.91	
	Team_Effectiveness5	0.78	0.92	
	Team_Effectiveness6	0.86	0.91	
	Team_Effectiveness7	0.71	0.92	
	Team_Effectiveness8	0.61	0.93	
	Team_Effectiveness9	0.73	0.92	
Innovation	Team_Innovation1	0.78	0.85	0.89
	Team_Innovation2	0.79	0.85	
	Team_Innovation3	0.80	0.83	

Note. $N = 130$.

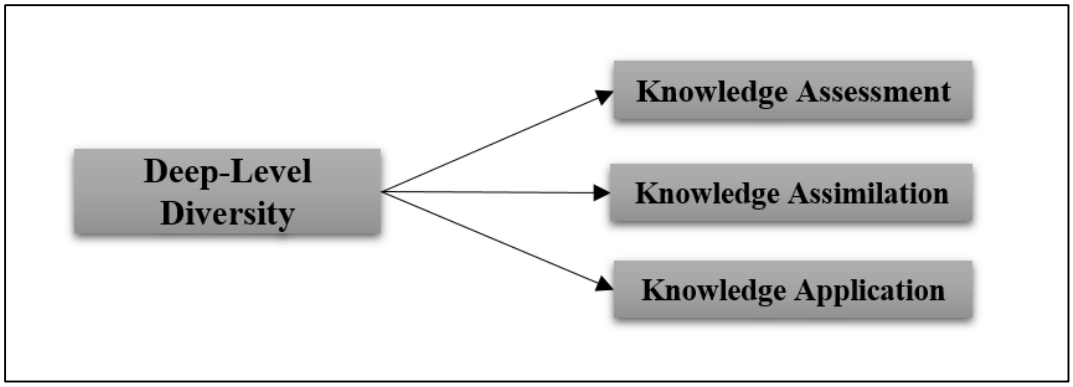


Figure 10 Deep-level diversity and ACAP correlations

Table 25 Functional-level diversity and ACAP Pearson correlation coefficients

		1	2	3	4
1.Functional-level	*r*	—	0.28**	0.25**	0.21**
Diversity	Sig. (1-tailed)		0.00	0.00	0.00
2.Knowledge Assessment	*r*		—	0.56**	0.41**
	Sig. (1-tailed)			0.00	0.00
3.Knowledge Assimilation	*r*			—	0.59**
	Sig. (1-tailed)				0.00
4.Knowledge Application	*r*				—
	Sig. (1-tailed)				

Note. $N = 130$.
**Correlation is significant at the .01 level (1-tailed).

Hypothesis 1.1a: Functional-level diversity will be negatively associated with knowledge assessment

Pearson product-moment correlation coefficient shows there is sufficient evidence (r) = 0.28, $p < 0.01$) to support the alternative hypothesis that there is a moderate, positive association between functional level diversity (M=3.82, SD = 1.59) and knowledge assessment (M=5.18, SD=1.14). A higher level of knowledge assessment is associated with a higher level of functional level diversity.

Hypothesis 1.1b: Functional-level diversity will be negatively associated with knowledge assimilation

Pearson product-moment correlation coefficient shows there is sufficient evidence (M=5.25, SD=1.18) ($r(130) = 0.25$, $p<0.01$) to support the alternative hypothesis that there is a moderate, positive association between functional level diversity (M=3.82, SD = 1.59) and knowledge assimilation. A higher level of knowledge assimilation is associated with a higher level of functional level diversity.

Hypothesis 1.1c: Functional-level diversity will be negatively associated with knowledge application

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.21$, $p<0.01$) to support the alternative hypothesis that there is a moderate, positive association between functional level diversity (M=3.82, SD = 1.59) and knowledge application (M=4.78, SD=1.29). A higher level of knowledge application is associated with a higher level of functional level diversity.

Hypotheses 1.2a–1.2c: Deep-level diversity and ACAP dimensions

The alternative hypotheses 1.2a – 1.2c states that deep-level diversity will have a negative relationship with the ACAP dimensions in virtual teams. These hypotheses were evaluated and tested using Pearson's correlation coefficients. The set of hypotheses between deep-level diversity and the ACAP dimensions were analyzed as represented in Figure 11. Table 26 depicts these correlations along with their statistical *p* value significance.

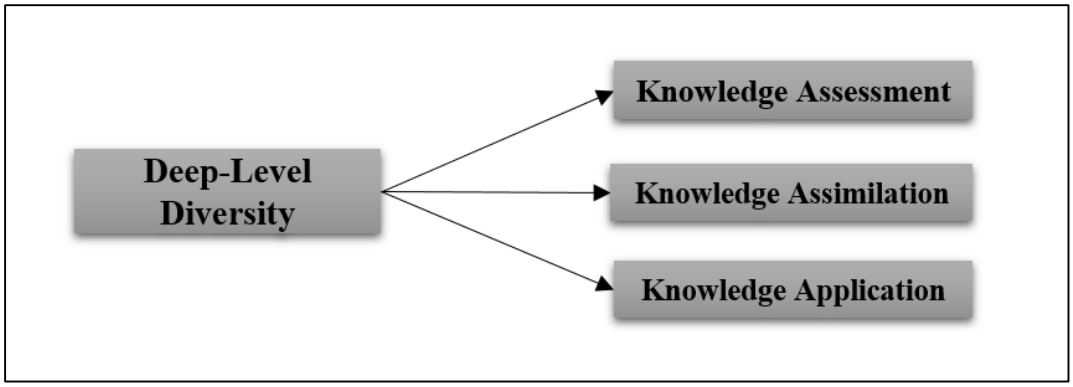


Figure 11 Deep-level diversity and ACAP correlations

Table 26 Deep-level diversity and ACAP Pearson correlation coefficients

		1	2	3	4
1.Deep-level Diversity	*r*	—	-0.42**	-0.41**	-0.20**
	Sig. (1-tailed)		0.00	0.00	0.00
2.Knowledge Assessment	*r*		—	0.56**	0.41**
	Sig. (1-tailed)			0.00	0.00
3.Knowledge Assimilation	*r*			—	0.59**
	Sig. (1-tailed)				0.00
4.Knowledge Application	*r*				—
	Sig. (1-tailed)				

Note. $N = 130$.
**Correlation is significant at the .01 level (1-tailed).

Hypothesis 1.2a: Deep-level diversity will be negatively associated with knowledge assessment

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = -0.42$, $p<0.01$) to support the alternative hypothesis that there is a moderate, negative association between deep-level diversity (M=2.72, SD = 1.16) and knowledge assessment (M=5.18, SD=1.14). A lower level of knowledge assessment is associated with a higher level of deep-level diversity.

Hypothesis 1.2b: Deep-level diversity will be negatively associated with knowledge assimilation

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = -0.41$, $p<0.01$) to support the alternative hypothesis that there is a moderate, negative association between deep-level diversity (M=2.72, SD = 1.16) and knowledge assimilation (M=5.25, SD=1.18). A lower level of knowledge assimilation is associated with a higher level of deep-level diversity.

Hypothesis 1.2c: Deep-level diversity will be negatively associated with knowledge application

Pearson product-moment correlation coefficient shows *there is sufficient evidence* ($r(130) = -0.20$, $p<0.01$) *to support the alternative hypothesis* that there is a weak, negative association between *deep-level diversity* (M=2.72, SD = 1.16) and *knowledge application* (M=4.78, SD=1.29). A lower level of knowledge assimilation is associated with a higher level of deep-level diversity.

Hypotheses 2.1-2.6: ACAP dimensions and team outcomes

Hypotheses 2.1 – 2.6 state that ACAP dimensions will have positive association with team outcomes such as team effectiveness and team innovation. These hypotheses were evaluated and tested using Pearson's correlation coefficients. Table 27 depicts these correlations along with their p values of significance.

Hypothesis 2.1: Knowledge assessment will be positively associated with team innovation

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.35$, $p<0.01$) to support the alternative hypothesis that there is a moderate

positive, association between knowledge assessment (M=5.18, SD = 1.14) and innovation (M=3.42, SD=0.99). A higher level of knowledge assessment is associated with a higher level of innovation.

Table 27 ACAP dimensions Pearson correlation coefficients

		1	2	3	4	5
1.Knowledge Assessment	*r*	—	0.56**	0.41**	0.35**	0.28**
	Sig. (1-tailed)		0.00	0.00	0.00	0.00
2.Knowledge Assimilation	*r*		—	0.59**	0.46**	0.45**
	Sig. (1-tailed)			0.00	0.00	0.00
3.Knowledge Application	*r*			—	0.51**	0.31**
	Sig. (1-tailed)				0.00	0.00
4.Innovation	*r*				—	0.46**
	Sig. (1-tailed)					0.00
5.Effectiveness	*r*					—
	Sig. (1-tailed)					

Note. $N = 130$.
**Correlation is significant at the .01 level (1-tailed).

Hypothesis 2.2: Knowledge assimilation will be positively associated with team innovation

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.46$, $p<0.01$) to support alternative hypothesis that there is a moderate, positive association between knowledge assimilation (M=5.25, SD = 1.18) and innovation (M=3.42, SD = 0.99). A higher level of knowledge assimilation is associated with a higher level of innovation.

Hypothesis 2.3: Knowledge Application Will Be Positively Associated With Team Innovation

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.31$, $p<0.01$) to support the alternative hypothesis that there is a moderate, positive association between team knowledge application (M=4.78, SD = 1.29) and team

innovation (M=3.42, SD= 0.99). A Higher level of knowledge application is associated with a higher level of innovation.

Hypothesis 2.4: Knowledge assessment will be positively associated with team effectiveness

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.28$, $p<0.01$) to support the alternative hypothesis that there is a moderate positive association between team knowledge assessment (M=5.18, SD = 1.14) and effectiveness (M=3.42, SD=0.99). A higher level of knowledge assessment is associated with a higher level of innovation.

Hypothesis 2.5: Knowledge assimilation will be positively associated with team effectiveness

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.45$, $p<0.01$) to support the alternative hypothesis that there is a moderate, positive association between team knowledge assimilation (M=5.25, SD = 1.18) and effectiveness (M=3.42, SD= 0.99). A higher level of knowledge assimilation is associated with a higher level of effectiveness.

Hypothesis 2.5: Knowledge application will be positively associated with team effectiveness

Pearson product-moment correlation coefficient shows there is sufficient evidence ($r(130) = 0.31$, $p<0.01$) to support the alternative hypothesis that there is a moderate *positive* association between *knowledge application* (M=4.78, SD = 1.29) and *effectiveness* (M=5.42, SD=1.03). A higher level of knowledge application is associated with a higher level of effectiveness.

Hypothesis 3: Confirmatory factor analysis–ACAP

The main goal of a CFA is to determine the capability of a predefined theoretical model to fit an observed set of empirical data (Brown, 2006). Cohen and Levinthal (1990) describe ACAP as three interrelated dimensions that consists of knowledge assessment, knowledge assimilation and knowledge application. The primary purpose of this CFA model is to explain and analyze the interrelated relationships simultaneously between the set of first order latent variables (knowledge assessment, knowledge assimilation, and knowledge application) and a second order latent variable (ACAP).

In structural equation modeling, the latent variables are theoretical constructs that can only be determined to exist as a combination of other measurable variables. Latent variables are variables that cannot be directly observed but can account for the covariance among a larger set of observed variables or manifest variables (Byrne, 1998). Furthermore, latent variables can be either exogenous (independent) or endogenous (dependent) variables. An endogenous variable is a factor in the causal model whose value is determined by the state of other variables in the model. On the other hand, an exogenous variable is a factor in the causal model whose value is independent of the state of other variables in the model. The endogenous variables are differentiated graphically from the exogenous variables by having directed arrows pointing towards them, while exogenous variables don't have any straight, single headed arrow pointing at them (Brown, 2006).

Figure 12 is a hypothesized second-order model for ACAP. In this model, there is one second order factor (ACAP) and three first-order factors (knowledge assimilation, knowledge assessment, and knowledge application). Each first-order factor is represented

by observed variables (questionnaire items) plus residual variables for each observed variable. There are also second-order path coefficients between the first-order latent variable to the second-order latent variable, and first-order path coefficients between observed variables and the first order latent variables.

Residuals for the endogenous variables are the measurement error that needs to be identified for endogenous variables (i.e. observed variable) in the model (Brown, 2006). Therefore, as shown in Figure 12, residual variables (e1 to e12) are assigned to the observed variables. Parameter estimates includes the second-order factor loadings (γ) (assimilation, assessment, application) and first-order factor loadings (ACAP_Asses1, ACAP_Asses 2, ACAP_Asses 3, ACAP_Assim 1, ACAP_Assim 2, ACAP_Assim 3, ACAP_Apply1, ACAP_Apply 2, ACAP_Apply 3).

Assessing the fit between model and data with goodness-of-fit indices

The overall fit of the CFA measurement model in this study was evaluated by examination for the following indices: chi-square $\chi 2$, $\chi 2/df$, CFI, NFI, RMSEA and SRMR. A summary of fit indices for the hypothesized model is provided in Table 28.

The proposed second-order model showed good fit $\chi 2/df=1.54$, *CFI= .972, IFI=.973, RMSEA=0.064 and SMSR=0.0468.* The values of CFI greater than .90 and a ratio of chi-square to the degrees of freedom less than 2 all indicate acceptable model fit (Kline, 2005). Figure 13 provides a visual representation of the ACAP model. Based on the result of the CFA, the theorized model of ACAP is considered a good representation of the data and hence supporting Hypothesis 4: ACAP is a three-dimensional construct consisting of knowledge assessment, knowledge assimilation and knowledge application.

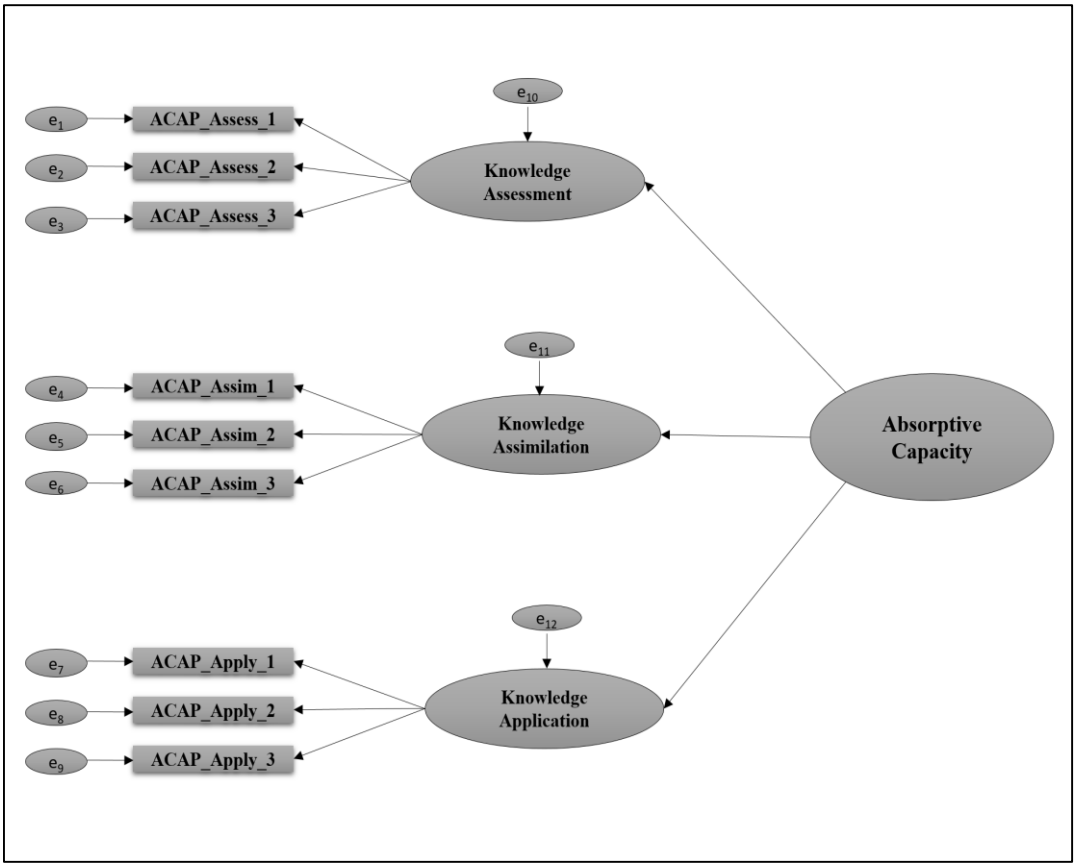


Figure 12 ACAP second-order model

Table 28 Summary of fit indices

CFA	$\chi 2$	*df*	$\chi 2/df$	CFI >0.90	NFI >0.90	IFI >0.90	RMSEA <0.08	SMSR <0.08
ACAP Model (3-Dimensional) [Assess], [Assim], [Apply]	36.98	24	1.54	0.97	0.93	0.97	0.06	0.05
ACAP Model (2-Dimensional) [Asses\Assim], Apply	75.59	26	2.9	0.89	0.85	0.90	0.12	0.07
ACAP Model (1-Dimensional) [Asses\Assim\Apply]	86.50	27	3.2	0.87	0.83	0.87	0.13	0.08

Note. $N = 130$.

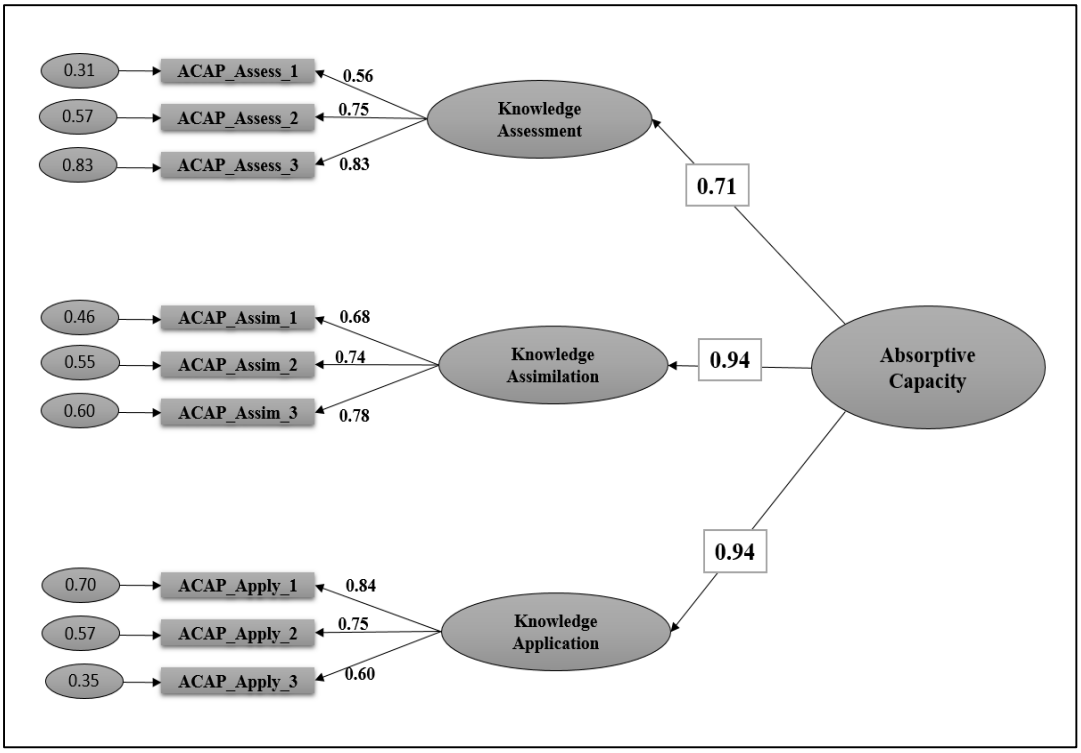


Figure 13 ACAP model and standardized loadings

Convergent validity

Convergent validity is the degree to which the items in a factor agree in their measurement of that factor. Convergent validity is specified by significant factor loadings of each of the measures on an appropriate scale (J. . Anderson & Gerbing, 1998). Hair et al. (2010) also recommended that all factor loadings should have a value greater than 0.50 to be statistically significant. As shown in Table 29, all factor loading for the observed variables were statistically significant at $p < 0.05$. This data provides supporting evidence for the convergent validity of all items, which effectively measure the same construct.

Table 29 Factor loadings for constructs and items

Construct	Item	Factor Loading
Knowledge Assessment	ACAP_Asses1	0.56*
	ACAP_Asses2	0.75*
	ACAP_Asses3	0.83*
Knowledge Assimilation	ACAP_Assim1	0.68*
	ACAP_Assim2	0.74*
	ACAP_Assim3	0.78*
Knowledge Application	ACAP_Apply1	0.84*
	ACAP_Apply2	0.75*
	ACAP_Apply3	0.60*

*$p < .05$. $N = 130$.

Discriminant validity

To test and evaluate the discriminant validity of the construct, Anderson & Gerbing (1988) suggested modifying the unconstrained free model with the correlations among the construct dimensions set to be 1.0, and in this case the model would be considered the constrained model. If the Chi-square difference between the two models is significant, the dimensions of the construct are significantly different and should not be merged into one dimension. In addition, we compared the hypothesized three-factor model with a two-factor model combining the ability to assess and assimilate into one factor, also another single dimensional model combining assess, assimilate and apply into one factor as described in Table 30. If construct shows good discriminant validity each successive model will show poorer fit. Table 30 shows that the three dimensional model (Cohen & Levinthal, 1990) fits best with the data and the fit declines significantly with reduced number of dimensions.

Table 30 Discriminant validity test

CFA	$\chi 2$	*df*	$\chi 2/df$	CFI >0.90	NFI >0.90	IFI >0.90	RMSEA <0.08	SMSR <0.08
ACAP Model (3-Dimensional) [Assess], [Assim], [Apply]	36.98	24	1.5	0.97	0.93	0.97	0.06	0.05
ACAP Model (3-Dimensional) Constrained Model	60.11	25	2.4	0.92	0.88	0.93	0.10	0.14
ACAP Model (2-Dimensional) [Asses\Assim], Apply	75.59	26	2.9	0.89	0.85	0.90	0.12	0.07
ACAP Model (1-Dimensional) [Asses\Assim\Apply]	86.50	27	3.2	0.87	0.83	0.87	0.13	0.08

Note. $N = 130$.

Hypotheses 4a and 4b: ACAP as a mediator variable

The alternative hypothesis 4a states that the influence of team diversity on team innovation is fully mediated by ACAP. An analysis of this hypothesis was rigorously undertaken to evaluate if ACAP will mediate the relationship between team functional-level diversity and team innovation. The mediator hypotheses were tested using the regression approach of Baron and Kenney (1986). Based on this method, there are four steps to be performed. Figure 14 shows the basic understanding of the mediator analysis method which needs to establish the following three conditions in order to determine whether a mediation relationship exists.

1. The independent variable (IV) predicts the dependent variable (DV).
2. The independent variable (IV) predicts the mediator variable (MV).
3. The mediator variable (MV) predicts the dependent variable (DV).

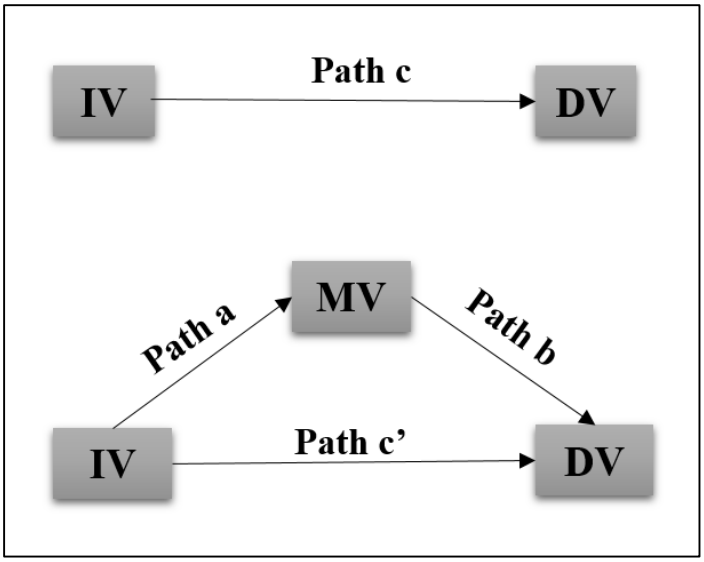


Figure 14 Mediator analysis

Hypothesis 4a: Mediation analysis with functional -level diversity as independent variable

Alternative hypothesis 4a involves detecting mediator effects between functional-level diversity and team innovation. It is tested using team innovation as the dependent variable by using the four-step mediated regression approach. The first step involved in testing for the mediation, is testing for the significance of path c. The second step was to show that the predictor was related to the mediator (path a). The third step was to show that the mediator was associated to the outcome variable, and it was assessed by controlling for the effects of the predictor on the outcome (path b). The fourth step in the mediation analysis is to show that the strength of the relationship between the IV and the DV is significantly reduced when the mediator is added into the regression model, that is by comparing path c and path c'. To test for full mediation, the relationship between the IV and DV will need to be statistically insignificant in the presence of the mediator variable in the regression model. If the variable was a full mediator, then the relation

between the predictor and the outcome would not be significant after the mediator was added to the model (analyzing path c with path c' as shown in Figure 14).

Table 31 presents the results from the mediated regression analysis for ACAP (H3). First, model 1 tested the significance of path c. It was significant with an F value of 1.69 ($p < 0.05$). This is an indication that step 1 has been established. Second, the significance of the predictor and mediator relationship was established in model 2 (path a) with an F value of 2.76 ($p < 0.05$), providing an indication that step 2 has been established. Model 3 tested for both path b and path c', which are used in the same hierarchical regression model. The F value for step 2 model was 4.904 at significant level $p < 0.01$ which established the significance of path b and path c'. The coefficient f of the ACAP (mediator) variable was positive 0.31 and significant at $p < 0.01$. A careful analysis of the various coefficients of the functional-level diversity variable clearly shows the explanatory power of the model by including the mediation variable. The coefficient of functional-level diversity in model 3 decreased from step 1 (0.02, $p < 0.05$) to step 2 (0.02, $p < 0.05$), indicating the positive effect of ACAP on team innovation. This result also suggests that partial mediation exists since functional-level diversity did not completely drop out of significance in step 2. Based on this result, the mediation hypothesis of ACAP between functional-level diversity and team innovation is supported in our model as partially mediated, but not fully mediated.

Table 31 Mediator analysis for ACAP

	Model 1 (Path c)	Model 2 (Path a)	Model 3 (Paths b and c)
	β	β	β
Step 1: Control Variables			
Team Size	-0.00	-0.01	-0.00
Team Tenure	-0.03	0.02	-0.04
Isolation Index	0.13	0.34	0.13
Imbalance Index	-0.10	0.60	-0.23
Functional-Level Diversity	NA	NA	0.24*
F(Model)	0.50	0.02	3.70*
R^2	0.02	0.04	0.14
Adjusted R^2	-0.02	-0.00	0.10
Step 2: Main Effects			
Functional-Level Diversity	0.24*	0.22*	0.17*
ACAP	NA	NA	0.31**
F(Model)	1.69*	2.76*	4.90**
R^2	0.88	0.14	0.22
Adjusted R^2	0.04	0.09	0.17
ΔR^2	0.07	0.09	0.08

Note. $N = 130$. Model 1: Regressing team innovation on functional diversity; Model 2: Regressing ACAP on functional diversity; Model 3: HMRA Regressing Team Innovation on functional-level diversity & ACAP.
*Correlation is significant at the .05 level. **Correlation is significant at the .05 level.

Hypothesis 4b: Mediation analysis with deep-level diversity as the independent variable

Alternative hypothesis 4b involves detecting mediator effects between deep-level diversity and team innovation. The mediator analysis is shown in Table 32. First, model 1 tested the significance of path c. It was significant with an F value of 1.63 ($p < 0.05$). This is an indication that step 1 has been established. Second, the significance of the predictor and mediator relationship was established in model 2 (path a) with an F value of 1.62 ($p < 0.05$) providing an indication that step 2 has been established. Model 3 tested for both path b and path c' simultaneously in the hierarchical regression model. The F value for step 2 was 5.01 at significant level $p < 0.01$ which established the significance

of path b and path c'. The coefficient f of the ACAP (mediator) variable was positive 0.406 and significant at $p < 0.01$. A careful analysis of the various coefficients of the functional-level diversity variable clearly shows the explanatory power of the model by including the mediation variable. The coefficient of deep-level diversity in model 3 decreased from being significant in step 1 (-0.25, $p < 0.05$) to non-significant in step 2 (-0.16, $p > 0.05$), indicating the positive effect of ACAP on team innovation and overcoming the negative impact of deep-level diversity. These results also suggest that full mediation exists since deep-level diversity did completely became non-significant in step 2. Based on this result, the mediation hypothesis of ACAP between deep-level diversity and team innovation is supported in our model as fully mediated.

Table 32 Mediator analysis for ACAP

	Model 1 (Path c)	Model 2 (Path a)	Model 3 (Paths b and c)
	β	β	β
Step 1: Control Variables			
Team Size	-0.00	-0.01	-0.00
Team Tenure	-0.03	0.02	-0.02
Isolation Index	0.13	0.34	-0.07
Imbalance Index	-0.10	0.60	-0.49
Deep-Level Diversity	NA	NA	-0.25*
F(Model)	0.50	0.96	1.63*
R^2	0.02	0.04	0.09
Adjusted R^2	-0.02	-0.00	0.03
Step 2: Main Effects			
Deep-Level Diversity	-0.25*	-0.22*	-0.16
ACAP	NA	NA	0.41**
F(Model)	1.63*	1.62*	5.01**
R^2	0.85	0.08	0.26
Adjusted R^2	0.03	0.03	0.21
ΔR^2	0.06	0.04	0.17

Note. Model 1: Regressing team innovation on deep-level diversity; Model 2: Regressing ACAP on deep-level diversity; Model 3: HMRA Regressing Team Innovation on deep-level diversity & ACAP. $N = 130$. *Correlation is significant at the .05 level. **Correlation is significant at the .01 level.

Assumption testing

Prior to the conduct of the statistical regressions analysis for the hypotheses tests, the data were screened and cleaned to evaluate the sample distribution. An exploration of the skewness and kurtosis values for all the variables were evaluated for normality as shown in Table 22, linearity and regression residuals were also evaluated as shown in Appendix C.

Cook's distance was also evaluated in SPSS. The maximum Cook's distance for the sample was less than 1 (0.43), which suggested there were no outlier cases that impacted the model. The Durbin-Watson test value was less than 2 (1.99), an indication that the residuals were uncorrelated (Field, 2013). The variance inflation factor (VIF) and collinearity statistical tolerance were used to assess multicollinearity of the predictor variables. VIF indicates the degree to which the standard errors are inflated due to the levels of collinearity, VIF values of 10 or greater are often cited as indicative of problematic collinearity (Field, 2013). The second test for mulitcollinearity is collinearity statistical tolerance, which is the percentage of variance in the independent variable that is not accounted for by the other independents variables, tolerances values of 0.20 or less are cited as problematic (Field, 2013). The results of these two test indicates that the variance inflation factor values for all predictors within the model are well below 10 and the tolerance values are well above 0.2, which are good indicators that there is no multicollinearity present in the models.

Discussion and implications

The present study was motivated by the scantiness of prior research on ACAP at the virtual team level. Accordingly, one contribution of this research is the empirical

validation of ACAP as a higher-order factor with three dimensions (knowledge assessment, knowledge assimilation, and knowledge application) within in a virtual team environment. Results from the confirmatory factor analyses suggest that the three-factor model of ACAP, as conceptualized, is appropriate for use in the context of virtual teams. Furthermore, reliability indicators, factor loadings, and convergent validity revealed that all the indicators are related to the underlying constructs they were designed to measure. Discriminant validity of the construct was tested by showing that the three distinctive dimensions exist in the ACAP model. The evidence of reliability and validity provides support for the ACAP model, as well as information about the usefulness of the ACAP construct in a virtual team environment. This work represents a step toward the validation of ACAP within a virtual team context. This empirical analysis allows for more fine-grained research on ACAP and the ability to analyze ACAP dimensions in concert with one another, supporting further research opportunities in the virtual team research field.

Following the empirical validation of the ACAP construct, the hypotheses were examined to determine the mediating influence of ACAP on the relationship between team diversity and team innovation. First, we examine the mediating role of ACAP on the relationship between deep-level diversity and team innovation outcomes. The findings suggest that ACAP fully mediates the relationship between deep-level diversity and virtual team innovation outcomes, suggesting that diversity related to values and attitudes within the team affect innovation via the team's capability to assess, assimilate, and apply knowledge (ACAP).

While the mediating role of ACAP is found with respect to the relationship between deep-level diversity and innovation outcomes, this study (unexpectedly) found

that deep-level diversity is negatively related to ACAP. This result is consistent with prior studies that found deep-level diversity resulting in fewer creative ideas (Harvey, 2013). Interpreted within the context of virtual teams, diversity in values and attitudes (associated with deep-level diversity) are likely to inhibit the virtual team's capability to assess, assimilate, and apply new knowledge. This finding is in line with studies of affective conflict, which suggest that teams with higher levels of affective conflict (characterized by personal incompatibilities) undermine inter-relational trust within the team and hinder decision-making and decision quality (Amason, 1996).

Similarly, the mediation effect of ACAP on the relationship between functional-level diversity and team innovation was also examined. The findings suggest that the positive relationship between functional-level diversity and innovation outcomes is partially mediated by ACAP. This is a notable finding of this research, given that a primary purpose for forming virtual teams is to pool core competencies from experts of various technical and functional backgrounds (Hertel et al., 2006), and ACAP has an integral role in the virtual team environment and in enabling higher levels of team innovation outcomes. Virtual team members use their complementary and collective knowledge to achieve higher levels of innovation by enhancing the team's capability to assess, assimilate, and apply new knowledge via ACAP. These results lend support to our argument that ACAP is integral to enabling the virtual team to successfully create value from functional-level diversity.

The findings of this research have valuable implications for how researchers and managers address the benefits of deep-level diversity and the challenges of functional-level diversity in virtual teams. The results of this investigation call for more detailed

attention to deep-level diversity in order to examine how to offset the potentially negative effects on the team's ACAP processes. Offsetting the negative effects may be done through team member training that encourages tolerance for diversity, developing and sharing a common language for encouraging dialogue, openness to diverse opinions, and resolution of conflicts immediately as they arise (Fiol, 1996; Saguy & Sirotinskaya, 2014). Conflict in virtual teams negatively impacts team member perception and the desire to remain with the team (Tekleab & Quigley, 2014b) and should therefore be addressed immediately. Virtual team managers can drive higher innovative performance through creating an infrastructure of mechanisms and processes to support knowledge assessment, knowledge assimilation, and knowledge application in their team design. A virtual team with well-developed ACAP can be a key activator of knowledge creation which is a critical enabler for innovation (Cohen & Levinthal, 1990; Fabrizio, 2009; Nemanich et al., 2010).

Virtual team leaders also have the responsibility to monitor the team's ACAP. Virtual teams tasked with technology development and innovation are expected to collaborate with each other rigorously. Therefore, our ACAP framework is designed to aid virtual team leaders in assessing and monitoring their teams' ACAP. By monitoring this capability, leaders may proactively take the action necessary to enhance ACAP among virtual team members for improved innovation performance. This model also demonstrates a practical and comprehensive way to measure the ACAP of the virtual team. A key aspect of this scale is that virtual team managers can use the ACAP model as a comparative measure of teams by measuring and managing virtual team ACAP, thereby gaining an important competitive advantage for their firms.

Limitations and future research

Although the findings of this investigation contribute to the advancement of virtual team research, the findings should be interpreted with respect to the study's limitations. First, the sample was drawn from a single organization, which limits the generalization of the findings. Future researchers are encouraged to examine ACAP in alternate virtual contexts to further validate the measurement and noted relationships with team phenomena.

Second, the non-probability sampling approach used in this study poses a potential limitation. Random sampling was not an option since this study involved a specific sample within one organization. The organization in which the study was conducted did not permit the collection of respondent age, gender, and similar demographic data. Thus, future researchers are encouraged to explore the demographic contexts in which ACAP is optimal and under what conditions ACAP is restricted.

Third, another limitation is potential common method variance (CMV). Podsakoff, MacKenzie, Lee, and Podsakoff (2003) indicate that survey-based research has the possibility of having a CMV bias in situations where a study relies on self-reported measures. In this study, CMV could arise given one respondent reporting for all observed measures. We attempted to minimize the bias by assuring the participants that the survey would be anonymous and encouraging honesty in responses. Researchers that have studied this methodological issue have concluded that even if CMV bias exists in the observed correlations, it is not necessarily sufficient to challenge the theoretical interoperation of the relationships (Doty & Glick, 1998). They further indicated that although CMV bias should be avoided to the extent that this is possible, it is not likely to

be large enough to invalidate the theoretical interpretations and research conclusions (Doty & Glick, 1998). The presence of CMV was evaluated in this study by using Harman's single-factor method (Podsakoff et al., 2003). Through the use of this method, no single factor emerged accounting for more than 50% of the overall variance suggesting that CMV did not impose a notable effect.

Fourth, to limit the influence of non-response bias, the sample was divided into two groups consisting of early and late respondents (Armstrong & Overton, 1977) at the date midpoint between the first and the last respondent. Differences in the groups (Group 1 = early respondents and Group 2 = late respondents) were analyzed for all the variables. Statistical significance was estimated, and no significant differences existed for all the variables suggesting no nonresponse bias.

Last, this study used the correlation method design, which requires caution when interpreting correlations and relationships. Casual inferences must be treated with caution when using these types of correlation studies. Although the results are consistent with prior research and with our hypothesized model, extending our casual inference should be taken with caution.

Furthermore, this study suggests a number of implications for future research, many of which were previously noted. Additionally, future researchers are encouraged to extend the current study to determine whether similar results and relationships are achieved at various industries that rely on virtual teams such as software companies. Testing this model in different work environments would address its generalizability. Another challenge for future research is to identify factors that facilitate deep-level diversity on team performance. Future research should attempt to disentangle the effects

of deep-level diversity on virtual teams. For example, how familiar do virtual team members need to be with one another in order to outweigh the negative effect of deep-level diversity.

Conclusion

The present study addresses issues important to globally distributed virtual teams. The purpose of this investigation is to understand the role of ACAP in virtual teams and to demonstrate how team diversity, ACAP, and team innovation outcomes are related. This study finds that virtual teams with deep-level diversity tend have a negative impact on the team's capability to leverage ACAP, while functional-level diversity is positively related to team-level ACAP. In both instances, however, ACAP is shown to be a means through which the virtual team leverages knowledge resources for the purposes of creating innovation outcomes. While the conventional wisdom in organizations assumes diversity is beneficial to teams because it brings various perspectives to the table to solve complex problems, this study demonstrates that the type of diversity within the team is important. In conclusion, this research was conducted with a quantitative approach to extend and validate virtual team ACAP. This study establishes empirical evidence of the construct validity and psychometric properties of ACAP at the virtual team level, providing a foundation upon which future studies can extend insights into the internal dynamics of virtual teams. Table 33 summarizes the hypotheses results of this chapter.

Table 33 Summary of hypotheses results

Alternative Hypothesis	Results
Hypothesis 1.1a Functional-level diversity will be positively associated with knowledge assessment.	Supported
Hypothesis 1.1b Functional-level diversity will be positively associated with knowledge assimilation.	Supported
Hypothesis 1.1c Functional-level diversity will be positively associated with knowledge application.	Supported
Hypothesis 1.2a Deep-level diversity will be negatively associated with knowledge assessment.	Supported
Hypothesis 1.2b Deep-level diversity will be negatively associated with knowledge assimilation.	Supported
Hypothesis 1.2c Deep-level diversity will be negatively associated with knowledge application.	Supported
Hypothesis 2.1. Knowledge assessment will be positively associated with team innovation.	Supported
Hypothesis 2.2. Knowledge assimilation will be positively associated with team innovation.	Supported
Hypothesis 2.3. Knowledge application will be positively associated with team innovation.	Supported
Hypothesis 3: ACAP is a three-dimensional construct consisting of knowledge assessment, knowledge assimilation and knowledge application.	Supported
Hypothesis 4a: The relationship between deep-level diversity and virtual team innovation outcomes is mediated by ACAP.	Supported
Hypothesis 4b: The relationship between functional-level diversity and virtual team innovation outcomes is mediated by ACAP.	Supported

CHAPTER IV

COLLABORATION CAPABILITY AND ABSORPTIVE CAPACITY IN DIVERSE VIRTUAL TEAMS

Introduction

Virtual teams play a critical role in many global firms in today's globalization. The performance of virtual teams enables firms to strengthen their competitive advantage by tapping into global talents in order to enable collaboration for innovation. Technology has advanced in ways that support collaboration among a team of experts who are remotely located in relation to one another. Effective collaboration is essential to a virtual team's innovation performance. Virtual teams, consisting of members collaborating from various geographical locations and who may be in different time zones and countries, are becoming more common in practice. Diverse virtual teams have created an unprecedented opportunity for businesses to achieve new levels of corporate effectiveness through enhanced innovative capability (Hosseini & Chileshe, 2013). This capability to innovate is critical to organizational success, and is increasingly vital to competing in the global marketplace (Gorodnichenko et al., 2010).

While virtual teams provide a wide range of benefits and are appealing to the industry, there are significant challenges to their use that need to be considered. These challenges exist due to an extremely complex system of diversity of languages, cultures, social cues, and a lack of effective collaboration among team members. A study

conducted by MIT Sloan Management Review found that only 18% of virtual teams have high success rates with respect to effectiveness and overall performance.

The present study answers this primary research question: How can a diverse virtual team be made more innovative and effective? The elements that contribute to the innovation outcomes of virtual teams need to be identified and understood. This study proposes and demonstrates that there are two important areas to consider when designing and evaluating virtual teams: Collaboration Capability (CCAP) and Absorptive Capacity (ACAP). The first area is the relational and collaboration capability aspect of virtual team members. Virtual team members are challenged to collaborate with members from diverse cultures, languages, and educational and technical backgrounds, while often working in different time zones. Collaboration is becoming more popular among global organizations in order to maximize economic benefits and performance, where mutual collaboration can be more productive than self-reliance. In order to deepen our understanding of collaboration in a virtual environment, it is necessary to investigate the interrelated factors that impact collaboration and affect the ability of virtual teams to innovate. Blomqvist & Levy (2006) identified three important dimensions that are crucial to successful collaboration and innovation in a network team: trust, communication, and commitment.

The second area of this study focuses on the theoretical concept of ACAP. Cohen and Levinthal (1994) defined ACAP as the "ability of the firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends." This study builds upon the concept in which ACAP will play a significant role in managing external knowledge and creating value and innovation in virtual teams. The innovation outcomes

of the virtual team would involve the application of new knowledge that has been gained from virtual team interaction. Therefore, the team's potential to create innovative results is enhanced by the accumulation of knowledge that they have absorbed and learned.

Until now, a full investigation of the combined effects of CCAP and ACAP in virtual teams has not been carried out. Therefore, this study aims to design a comprehensive framework that can be used as a guide to build and assess the innovation performance of virtual teams. This is done by adopting the two concepts of CCAP and ACAP in a virtual environment and exploring how CCAP and ACAP impact a virtual team's innovation performance.

Objectives of the study

The overall objective of the present study is to identify factors that promote knowledge creation and collaborative innovation in virtual teams. This is based on this primary research question: How can a diverse virtual team be made more innovative and effective? Virtual Team innovation is a dynamic and a complex process that needs constant, progressive, and masterful management. Thus, organizations need to develop and measure their innovation capacity to manage the innovation process. This study will aim to provide a more complete representation of the complex nature of virtual teams. Team diversity, media richness, ACAP, CCAP, and team innovation are the factors that are explored.

Significance of the study

The present study will make significant contributions to the literature by developing a comprehensive model that combines ACAP and CCAP in a virtual and

diverse team environment. To our knowledge, researchers have yet to consider how ACAP and CCAP can act as enablers to foster knowledge creation and collaborative innovation. We will address this gap in the literature by analyzing the combined effects of ACAP and CCAP on virtual team innovation. We will demonstrate that a team's innovation is achieved through integrating ACAP and CCAP. The outcome of this research aims to help global firms and virtual team managers make effective use of their teams toward more innovative outputs.

The second key contribution lies in demonstrating that the diverse attributes of virtual teams, such as combining team members from diverse locations, educational backgrounds, and skills, do not produce innovation by themselves; they do so by enabling the dimensions of ACAP and CCAP in virtual teams. ACAP and CCAP enhance innovation by finding and enabling unique associations between complementary ideas and knowledge held by the various members of the virtual team. The outcome of this study will produce a comprehensive analysis of virtual team performance that will produce best practices and recommendations as a guide for improving design and training of virtual teams.

Literature review

A requisite condition for the success of organizations is innovation. Innovation relates to the organizational capacity to participate and be involved in innovation; this involves the introduction of new products, services, and ideas (Huang, Lai, & Lin, 2011). This capability to innovate is the most important dynamic that impacts organizational success, and it is becoming increasingly vital to maintaining competitive edge in the global marketplace (Gorodnichenko, Svejnar, & Terrell, 2010). Innovation also has a

great influence on the overall economy since it enhances the growth of national productivity and competitiveness (Huang et al., 2011).

In today's globalization climate, innovation frequently involves diverse teams that are physically located across the globe. These teams must continually communicate and align with one another as they move forward on their assigned projects. An efficient and integrated collaborative process and structure is critical to the completion of interdependent tasks and the achievement of specific goals. Inappropriate and unsuccessful collaboration hinders the effectiveness of collaboration within diverse virtual teams, and ultimately hampers their innovation output.

Team diversity is defined as the degree to which there are differences between people within a team (Harrison et al., 2002). Researchers have defined diversity on three levels (Milliken & Martins 1996); the first is surface level diversity, which reflects difference such as age, sex, race that is easy to measure. The second, deep-level diversity, refers to the differences in personal characteristics such as values, beliefs and attitudes that are communicated through extended, personalized interaction and information gathering (Milliken & Martins 1996). The third level of diversity, functional diversity, is the degree to which team member differ in knowledge, skills, information, and expertise. A large body of research in the past few decades has provided a number of studies that examine the complex relationship between team diversity and team performance (Tekleab & Quigley 2014). The outcome of the previous research has reported both positive and negative effect relationships between team diversity and performance. Some researchers have indicated that team diversity can act as a double-edge sword, having positive effects in some contexts and negative effects in other (Milliken & Martins 1996).

Two major theoretical perspectives have emerged in the diversity literature to examine the positive and negative implications of diversity: the social categorization perspective and the information perspective. The social categorization perspective argues that team members tend to create social categories (in-group and out-group) based on similarities and differences among them (Turner et al. 1987). In-group members tend to communicate more frequently and trust each other more than the out-group members. These natural tendencies occur due to the fact that in-group members share the same worldviews and shared perceptions (Moynihan et al. 2006). Fostering these types of diversity and biases could cause variations and uncertainties in the relationships within the virtual team and eventually disturb CCAP and innovative performance of the team.

The second theoretical perspective is the information perspective that argues that teams with diversity outperform homogeneous teams because heterogeneous teams possess larger poor of informational resources (Milliken & Martins 1996). These diverse resources include wider ranges of relevant knowledge, skills and abilities that are distinct. These non-redundant resources provide an advantage to such teams enabling them to make higher quality decisions along with creative and innovative solutions (van Knippenberg et al. 2013). From this information perspective, researchers therefore claim that team diversity has a positive effect on team performance that is produced by the team's diversity through collaborations (Chae et al. 2014). A virtual team's architecture provides the benefit of pooling and enabling a wide range of functional and surface level diversity in the organization; at the same time, it brings with it a deep-level diversity, which can have a strong effect on CCAP.

Collaboration capability

Factors that support the success of CCAP in networked organizations are linked to high levels of trust, commitment, and open and transparent communication (Ulbrich et al., 2011). These factors are vital, because collaboration depends on the mutual adaptation of partners' behaviors in transferring knowledge (Bedwell et al., 2012). Blomqvist and Levy (2006) also identified the attributes of trust, communication, and commitment as critical prerequisites for CCAP.

Team trust

Team trust has been defined as the level of confidence that is exercised among team members (Pinjani & Palvia, 2013). Trust has been viewed by scholars as a fundamental lubricant for a social system, since it opens up communication (Putnam, 2000). Trust has also been described as the glue that holds the links of virtual teams together (Lipnack & Stamps, 2000). Intra-team trust is one of the critical factors that impact the performance of both face-to-face and virtual teams (Rusman et al., 2010). If there is a lack of trust, team members will not engage in effective collaboration activities. This could lead to serious problems, such as increased risk of miscommunication, poor decision-making, and inadequate flow of information (Rusman, van Bruggen, & Sloep, 2010). It is also been noted that teams with a high level of trust are more likely to have a steady and firm foundation of relationships, which results in a higher level of synergy and a reduction in cognitive conflict (Ensley, Pearson, & Amason, 2002).

Trust is a vital quality for the effective interaction of virtual teams. It involves every team member's willingness to be open, while allowing information to flow freely. Trust builds around the credibility and mutual goodwill of each team member; this

engenders a general predictability of everyone's behavior (Ulbrich et al., 2011). Mutual trust brings about a number of benefits in working relationships, such as open communication, better cooperation, and a high level of decision-making (McKnight et al., 1995).

Trust in virtual teams can be very fragile, and it takes time to build. Team members' past experiences give rise to trust or distrust (Rusman et al., 2010). Trust has been noted as the needed threshold condition for successful collaboration (Blomqvist & Levy 2006). Integrity and honesty is crucial in building trust, especially in a virtual team environment when there is no face-to-face interaction. The absence of face-to-face interaction makes trust even more vital in virtual teams (Rusman et al., 2010). Members depend on each other to complete tasks successfully and on time. Without trust, things will not get done as efficiently.

Greenberg et al. (2007) indicated that trust can be developed in two ways: one is called cognitive trust, which is based on team member integrity and ability; the second way is called affective trust, which is based on social interaction and emotional ties that have been developed over time. They also indicated that "a trustworthy person is honest, able, and caring" (Greenberg, Greenberg, & Antonucci, 2007). Trust, therefore, is a critical factor in achieving high-level CCAP, where high-level trust supports the ability of the group to dynamically adapt to change and position themselves strategically (Furumo & Pearson, 2006). Trust becomes the important pillar upon which virtual team members create high-level collaboration in order to optimize effectiveness.

Team communication

Team communication has been studied since the 1960s, and there is large body of literature characterizing the importance of internal communication; however, an exploration into virtual collaboration is more recent and still developing (Badir, Büchel, & Tucci, 2012; Piekkari & Tietze, 2011). This is because communication in virtual teams is affected by time zones, space, and cultural differences (Reed & Knight, 2010). Reed and Knight (2010) state that poor communication can negatively impact the sufficiency of knowledge transfer, posing risks for team performance.

Poor communication results in deterioration of the effectiveness of the team in building relationships and promoting efficient team coordination (Montoya, Massey, Hung, Caisy, & Crisp, 2009). Poor and infrequent communication has been shown to be costly in terms of wasted time and resources, and frequently results in confusion and uncertainties that weaken the cohesion among the team members (Reed & Knight, 2010). In order for the organization to reap the benefits of virtual team structures, organizational leadership must help to build online relationships and effectively manage the complexity of this online communication as team members navigate space, time, and cultural barriers, where direct interface and supervision is often minimal.

Quality communication is essential for innovation in virtual teams. Innovation is not seen as a solo creative endeavor taken on by one talented individual; rather, innovation is supported through the communication process among people (Offenbeek & Koopman, 1996). In order to meet the demand of innovation, media richness and intensity is crucial in facilitating the proper communication environment for innovation (Badir et al., 2012). Media richness theory (MRT) states that task performance and

communicative effectiveness can be affected by the different communication media characterized by the five hierarchies: face-to-face, video conference, phone calls, email exchange, paper, and reports (Daft & Lengel, 1984) . According to this theory, media richness is classified by its ability to provide rapid feedback and convey personal behavior, the richness of the information that can be transferred, and its ability to convey social cues such as body language cues, emotional signs, expression of opinion and natural language. MRT argues that the face-to-face medium is the richest form and the most effective medium for the instantaneous observations of various signs of body language, facial expressions, and tone of voice, which is effective in reducing ambiguity especially in knowledge-intensive projects (Daft & Lengel, 1984). Figure 15 shows the conceptual view of MRT and a media richness hierarchy with respect to media richness and communicative effectiveness. It has been suggested that, if a medium is chosen that is lower than the appropriate richness required by the task, a decrease in overall performance and task quality will result (Montoya et al., 2009).

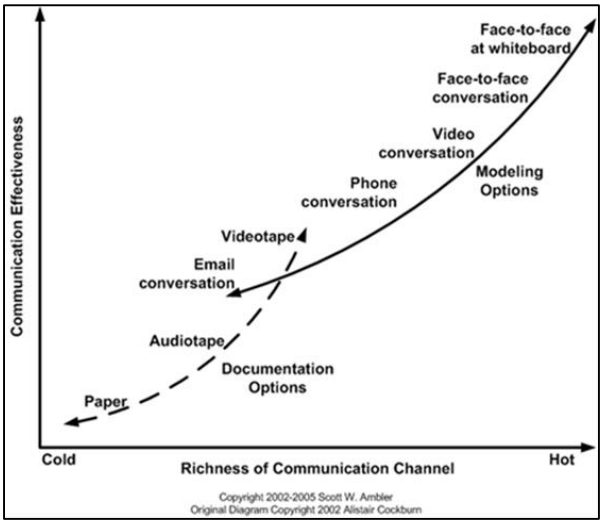


Figure 15 Types of communication

Intensity of communication is another attribute of the multi-dimensional aspect of communication (Badir et al., 2012). Intensity of communication is referred to as the frequency of interaction required to gather information, brainstorm, and analyze for sufficient knowledge transfer among team members (Badir et al., 2012). Gerwin and Ferris (2004) found a positive correlation between intensity of communication and trust, where the lower the trust, the lower the intensity of communication. High levels of communication intensity are essential among innovation-driven networks, because higher social interactions between members will more likely produce better, stronger ties within the team (Oke & Idiagbon-Oke, 2010). The proper threshold of the intensity level is therefore dependent on the complexity, the uncertainty, and the interdependency of the tasks (Badir et al., 2012). From the literature, we see that these two qualities of communication (degree of media richness and intensity level) can be crucial contributors to the success of collaboration and efficient performance in the environment of highly uncertain and complex tasks.

Team commitment

Meyer and Allen (1991) described three types of commitment: affective (desire to belong), normative (feeling obligation to stay), and continuance (awareness of cost of leaving). The type of commitment that is beneficial to teams is the affective commitment; this was indicated in a study that showed that affective commitment exhibited a strong positive correlation with team performance (Meyer & Herscovitch, 2002). Meyer and Herscovitch (2002, p.301) described commitment as "a force that binds an individual to a course of action of relevance to one or more targets." This psychological force has a large

effect on the behavior of the team members and their quality of collaboration (Chang, Chi, Chen, & Deng, 2012).

The degree of commitment among team members has a major impact on the established relationships of loyalty and dedication among team members (Chang, Chi, Chen, & Deng, 2012). It is also been noted that committed team members are essentially satisfied, and they develop constructive interactions with other team members (Mathieu & Zajac, 1990). The constructive interaction that stems from a high level of commitment can cultivate knowledge sharing among members of the team (Huang & Lin, 2011). When knowledge is shared and transferred to other team members, it then adds value and has a direct positive impact on the innovative capability of the firm (Sáenz et al., 2009).

Geographical proximity will influence how virtual team members' behavior impacts team goals, values, and norms (Bishop & Scott, 2000), especially if the team members feel isolated and left alone (Workman, Kahnweiler, & Bommer, 2003). One way to eliminate the sense of loneliness is to strengthen the social bonds of the team, which has been shown to have a positive impact on affective commitment (Cater & Zabkar, 2009). Further, it has been shown that members with strong affective commitment to the team are more apprehensive about the performance and the fate of the team; this, in turn, produces favorable collaborative behavior (Kang, Lee, Lee, & Choi, 2007). However, it is inherently more difficult to do this in virtual teams, where members have to rely entirely on technology and media to reinforce social bonds. To develop and sustain affective commitment, the organization must supply suitable media for the environment.

Absorptive Capacity

External sources of knowledge are critical to innovation output and in predicting future technological advances of a firm (Lee-Kelley & Sankey, 2008; Murovec & Prodan, 2009; Nemanich et al., 2010). In recent years, firms have begun moving away from relying exclusively on the generation of knowledge within the firm. Today, many are collaborating with partners that complement their knowledge resources, especially in the knowledge intensive sectors characterized by knowledge-intensive firms. In general, knowledge-intensive firms provide creative and innovative solutions to complex problems; examples of such firms include computer and electronics design and manufacturing companies, engineering firms, and research centers (Escribano, Fosfuri, & Tribó, 2009).

Many firms recognize the importance of external knowledge to innovation and no longer depend on internal knowledge generation alone. Cohen and Levinthal (1990) refer to the absorption and application of new external knowledge for commercial purposes as ACAP. In order to assess, assimilate, and apply new knowledge, firms should have an existing (internal) knowledge base on which to build the new, external knowledge. By having diverse internal knowledge resources within the firm, the organization possesses the internal prior knowledge necessary to recognize new, valuable external opportunities. Thus, the scope of prior related knowledge is a driver of the firm's ability to appropriately leverage ACAP capabilities (Zahra & George, 2002; Volberda et al., 2010).

ACAP is also conceptualized within the context of the team, and the present study extends such insights to the context of the virtual team. As virtual teams are increasingly used in a hypercompetitive business environment to collaborate with suppliers,

technology providers, or competitors to access external knowledge, the ability of the virtual team to utilize its diverse internal resources to potentially enhance the team's ACAP becomes a source of advantage. Therefore, this study investigates how two types of internal team diversity relate to the ACAP dimensions of knowledge assessment, knowledge assimilation, and knowledge application.

Knowledge assessment

In today's rapidly-advancing field of information technology, the flow of information has increased rapidly, and the pressure now is on teams to process immense amounts of information reasonably and logically. In this fluid environment, ACAP is revealed in the ability of the receivers to discover new knowledge and assess the value and importance of knowledge transmitted to them (Gebauer, Worch, & Truffer, 2012). In the context of team-level work, this capability is demonstrated by the ability "to easily comprehend new technological developments in their field well enough to accurately assess the potential usefulness of those developments for their own work and for the industry" (Nemanich et al., 2005, p. 21).

It is important to note that knowledge management literature has classified knowledge into two dimensions: explicit and tacit knowledge. Explicit knowledge is the type of knowledge that can be easily identified, communicated, retrieved, and codified (documents, reports, etc.), while tacit knowledge is the collection of knowledge that a person possesses from ideas, thinking patterns, beliefs, and schemata that are deeply embedded within the individual. Tacit knowledge was introduced by Polanyi (1966) with the assertion that "we can know more than we can tell" (p.4). Tacit knowledge has a crucial effect on the realization of innovation in companies (Fang, Fang, Chou, Yang, &

Tsai, 2011), and has long been regarded as a recipe for competitive advantage .(Spender, Edmondson, & Moingeon, 1996)

From a knowledge management perspective, the processes and practices that cultivate knowledge assessment capability are related to the cognition element of an individual's thinking patterns, knowledge structure, and their ability to recognize and judge new knowledge. It is also related to the background and professional experience of an individual, which defines the quality and quantity of one's tacit knowledge base. Nonaka (1994) posited that socialization plays a crucial part in building tacit knowledge; he referred to this as the spiral of knowledge creation model. In collaborative virtual team environments, the valuation capability of tacit knowledge is critical and strongly dependent on the individual's cognitive and experience level and how those levels are challenged by virtual interaction and the inherent complexities of codifying tacit knowledge (Jabar, I, & H, 2010).

Knowledge assimilation

The assimilation of new, external knowledge is the next fundamental step in ACAP. This is the means by which teams gain the benefits of collaboration and the extension of the innovation boundary through knowledge diffusion. Assimilation as a cognitive process has been characterized as an integral part of knowledge transfer and knowledge sharing (Nemanich et al., 2005). Szulanski (2000) defined knowledge transfer "as a process not a one-time act" and as a process "in which an organization recreates a complex, causally ambiguous set of routines in new settings and keeps it functioning" (p. 5). The difficulty is that knowledge transfer is highly dependent on the complexity of the knowledge and its tacitness; as the complexity level increases, stronger intimate relations

are required between the collaborating members in order to ease the knowledge transfer process and make it a success (Uygur, 2013).

The other integral part of assimilating knowledge is the level of knowledge sharing among the team. It is not enough for one team member to hold the new, external knowledge; it needs to be distributed in an efficient manner so that it can be easily shared and understood by other team members (Rosen, Furst, & Blackburn, 2007). Prior researchers have identified the importance of intranet-based infrastructure and the implementation of mechanisms for sharing and distributing knowledge and expertise among team members (Rosen et al., 2007). These mechanisms include electronic bulletin boards, discussion forums, instant messaging, and the creation of dedicated team web pages (Rosen et al., 2007). Recent research has also been striving to further understand the complicated roles that culture and social issues play in knowledge sharing among team members (Wang & Noe, 2010). Trust has been identified as a major factor that influences knowledge sharing and is a factor that can lessen the negative influence of supposed costs on knowledge sharing (Wang & Noe, 2010). As the processes of knowledge transfer and knowledge sharing are exercised efficiently, the assimilation level of the team increases as it integrates new valuable external knowledge with existing knowledge.

Knowledge application

Cohen and Levinthal (1989, 1990) did not give specific definitions for the ACAP dimensions. Later theorists, such as (Alavi & Tiwana, 2002), argued that knowledge application is the key to knowledge integration, which they define as "the synthesis of individuals' specialized knowledge into situation-specific systemic knowledge" (p. 1030).

Alavi and Tiwana also put emphasis on the point that knowledge integration is a key component of knowledge application, and that "the value of individual and organizational knowledge resides primarily in its application, an activity that we view as the crux of knowledge management" (p. 1031). The reason for that is that knowledge application enables an organization to sense, interpret, and respond to new opportunities and challenges (Alavi & Tiwana, 2002). Although a firm's infrastructure provides the "bones," it is the team's capacity level of knowledge integration that provides the "flesh and blood" (Van Den Bosch, Volberda, & De Boer, 1999).

The team's ability to integrate diverse arrays of knowledge depends on its social and cognitive processes, which shape the team's ability to combine diverse knowledge; the team has to overcome numerous compositional, team, and background barriers to successfully generate innovative knowledge (Salazar, Lant, Fiore, & Salas, 2012). Therefore, the process of integrating external know-how can be rather difficult to accomplish, and many organizations do not perform well at this process, even with the smartest and brightest experts (Hage, Jordan, Mote, & Whitestone, 2008). The process of knowledge integration is not static, but rather dynamic; it requires team members to engage in ongoing mutual readjustments and behavioral action (Gardner, Fong, & Huang, 2010). Successful knowledge integration requires the development of a dynamic and systematic approach that supports the consistent integration and coordination of member knowledge throughout the duration of team interaction (Gardner et al., 2010).

There are specific challenges to knowledge application and integration in virtual team environments because knowledge is distributed and socially shared (Alavi & Tiwana, 2002). Knowledge integration requires coordination that accommodates

differences in time, proximity, and configuration, across various units and communities. Unless these activities are managed well and facilitated by rich and iterative communication collaborations, the goal of achieving high performance will suffer, and knowledge utilization will be limited (Kotlarsky, Fenema, & Willcocks, 2008).

Virtual teams are becoming a desirable way to access and incorporate knowledge in collaborative networks, yet the literature review reveals that ACAP in virtual teams has received little research attention. In this study, we will deepen understanding of the innovative processes within virtual teams by analyzing the interrelationships between team diversity, ACAP, and team innovation.

Research framework and hypotheses

Mediating role of absorptive capacity

Virtual team innovation is a dynamic and complex process that needs constant, progressive, and masterful management. A careful review of the factors mentioned in the literature review led us to argue that virtual team innovation, as the predicted variable, will increase with the development of ACAP between the team members, which will be influenced by diversity. Although diverse teams are noted to respond better to various types of change (Bowers et al., 2000) and competitive threats (Hambrick, 1996), understanding of how diversity enables the teams to do so remains limited. Researchers report that the integration of team diversity is the common element in high performing teams (Nederveen, Pieterse et al., 2011). Leonard-Barton (1992) finds that the diversity of teams creates divergent thinking and is essential to prevent core capabilities from developing into core rigidities. Maznevski (1994) argues that diversity is a necessary but insufficient driver of team innovation outcomes, suggesting that team diversity leads to

higher performance only when team members create novel linkages between the disparate ideas, perspectives, and knowledge held by individual team members. We build on this perspective and suggest that diversity creates value for the virtual team through relationships with ACAP.

Without a refined ACAP in the virtual team, the team's ability to transform its diverse knowledge into innovative value is lacking. In order for the team to successfully examine the environment, it must possess the capacity to understand the environmental landscape and recognize the presence of new, potentially valuable knowledge. Possession of prior knowledge and experience enables the team to readily identify external knowledge worth acquiring (Zahra & George, 2002). We suggest, however, that having sufficient diversity within the team is not sufficient to deliver desired outcomes; rather, a means of leveraging the diverse knowledge and creating value is necessary to enable the team to perform. To this end, we suggest that ACAP is the mechanism that enables the team to create value from intra-team diversity and deliver innovation-related outcomes.

ACAP is a capability that must occur with efficiency in order to generate competitive innovation and is noted in prior studies for its value-creating role as a mediator driving outcomes (e.g., Kostopoulous, et. al., 2011; Liao, Wu, Hu, & Tsuei, 2009). In the context of virtual teams, the present study suggests that the diversity of functional knowledge and expertise among members broadens the scope of knowledge resources accessible to the team and enhances the capability of the team to assess, assimilate, and apply new knowledge in pursuit of innovation outcomes. Similarly, this study suggests that deep-level diversity among team members provides access to a

greater array of potentially complementary knowledge resources, enhancing the team's capability to assess the external environment, assimilate, and apply new knowledge.

Given the complex nature of the virtual team environment, the innovation success of the virtual team is characterized by the central, value-creating role of the team's ACAP. In the absence of a refined ACAP, diverse knowledge resources in the team are unlikely to provide valuable innovation returns in the context of a dynamic environment. However, the virtual team that appropriately leverages deep-level and functional-level diversity through the capability of ACAP is more likely to experience desired innovation outcomes, given the value-creating benefits of ACAP. When virtual teams with deep-level and functional-level diversity have a refined ACAP, this study suggests that members will have greater advantages in their innovation efforts, which will lead to creative solutions, thereby enhancing team innovation outcomes. Thus, this study also suggests that deep-level and functional-level diversity relate to innovation outcomes, and both relationships are mediated by ACAP as shown in Figure 16.

- Hypothesis 1: The relationship between deep-level diversity and virtual team innovation outcome is mediated by ACAP.
- Hypothesis 2: The relationship between functional-level diversity and virtual team innovation outcome is mediated by ACAP.

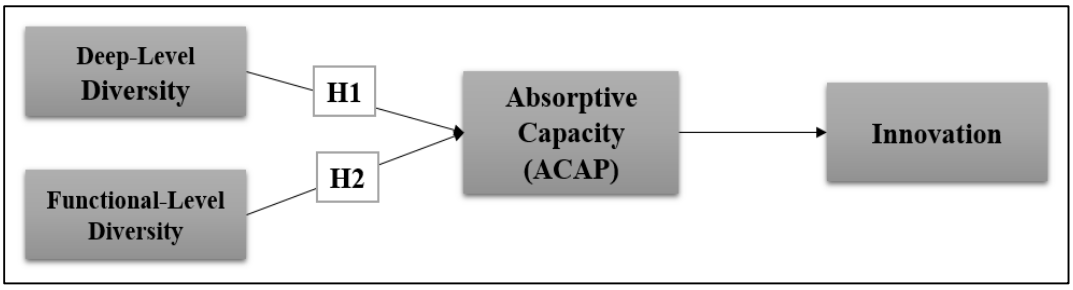


Figure 16 The mediating role of absorptive capacity on the relationship between virtual team diversity and innovation

Moderating role of collaboration capability

Researchers on team diversity have long argued that broadening the range of expertise of the team results in enhanced team innovation (Bantel & Susan, 1981). Accordingly, numerous studies find a relationship between diversity and innovation within a team (e.g., Gibson & Gibbs, 2006; Ostergaard, Timmermans, & Kristinsson, 2011). When deep-level diversity exists, members within a team have heterogeneous personalities, values, and attitudes (David Harrison, Price, & Bell, 1998; Jackson & Joshi, 2004). The diversity of values and similar deep-level factors are shown to positively influence performance in global innovation teams, suggesting that such diversity provides the team with diverse perspectives beneficial for problem-solving and knowledge creation (Paul, 2015; Winkler & Bouncken, 2011). Additionally, functional-level diversity in teams—demonstrated by varied skills and expertise among members—provides access to a broad array of knowledge, and such knowledge resources essential to ACAP-oriented tasks. Studies of teams and organizations generally confirm the significant relationship between functional-level diversity and innovation outcomes (Yap, Chai, & Lemaire, 2005).

Although diverse teams are better able to respond to various types of change (Bowers, Pharmer, & Salas, 2000) and competitive threats (Hambrick, 1996), virtual teams with deep and functional-level diversity may be unable to fully harvest the benefits of diverse knowledge resources if trust, communication, and commitment among members are lacking. Blomqvist and Levy (2006) note that CCAP is formed by trust, communication, and commitment; that is, depending on the level of such factors, the CCAP within the team may promote or discourage the exchange of knowledge, thereby

affecting innovation success. Without a proper exchange of ideas and a variety of perspectives on how to solve innovation-related issues, achieving innovation-related success is hindered. Thus, collaboration is an integral factor if diverse teams are to secure advancement during innovation processes (Nissen, Evald, & Clarke, 2014).

Given the complex nature of the virtual team environment, we posit that CCAP has a relevant impact on the ability of a team to establish ACAP within the virtual team environment, suggesting that the success of diverse virtual team ACAP is associated with CCAP as shown in Figure 17. When virtual teams are characterized by deep-level diversity, a variety of values, beliefs, and attitudes may undermine ACAP efforts if team members are not guided by trust, communication, and commitment. Thus, when virtual teams with deep-level diversity have a refined CCAP, we suggest that members work together more collaboratively, thereby enhancing the development of ACAP. Similarly, when virtual teams are composed of functional-level diversity, and a variety of knowledge, skills, and abilities exist among team members, we suggest that when collaboration among members is based on trust, communication, and commitment, ACAP development is significantly enhanced.

- Hypothesis 3: CCAP positively moderates the relationship between deep-level diversity and ACAP, such that ACAP is strongest when CCAP is high and weakest when CCAP is low.
- Hypothesis 4: CCAP positively moderates the relationship between functional-level diversity and ACAP, such that ACAP is strongest when CCAP is high and weakest when CCAP is low.

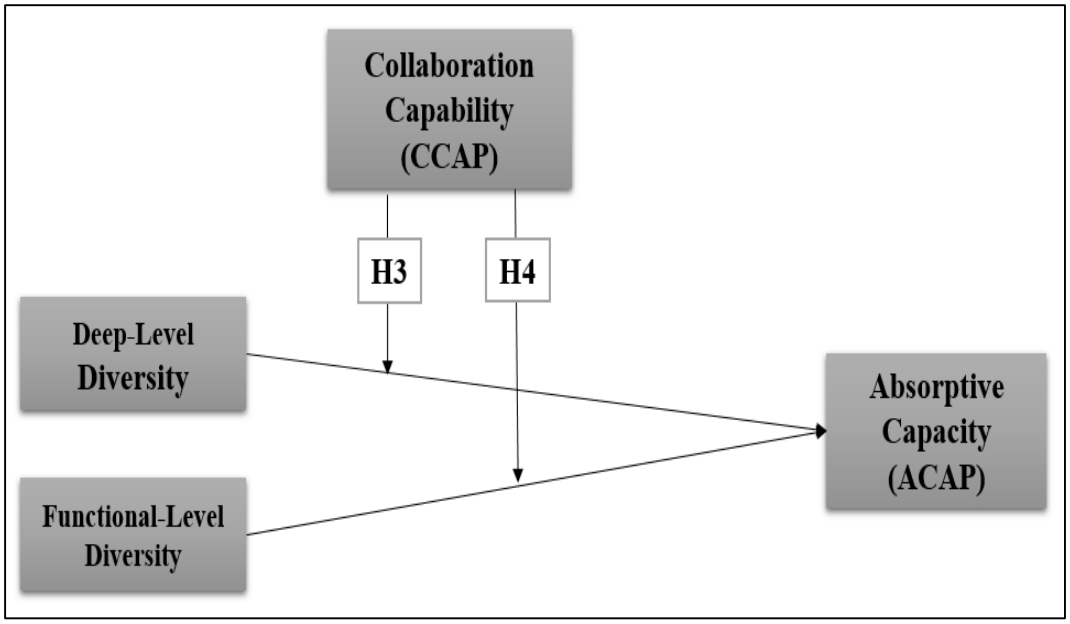


Figure 17 The mediating role of absorptive capacity on the relationship between virtual team diversity and innovation

The influence of media richness on ACAP

The use of communication media for knowledge sharing and collaboration is important in virtual teams. MRT proposes that team members participate in communication in order to reduce complexity around a given task. It is defined as a medium's capacity to process rich information (Daft & Lengel, 1984). According to MRT, richer media should result in enhanced performance on equivocal tasks. Previous studies have found that media richness impacts knowledge sharing and integration in distributed environments (Hong & Zhang, 2014; Peltokorpi, 2015; Klitmøller & Lauring, 2013). In addition, increased media richness helps members reduce the uncertainty and equivocality of information processing for knowledge management in organizations (Hong & Zhang, 2014). Furthermore, richer media encourages greater participation through a free exchange of knowledge without the need to wait (Pinjani et al., 2013).

Previous researchers also suggested that communication media and knowledge sharing in virtual teams is more challenging than collocated teams, and media richness can facilitate coordination and knowledge sharing between team members (Stahl et al., 2010). This leads to the following hypothesis as shown in Figure 18:

- Hypothesis 5: Media richness is positively associated with ACAP.

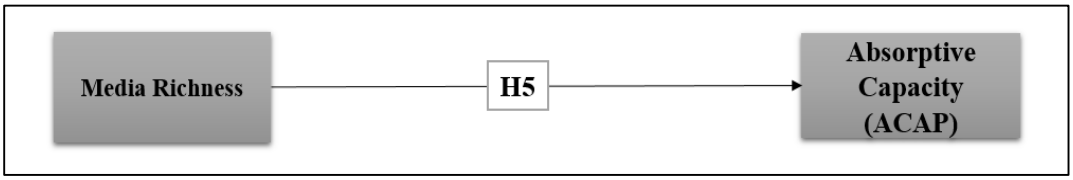


Figure 18 Media richness association with ACAP

Measures

Deep-level diversity

Following team diversity researchers (e.g., Pinjani & Palvia, 2013; Martins et al., 2003; Harrison et al., 2002), we used a 9-item scale adapted from (Luis L Martins et al., 2003), which measures the perceived differences with respect to non-visible underlying personal characteristics such as values, beliefs, and attitudes. A sample item is "Members of the team are similar in terms of their personal values."

Functional-level diversity

We used a three-item scale adapted from (Kirkman et al., 2004) that measures the degree to which team members differ in their functional background and expertise. A sample item is "Members of the team are similar in terms of their functional expertise."

CCAP

Blomqvist and Levy (2006) define CCAP as the ability to build and manage network relationships based on trust, communication, and commitment. Each dimension of CCAP was measured independently using existing validated scales from the literature. For team trust, we used a four-item measurement scale adapted from Pinjani and Palvia (2013). A sample item is "Team members can rely on fellow team members." For team commitment, we used a four-item scale adapted from (Han & Harms, 2010). A sample item is "Team members feel a strong sense of belonging to their team." For team communication, we used six-item scale adapted from (Worley et al., 1999). A sample item is "If we have a decision to make, everyone is involved in making it."

ACAP

We used multi-dimensional construct developed by (Cadiz et al., 2009) that measures ACAP at the team level. A sample item is" We know enough about the technology we use to determine what new information is credible and trustworthy."

Innovation

We used a three-item scale adapted from (Vera & Crossan, 2005) that measures innovation at the team level. A sample of this measure is "The team is highly innovative."

Control variables

In this study, we are interested in analyzing team diversity, CCAP, ACAP, and team innovation, but other factors could be argued to have an effect on the performance,

therefore this study will use team size, team tenure, and degree of dispersion as the control variables.

Team size

Previous research established that team size can have an impact on team performance (Harrison et al. 2002; Haleblian & Finkelstein 1993), where with an increase in team size, the psychological distance can increase (Pearce & Herbik 2004). It is important in our study to control team size because in larger virtual teams it may be harder to develop ACAP and this may influence team outcomes.

Team tenure

The length of the team existence is likely to influence team outcomes (Barsade et al. 2000). The longer the team members interact with each other they may develop higher level of collaboration.

Degree of dispersion

The degree of dispersion represents the extent to which a team is virtual (Staples & Webster, 2008). O'Leary and Cummings (2007) argued that team outcomes are differentially associated to the dimension of dispersion. O'Leary & Cummings (2007) suggested the below dispersion indices:

- *Isolation:* Percent of team members with no other team members at their site. Low values of this index indicate low levels of isolation.
- *Imbalance:* Equals the standard deviation ($n_1, n_2, \ldots n_k$)/N, where k is the total number of sites represented in the team, n_i is the number of team members from the i^{th} site, and N is the total number of team members across all sites.

Research methodology

A survey was conducted to test the hypothesized relationship and the CCAP and ACAP models. This approach was appropriate for this study given the objective was to empirically confirm the proposed hypotheses about virtual teams. In addition, this approach is in synthesis with prior work that examined virtual teams. The sample of this study was collected from a global engineering department of a high-tech firm in Silicon Valley, California, which consists of 375 design and software engineers (42 teams) in multiple locations across Asia, Europe and the United States. The respondents were asked to rate each statement of the composite survey based on their knowledge, experience, and understanding of each item using a seven-point Likert scale.

Ethical clearance and institutional permission from the participating company was obtained prior to conducting the research; however, the institution where this research was conducted did not permit the collection of specific demographic data citing the need to protect employee privacy. Employees in the global engineering department were asked to complete the questionnaire by a representative of the Human Resources department of the organization. The survey was voluntary and individual anonymity was guaranteed (citing the academic nature of the study). To enhance participation, participants were offered the opportunity to enter a raffle for a gift.

A total of 166 respondents completed the questionnaire, yielding a response rate of 42.27 percent. Of the 166 collected responses, 36 responses were incomplete and were removed from the final analysis. Therefore, a total of 130 responses were used for the analysis. Four of the 130 completed responses only had one piece of data missing, and these values were then coded into SPSS as missing data.

Although specific demographic information was not collected from the respondents due to Human Resource department restrictions, data on educational background of the respondents was permitted. Of the participants responding to the questionnaire, 27% had a doctoral degree, 37% had a Master's degree, 33% had a Bachelor's degree, and 3% had an Associate's degree.

Quantitative data analysis

The four major categories for quantitative research are descriptive, correlational, quasi-experimental and experimental study designs (Creswell, 2008). Based on the objectives of this research, a multivariate correlation design is appropriate for determining to what degree team diversity impacts ACAP and how ACAP influences team innovation. This was accomplished by calculating the correlation coefficient and determining the strength and direction among the variables of interest. Below is a brief introduction to the methods that were used in this analysis with further details provided in later sections.

First, a Pearson correlation-based approach was used to explore potential relationships between variables, the correlation coefficient was used to assess the magnitude and direction of the movement of one variable when the other is changed. It is important to note that these correlation measures cannot be interpreted as a cause and effect relationship but only indicate a degree of correlation and association of the variables with one another. "Any conclusions about a cause-and-effect relationship must be based on the judgment of the analyst" (Taylor, 1990).

This study will use multiple regression analysis because it involves theory testing and quantitative statistical analysis. Multiple regression analysis is a statistical technique

used to study multivariate relationships between explanatory variables. The advantage of using multiple regression analysis permits the researcher to simultaneously investigate the relationship and predict the outcomes between several variables (Cohen et al. 2003). Multiple regression analysis was utilized to accept or reject the hypotheses in relation to the relationships among the variables. Regression analysis will also test the casual chain in which virtual team diversity affects ACAP and in turn affects a team's outcome. Baron and Kenny (1986) proposed a four-step approach to test the hypothesized causal chain. This involved using multiple regression analysis with the significance of the coefficients being observed at every stage as explained in section 4.8.7.

Correlational hypothesis testing

As each of these hypotheses represent the relationship between two variables, the testing of these hypothesis will all follow the same outline. Prior to the statistical analysis, the Likert data was normalized by computing the median. Then a correlation coefficient on the normalized values of these two variables is computed to identify the direction and magnitude of the association. Next, a statistical test will then be performed to identify if the correlation is statistically significant. Specifically, for any two variables A and B, we will test two hypotheses versus one another:

- H_o: A and B are not significantly correlated, versus
- H_a: A and B are significantly correlated.

A p-value along with a conclusion of the test based upon the 5% significance level will then be used. A Pearson correlation coefficient will then be calculated between the two variables, and a one-tailed hypothesis test (as we are only testing for increase or

decrease) was performed. The classification of Pearson correlation values were assessed based on Cohen's classification (J. Cohen et al., 2003) of correlation Table 34.

Table 34 Cohen's correlation classification

r	Classification
±0.50	Considered Strong
±0.30	Considered Moderate
±0.10	Considered Weak

Data analysis

This section details the analysis of data collected through the online field survey. The survey constructs were assessed to insure they are reliable and measure their respective constructs in order to be used to test the research hypotheses. Based on the research model each construct was consisted of multiple measurement items. The questionnaire scales psychometric properties are assessed at two levels: item level and construct level.

Data preparation

After the survey was conducted, the following steps were taken to prepare the data for hypotheses testing. First, all the data was exported from the Survey Monkey site into IBM SPSS statistical software V22. SPSS is an incorporated collection of quantitative analysis software that can perform statistical analysis tasks such as generation of descriptive statistics, bivariate analysis, multiple dimensional scaling and reduction, regression analysis, factor analysis and many more capabilities.

After the survey was administered and collected, several steps were taken to prepare the data for hypothesis testing. First, all data was initially gathered into a master

SPSS worksheet. Initial review of the data showed a total of 166 responses were collected. Of the 166 collected responses, there were 22 responses that didn't fully participate in the survey because they only completed the consent section, also an additional 14 responses showed inconsistencies in their responses and were removed from the final analysis. Therefore, a total of 130 usable responses were used for the analysis, which is above our initial goal of 120 responses. Four out of the 130 responses had one piece of data missing. These missing values were then coded into SPSS as missing data. The completed set of data were coded using their original scales, for example, the data employing a seven-point Likert scale were coded using the following scale: (1) strongly disagree, (2) disagree, (3) somewhat disagree, (4) neither disagree nor agree, (5) somewhat agree, (6) agree, and (7) strongly agree.

Media usage

This section provides the results on the usage of virtual media by the virtual teams with the frequency responses for the various communication media as shown in Table 35. A high percent of the responses 60.9% shows no face-to-face interaction or interactions that occur less than once a month. This is a true characteristic of virtual teams that rely on virtual technologies. This is consistent with recent research that the virtual team members have less face-to-face interaction requiring that they rely on the use of different techniques for communication and forming relationships (Haines, 2014). A high percent 91.9% of respondents use emails in their team communication on a weekly or daily basis. Emails are the most popular means of communication due to the ease of usage and the control of communication between the sender and the recipient (W. D. Harvey et al., 2004). Instant Messaging is a popular application for communication with team

members due to its ease of use and the instant communication response between the sender and the receiver. A total of 68.3% of responses used instant messaging on a weekly or daily basis. Telephone calls are also popular means of communication in virtual teams, a total of 74.4% of responses indicate telephone calls are used on weekly or daily bases. Only total of 14.5% of responses uses video conference communication on a weekly or daily basis. This could be due to the lack of meeting rooms enabled for video conferences or people in general might not feel comfortable being seen on cameras and therefore they avoid video conferences.

Table 35 Frequency of media usage

	Media Usage (%)					
Occurrence	F2F	Email	IM	TeleCalls	TeleConf	VideoConf
Never	36.7	5.6	23.8	11.2	17.8	58.9
Less than once a month	24.2	1.6	4.0	5.6	4.7	18.5
Once a month	4.7	0.8	4.0	8.8	4.7	8.1
Once a week	6.3	2.4	5.6	30.4	34.9	10.5
A few times a week	14.8	29.0	32.5	32.8	27.9	0.8
Daily	13.3	60.5	30.2	11.2	10.1	3.2

Note. $N = 130$.

Descriptive statistics at the item level

The descriptive statistics of all the survey items are reported in Table 36 and include values for minimum, maximum, mean, standard deviation, skewness and kurtosis. The range for skew should be within ± 2 for the data to be approximately normally distributed (Lewis-Beck et al., 2007). The results in Table 22 indicates that all the kurtosis and skewness statistics for all the items are well within the acceptable range ±2, indicating that the items are approximately normally distributed for all the questionnaires.

Table 36 Descriptive statistics at item level

	Item	Min	Max	*M*	*SD*	Skewness	Kurtosis
Functional Diversity	DiversityFunc1	1.0	7.0	3.60	1.65	0.08	-1.28
	DiversityFunc2	1.0	7.0	4.46	1.63	-0.54	-0.78
	DiversityFunc3	1.0	7.0	4.22	1.62	-0.24	-1.15
Deep-Level Diversity	DiversityDeep1	1.0	7.0	3.35	1.58	0.28	-0.98
	DiversityDeep2	1.0	7.0	4.04	1.51	-0.29	-0.81
	DiversityDeep3	1.0	7.0	4.65	1.66	-0.72	-0.43
	DiversityDeep4	1.0	7.0	5.11	1.43	-1.12	0.94
	DiversityDeep5	1.0	7.0	5.43	1.21	-1.06	1.30
	DiversityDeep6	2.0	7.0	5.77	1.13	-1.11	1.11
	DiversityDeep7	1.0	7.0	5.44	1.36	-1.27	1.54
	DiversityDeep8	1.0	7.0	5.37	1.37	-1.02	0.82
	DiversityDeep9	2.0	7.0	5.72	1.02	-0.84	0.68
Communication	CCAP_Comm1	1.0	7.0	4.69	1.61	-0.49	-0.73
	CCAP_Comm2	1.0	7.0	4.35	1.46	-0.19	-0.69
	CCAP_Comm3	1.0	7.0	4.27	1.52	-0.33	-0.53
	CCAP_Comm4	1.0	7.0	5.10	1.41	-1.08	1.01
	CCAP_Comm5	1.0	7.0	4.83	1.50	-0.79	0.24
	CCAP_Comm6	1.0	7.0	5.33	1.32	-0.96	0.78
Trust	CCAP_Trust1	1.0	7.0	5.20	1.31	-0.80	0.30
	CCAP_Trust2	2.0	7.0	5.75	1.04	-1.06	1.15
	CCAP_Trust3	1.0	7.0	5.58	1.13	-1.21	1.83
	CCAP_Trust4	2.0	7.0	5.64	1.08	-0.81	0.53
Commitment	CCAP_Commit1	1.0	7.0	4.52	1.26	-0.20	-0.07
	CCAP_Commit2	2.0	7.0	4.76	1.25	-0.25	-0.44
	CCAP_Commit3	2.0	7.0	4.71	1.21	-0.31	-0.07
	CCAP_Commit4	1.0	7.0	4.61	1.34	-0.46	-0.13
Innovation	Team Innovation1	1.0	5.0	3.54	0.94	-0.72	0.44
	Team Innovation2	1.0	5.0	3.41	1.08	-0.36	-0.55
	Team Innovation3	1.0	5.0	3.41	1.04	-0.31	-0.48

Descriptive statistics at the construct level

Construct level data was computed by taking the median on all the items belonging to that construct. Table 37 shows the descriptive statistics for the various constructs used in this study. Given that the range of skewness and kurtosis are within +/- 2, this establishes the normality specification for the construct level.

Table 37 Descriptive statistics at construct level

Construct	Min	Max	*Mdn*	*SD*	Skewness	Kurtosis
Functional Diversity	1.0	7.0	3.0	1.58	0.37	-1.05
Deep-Level Diversity	1.0	7.0	2.0	1.17	1.24	1.94
Trust	2.0	7.0	6.0	1.02	-0.87	0.79
Commitment	2.0	7.0	5.0	1.17	-0.17	-0.10
Communication	1.0	7.0	5.0	1.37	-0.73	0.17
Innovation	1.0	5.0	4.0	0.99	-0.36	-0.35

Note. $N = 130$.

Validity of the scales

The notion of validity was articulated by Kelly (1927) who stated that a scale is valid if it measures what it claims to measure. Cronbach's α is commonly used to establish internal consistency construct validity (Nunnally & Bernstein 1994). Cronbach's α is widely understood to indirectly indicate the extent to which a set of items measures a single one-dimensional latent construct, which can be thought of as the percent of variability in an experimental variable that is accounted for by true scores on the underlying latent construct.

Other important statistics are the Cronbach's Alpha If Item Deleted and the Corrected Item-Total Correlation. Cronbach's Alpha If Item Deleted is important because it estimates Cronbach's alpha if a given item was deleted. On the other hand, if any item deleted would increase the overall Cronbach's Alpha, then this item would be flagged for further consideration if it should be removed from the analysis. The Corrected Item-Total Correlation is performed to test if any item in the questionnaire scale is inconsistent with the averaged behavior of others. If so, then the item will be eliminated. If the correlation is low, it means that the item is not measuring the same construct as the rest of the items are trying to measure. This step is performed prior to determining the factors that

represent the underlying latent construct. It is widely accepted and recommended in the literature that an item be removed or further analyzed if the item-to-corrected total correlation is 0.3 or below (De Vaus 2008). After analyzing the results from Table 38, it is evident that all the items and their respective construct meet the specifications of Scale Cronbach's α, Cronbach's α if Item Deleted and Corrected Item-Total Correlation.

Table 38 Reliabilities data item and construct level

Scale	Item	Corrected Item-Total Correlation	α If Item Deleted	Scale α
Functional Diversity	DiversityFunc1	0.56	0.76	0.78
	DiversityFunc2	0.60	0.72	
	DiversityFunc3	0.69	0.62	
Deep-Level Diversity	DiversityDeep1	0.42	0.82	0.83
	DiversityDeep2	0.55	0.80	
	DiversityDeep3	0.63	0.79	
	DiversityDeep4	0.66	0.79	
	DiversityDeep5	0.53	0.81	
	DiversityDeep6	0.43	0.82	
	DiversityDeep7	0.62	0.80	
	DiversityDeep8	0.42	0.82	
	DiversityDeep9	0.51	0.81	
Communication	CCAP_Comm1	0.73	0.91	0.88
	CCAP_Comm2	0.85	0.87	
	CCAP_Comm3	0.80	0.89	
	CCAP_Comm4	0.82	0.88	
	CCAP_Comm5	0.73	0.91	
	CCAP_Comm6	0.85	0.87	
Commitment	CCAP_Commit1	0.73	0.91	0.91
	CCAP_Commit2	0.85	0.87	
	CCAP_Commit3	0.80	0.89	
	CCAP_Commit4	0.82	0.88	
Trust	CCAP_Trust1	0.71	0.83	0.86
	CCAP_Trust2	0.69	0.83	
	CCAP_Trust3	0.68	0.84	
	CCAP_Trust4	0.78	0.80	
Innovation	Team_Innovation1	0.78	0.85	0.89
	Team_Innovation2	0.79	0.85	
	Team_Innovation3	0.80	0.83	

Note. $N = 130$.

Hypotheses testing

The mediation influence of ACAP

Mean, standard deviations, and correlations for the variables are provided in Table 39. A hierarchical regression model (HRM) approach, as described by (Baron & Kenny, 1986), is used to examine the mediating influence of ACAP. The mediation hypotheses are tested individually by using a sequence of regressions for each intermediate analysis as well as for the final dependent analysis. Mean, standard deviations, and correlations for the variable are provided in Table 39.

Table 39 Descriptive Statistics and Correlation (N = 130)

		M	*SD*	1	2	3	4
1. Functional-Level Diversity	*r*	3.82	1.59	—	-0.16	0.25**	0.23**
2. Deep-level Diversity	*r* (1-tailed)	2.72	1.16		—	-0.39**	-0.31**
3. ACAP	*r* (1-tailed)	5.18	1.13			—	0.47**
4. Innovation	*r* (1-tailed)	3.42	0.99				—

**Correlation is significant at the .01 level (1-tailed).

The results of the HRM and mediation analysis for Hypothesis 1 are presented in Table 40 and reveal that the control variables in Model 1 are not statistically significant ($F = 0.50$, $p > 0.05$). The first step to assess mediation is to examine the main effect relationship between deep-level diversity and innovation outcomes. The coefficient for this relationship was found to be negative and significant (-0.25; $p < 0.05$). Next, the relationship between deep-level diversity and ACAP was examined and also found to be negative and significant (-0.22; $p < 0.05$). Finally, the relationship between ACAP and innovation outcomes was examined simultaneously with the inclusion of deep-level diversity to determine the mediation effect of ACAP. When ACAP was included as a mediator in the main effect relationship, the coefficient of deep-level diversity decreased

from being significant in Model 1 (-0.25, $p < 0.05$) to non-significant in Model 3 (-0.16, $p > 0.05$). This finding suggests that ACAP fully mediates the relationship between deep-level diversity and innovation outcomes, which supports Hypothesis 1. However, this finding also suggests a negative relationship between deep-level diversity and ACAP, an unexpected finding.

Table 40 Mediation analysis for hypothesis 1

	Model 1 (Innovation Outcomes)	Model 2 (ACAP)	Model 3 (Innovation Outcomes)
	Step 1: Control Variables		
Team Size	0.00	-0.01	0.00
Team Tenure	-0.03	0.02	-0.02
Isolation Index	0.13	0.34	-0.07
Imbalance Index	-0.10	0.60	-0.49
Deep-Level Diversity			-0.25*
F(Model)	0.50	0.96	1.63*
R^2	0.02	0.04	0.09
Adjusted R^2	-0.02	0.00	0.03
	Step 2: Main Effects		
Deep-Level Diversity	-0.25*	-0.22*	-0.16
ACAP			0.41**
F(Model)	1.63*	1.62*	5.01**
R^2	0.85	0.08	0.26
Adjusted R^2	0.03	0.03	0.21
ΔR^2	0.06	0.04	0.17

Note. $N = 130$.
*Correlation is significant at the .05 level. **Correlation is significant at the .01 level.

The results of the hierarchical regression model and mediation analysis for Hypothesis 2 are presented in Table 41. These results reveal that the control variables in Model 1 are not statistically significant ($F = 0.50$, $p > 0.05$). The first step to assess mediation is to examine the main effect relationship between functional-level diversity and innovation outcomes. The coefficient for this relationship was found to be positive

and significant (0.18; $p < 0.05$), as was the relationship between functional-level diversity and ACAP (0.22; $p < 0.05$). Finally, the relationship between ACAP and innovation outcomes was examined simultaneously with the inclusion of functional-level diversity to determine the mediation effect of ACAP. When ACAP was included as a mediator in the main effect relationship, the coefficient of functional-level diversity decreased from (0.24; $p < 0.05$) in Model 1 to (0.17; $p < 0.05$) in Model 3 while remaining significant. This finding suggests that partial mediation exists, given the strength of functional-level significance reduced in Model 3 compared to functional-level significance in Model 1. Based on this result, the mediation hypothesis of ACAP between functional-level diversity and team innovation is supported as partially mediated.

Table 41 Mediation analysis for hypothesis 2

	Model 1 (Innovation Outcomes)	Model 2 (ACAP)	Model 3 (Innovation Outcomes)
Step 1: Control Variables			
Team Size	0.00	-0.01	0.00
Team Tenure	-0.03	0.02	-0.04
Isolation Index	0.13	0.34	0.13
Imbalance Index	-0.10	0.60	-0.23
Functional-Level Diversity			0.24*
F(Model)	0.50	0.02	3.70*
R^2	0.02	0.04	0.14
Adjusted R^2	-0.02	-0.00	0.10
Step 2: Main Effects			
Functional-Level Diversity	0.24*	0.22*	0.17*
ACAP			0.31**
F(Model)	1.69*	2.76*	4.90**
R^2	0.88	0.14	0.22
Adjusted R^2	0.04	0.09	0.17
ΔR^2	0.07	0.094	0.075

The moderation influence of CCAP

Mean, standard deviations, and correlations for the variables are provided in Table 42. The results of the hierarchical regression model are presented in Table 43. In step 1, control variables were entered into the regression equation. In step 2, the main effects for deep-level diversity and CCAP were entered into the second stage of the regression model, and in the third step, the interaction effect for CCAP and deep-level diversity was entered into the regression equation.

Results of the HRM revealed that the control variables in Model 1 of Table 43 are not statistically significant ($F = 0.96$, $P > 0.05$) and they only explain 4% of the total variance. In Model 2 in the HRM, the two main effect variables (deep-level diversity, CCAP) were examined and they are significant ($P < 0.05$), explaining 14% of the variance in ACAP. In Model 3, the interaction term (Deep-level diversity X CCAP) was examined, however, the results of the interaction term ($\beta = -0.01$, $P > 0.05$) did not show significance. Based on this data, moderation cannot be supported because the interaction term of the moderation analysis was not significant. Therefore, alternative Hypothesis 3 is not supported.

Table 42 Descriptive statistics and correlation

		M	*SD*	1	2	3	4
1. Functional-Level Diversity	*r*	3.82	1.59	—	-0.16	0.49**	0.25**
2. Deep-Level Diversity	*r* (1-tailed)	2.72	1.16		—	-0.39**	-0.31**
3. CCAP	*r* (1-tailed)	5.02	1.07			—	0.38**
4. ACAP	*r* (1-tailed)	5.18	1.13				—

Note. $N = 130$.
**Correlation is significant at the .01 level (1-tailed).

Table 43 Moderation analysis: Deep-level diversity, CCAP, ACAP

DV: ACAP	β	*F*(Model)	*R*	R^2	ΔR^2
		Model 1: Control Variables			
Imbalance Index	0.60	0.96	0.20	0.04	0.04
Team Tenure	0.02				
Isolation Index	0.34				
Team Size	-0.01				
		Model 2: Main Effects			
Deep-Level Diversity	-0.17	2.44**	0.38	0.14	0.10
CCAP	0.06				
		Model 3: Interactions			
Deep-Level Diversity X CCAP	-0.01	2.41	0.41	0.16	0.02

Note. Unstandardized β reported, $N = 130$.
**$p < .05$.

The results of the hierarchical regression model for H4 are presented in Table 44. In step 1, control variables were entered into the regression equation. In step 2, the main effects for functional-level diversity and CCAP were entered in to the second stage of the regression model, and in the third step, the interaction effect for CCAP and functional-level diversity was entered into the regression equation. Results of the HRM revealed that the control variables in Model 1 of Table 44 are not statistically significant (F = 0.96, P> 0.05) explaining only 4% of the total variance. In Model 2, the two main effect variables (functional diversity, CCAP) were examined and found to be positive and significant (P < 0.05) explaining 21% of the variance in ACAP. In Model 3, the interaction term (functional-level diversity X CCAP) was examined finding it to be positive and significant (β = 0.05, P < 0.01). These results indicate support for alternative hypothesis 4.

Table 44 Moderation analysis: Functional diversity, CCAP, ACAP

DV: ACAP	β	*F*(Model)	*R*	R^2	ΔR^2
		Model 1: Control Variables			
Imbalance Index	0.60	0.96	0.204	0.04	0.04
Team Tenure	0.02				
Isolation Index	0.34				
Team Size	-0.01				
		Model 2: Main Effects			
Functional-Level Diversity	0.09	4.25**	0.48	0.21	0.17
CCAP	0.16				
		Model 3: Interactions			
Functional-Level Diversity X CCAP	0.05	3.63**	0.48	0.23	0.02

Note. Unstandardized β reported, $N = 130$.
**$p < .05$.

To test Hypotheses 5, that media richness is positively associated with ACAP, the Pearson product-moment correlation coefficient was used. Results show there is sufficient evidence ($r(130) = 0.231$, $p<0.01$) to support the alternative hypothesis that there is a positive, association between media richness (M=65.03, SD = 19.68) and ACAP (M=5.02, SD=1.07). A higher level of media richness is associated with a higher level of ACAP.

Discussion

Theoretical implications

The use of virtual teams is rapidly increasing in industry, and therefore the understanding of how to organize and manage those teams is becoming more of a priority. In the present study, we have analyzed the role of ACAP and CCAP in the relationship between team diversity and team innovation outcomes in a virtual environment. We theoretically developed the idea that a virtual team's innovation is influenced by the extent to which its members develop their ACAP and CCAP to jointly

achieve innovative solutions. We then focused on some of the input factors that are rooted in the input compositional attributes of the team: functional-level diversity and deep-level diversity. These two types of diversity have an important impact on the integration of virtual teams and their performance. Therefore, we theorized that the influence of team diversity on ACAP is moderated by CCAP, and the influence on innovation is mediated by ACAP. We also conceptualized and tested that media richness has a significant influence on ACAP due to the virtual nature of the team.

This study, and its results, makes novel contributions to the virtual team literature. First, we conceptualized the perspective that team diversity influences innovation in the virtual environment, primarily through the process of ACAP. Consistent with prior literature on the role of ACAP on innovation performance, we found evidence that the innovation output is positively related to ACAP in virtual teaming. This is an important contribution, because it continues to highlight and extend the core role of ACAP in facilitating innovation– a relationship that has not previously been conceptually developed or tested in virtual team environments. This has a prevalent implication for virtual teams, because it focuses the attention to the core dimensions of ACAP (knowledge assessment, knowledge assimilation, knowledge application) and identifies a key mechanism through which diversity in a virtual team translates into innovativeness during the ACAP process.

Virtual teams that have developed ACAP will improve their innovation performance; the fact of presenting a diverse functional virtual team does not, on its own, necessarily imply more innovation in virtual teams. Our findings show that the diversity of a virtual team influences its innovativeness primarily through the process of ACAP.

Furthermore, this study enhances our understanding of the role of ACAP in the context of virtual teams. ACAP has received significant attention during the last two decades; it has been commonly used to better understand and predict various performance outcomes, such as knowledge transfer and innovation capability (Daspit & D'Souza, 2013; Volberda et al., 2010). Prior research has offered empirical evidence that ACAP has a positive impact on innovation at the team level (Leal-Rodríguez et al., 2014; Nemanich et al., 2010; Cadiz et al., 2009). Our analysis further validates and extends the concept of ACAP and its positive influence on innovation to the virtual team environment. The theoretical and empirical model introduced in our study shows that ACAP has an important role in allowing diverse teams to assimilate valuable knowledge present in external sources and to successfully apply it to generate innovation and increase team innovation. Our study reveals that ACAP has an important influence on how effectively team members coordinate their efforts to transform new, external knowledge into applicable knowledge for commercialization.

The second contribution of this study is in incorporating team diversity into the model to propose a new way to consider the potential effects of diversity on ACAP within virtual teams. While the general theme that diversity of perspective is expected to stimulate a team's novel ideas (Harrison et al., 1998), this assumption is not truly valid in the presence of deep-level diversity. Even when the team has a high level of ACAP and the team members are aware of other capabilities and expertise, deep-level diversity can have a negative impact on team members. They will be less likely to build on those ideas or integrate them with their own. In contrast, teams with lower levels of deep-level

diversity will tend to have a more positive virtual interaction that may result in building on each other's novel expertise, thus enhancing the team's overall ACAP.

The third contribution of this study is in showing how CCAP, at the team level, enhances team ACAP. No prior paper to our knowledge has examined the role of CCAP in enhancing ACAP at the virtual team level. It is noteworthy to highlight that the importance of collaboration in virtual teams is well recognized in the field; however, this is the first study to actually measure the concept of CCAP and empirically test its relationship with ACAP at the virtual team level. This finding validates the theoretical concept what was first developed by Blomqvist & Levy (2006), indicating that "continuous value creation and innovation in a dynamic environment are possible only in relationships with higher-order relational qualities such as trust, communication, and commitment" (Blomqvist & Levy, 2006, p. 41).

Our results showed that CCAP is positively associated with ACAP, and there is a positive and significant moderation effect of CCAP on the relationship between functional-level diversity and ACAP. This is a notable finding of this research, given that a primary purpose for forming virtual teams is to pool core competencies from experts of various technical and functional backgrounds (Hertel et al., 2006). The present study finds that CCAP plays a significant moderating role in the virtual team environment and in relational building that facilitates higher levels of ACAP. In line with previous research that studied various components of CCAP, knowledge creation in a team is contingent on the extent to which network members can trust and communicate in the team (Bishop & Scott, 2000; Blomqvist & Levy, 2006; Moenaert, Caeldries, Lievens, & Wauters, 2000). The present study suggests that higher levels of CCAP will facilitate the

virtual team members to exchange information, and better assimilate and apply external knowledge. This implies that ACAP is enhanced by developing collaboration linkages among team members, and among the functional-level diversity domains that individual team members bring to the virtual team. The simultaneous development of CCAP and ACAP will allow the virtual team to be brought together in a manner that directly contributes to the innovation performance of the team.

On the other hand, we found no moderation effect of CCAP on the relationship between deep-level diversity and team innovation. It was evident from the data that a high percentage (91.9%) of teams used email as the preferred technological medium for communication and interaction with each other, and 60% of the team members had no face-to-face interaction. The email dependency and the lack of face-to-face interaction could be strong contributors to the lack of moderation and interaction between deep-level diversity and CCAP. This lack of interactive reasoning due to high email dependency can be further justified based on Harrison et al.'s (1998) argument, that team members detect and identify the personalities and the non-visible underlying characteristics of their teammates through interactions and through observing their verbal and non-verbal behavior. Another possibility for the lack of moderation is that deep-level traits are not necessarily factors that are exchanged among virtual teammates since these traits are not easily detected and exchanged in a virtual environment. To do so, an extended period of time is likely necessary for these perceived differences to surface and be significant contributors in the behavior of the team.

The fourth contribution is in demonstrating how media richness in virtual teams influences ACAP. Media richness influences the extent to which team members can

develop ACAP by integrating their diverse knowledge and formulating coherent, applicable knowledge for innovation solution. This leads to continued insights on how media richness is an important factor in reducing complexity in knowledge integration and in handling multiple conflicting interoperations of information, which continues to be a critical challenge in global organizations (Klitmøller & Lauring, 2013; Zahra & George, 2002). The present study therefore demonstrated that higher levels of media richness at the virtual team level are associated with higher levels of ACAP. Our hypothesis predicted that media richness would have a positive effect on ACAP. The results supported this hypothesis: high media richness levels affected ACAP positively. Teams that communicated via richer media showed higher level of ACAP. These results are in line with the predictions of MRT (Daft & Lengel, 1984). The results of the present study support the concept that the richer the medium, the more efficient it is in transmitting significant external information to develop ACAP in virtual teams, which indicates that external knowledge transfer in virtual teams does not diffuse easily unless it is transferred through a rich media (Peltokorpi, 2015). Therefore, the findings of the present study provide an important suggestion for how global firms must approach the design and management of virtual teams for innovation-seeking projects.

Practical implications

This study has insightful implications for how firms can approach the task of organizing and designing their virtual teams for innovation seeking projects. Clearly, bringing together the right set of ACAP and CCAP skills and attributes is crucial for enhancing innovation development of virtual teams. On the other hand, the findings of this study caution virtual team managers that merely collecting a variety of pertinent

expertise in virtual teaming is not enough for innovation to emerge. Firms can collect all the talented expertise around the world in a virtual team yet fail to stimulate innovation unless they promote and lead in developing ACAP and CCAP in their virtual teams.

Managers can align their teams for innovation by considering both the relational aspect of CCAP among team members and the technical interrelation that composes a team's ACAP. Managers should more purposefully shape and ensure virtual CCAP context (in terms of trust, communication, and commitment) to enhance the overall collaboration environment among team members by providing strategic leverage for effectively supporting ACAP in virtual teams. CCAP therefore serves to facilitate team members' adjustments to the encountered virtual social setting in order support knowledge creation and application within ACAP processes.

This study also recommends that, to pursue innovation, teams should be able to search for new ideas that have innovative and commercial potential. One way to do this is by sustaining cross-functional relations with external sources such as customers, suppliers and vendors, conferences, universities, and even sometimes collaboration with competitors. Managers should also recognize that the mere fact of drawing on new, external ideas would not always enhance a virtual team's innovative performance; it is necessary to focus on the development of dimensions of ACAP. Cohen and Levintal (1990) proposed that the stock of knowledge in firms is a necessary condition to learn from external sources; therefore, virtual team managers should also use this strategy by enhancing the knowledge base necessary to facilitate the processes of knowledge assessment, assimilation, and application that enhance the development of ACAP. Therefore, managers of virtual teams need to obtain a high level of ACAP to close the

knowledge gap between external knowledge and applied knowledge; this will enhance team innovation.

Managers should also consider the structure of the team with respect to both deep-level diversity and functional-level diversity in determining whether the team is likely to be innovative. The results of this investigation call for more detailed attention to deep-level diversity in order to examine how to offset its potentially negative effects on a team's collaboration process. Managers should be aware of the negative impact of deep-level diversity within a virtual team and offset this negative effect by providing training for team members to facilitate collaboration building and to detect and resolve conflicts immediately as they arise. Conflict in virtual teams negatively impacts team member perception and the desire to remain with the team (Tekleab & Quigley, 2014) and should therefore be addressed immediately.

Adequate participation among team members is also essential in order for all team members to derive advantage from the virtual collaboration. Managers of virtual teams need to ensure that proper guidance and mentoring are available to encourage higher levels of interaction. Some team members might not embrace and feel comfortable with the virtual team environment and hence would hesitate to speak up and express their ideas. A virtual team manager has far more difficulty in ensuring and keeping team members connected and efficiently communicating with each other than the collocated teams. It is also much harder to communicate knowledge through virtual media compared to face-to-face communication (Daim et al., 2012). Follow-ups with individual team members might be necessary to ensure proper participation is achieved and policies are

being followed correctly. By breaking down participation barriers, knowledge will flow more freely between team members, and the team can function on a higher optimal level.

Managers should also focus on ways of improving the quality of information exchange within the virtual team environment. This study showed there is high dependency on email for communicating with team members. Email is the most popular means of communication due to its ease of usage and the control of communication between the sender and the recipient (Harvey, Novicevic, & Garrison, 2004). Since time zones can play a role in the delay of email responses, policies should be in place to ensure email response occurs within a set period for time (e.g., within 24 hrs.). Communication through voice and video media should be encouraged rather than the use of email communication when dealing with complex tasks. Language barriers can cause an increase in time for reflection and spelling when writing emails, communicating through voice or video conference will be much faster with less time wasted on writing and formulating emails (Daim et al., 2012; Klitmøller & Lauring, 2013). Therefore, virtual team members should be encouraged to communicate frequently with each other via a wide range of modes, not just email.

It is also worthy to note that the results of this study showed only 14.5% of team members use video conferencing in their virtual meetings. This could be due to the tendency to conduct virtual meetings using only voice communication even though technology is available through either virtual meeting rooms or video cameras on personal computers. Without the use of video conferencing in virtual meetings, there is a tendency for team members to be less engaged in the meeting conversations and more prone to distractions with other tasks while only listing to the meeting. Virtual team

managers are encouraged to enforce video conferencing to minimize distractions and to enable the team members to be more focused and engaged in the process of collaboration and information exchange; this could also help by reducing ambiguous communication.

Limitations and future research

Although the findings of this investigation contribute to the advancement of virtual team research, the findings should be interpreted with respect to the study's limitations. First, the sample was drawn from a single organization, which limits the generalization of the findings. Future researchers are encouraged to examine ACAP & CCAP in alternate virtual contexts to further validate the noted relationships with team phenomena.

Second, the non-probability sampling approach used in this study poses a potential limitation. Random sampling was not an option since this study involved a specific sample within one organization. The organization in which the study was conducted did not permit the collection of respondent age, gender, and similar demographic data. Thus, future researchers are encouraged to explore the demographic contexts especially the impact of gender in virtual teams. Previous researchers have highlighted that gender imbalance within a team does have a negative impact on team performance and equal gender mix teams have better performance (Hoogendoorn, Oosterbeek, & Van Praag, 2013). Boiney, (2001) also indicated that gender does influence team behaviors in terms of cohesion and communication where male team members tend to choose to work independently and whereas female members are more interested in improved communication and collaboration (Boiney, 2001).

Third, another limitation is potential common method variance (CMV). Podsakoff, MacKenzie, Lee, and Podsakoff (2003) indicate that survey-based research has the possibility of having a CMV bias in situations where a study relies on self-reported measures. In this study, CMV could arise given one respondent reporting for all observed measures. We attempted to minimize the bias by assuring the participants that the survey would be anonymous and encouraging honesty in responses. Researchers that have studied this methodological issue have concluded that even if CMV bias exists in the observed correlations, it is not necessarily sufficient to challenge the theoretical interoperation of the relationships (Doty & Glick, 1998). They further indicated that although CMV bias should be avoided to the extent that this is possible, it is not likely to be large enough to invalidate the theoretical interpretations and research conclusions (Doty & Glick, 1998). The presence of CMV was evaluated in this study by using Harman's single-factor method (Podsakoff et al., 2003). Through the use of this method, no single factor emerged accounting for more than 50% of the overall variance suggesting that CMV did not impose a notable effect.

To limit the influence of non-response bias, the sample was divided into two groups consisting of early and late respondents (Armstrong & Overton, 1977) at the date midpoint between the first and the last respondent. Differences in the groups (Group 1 = early respondents and Group 2 = late respondents) were analyzed for all the variables. Statistical significance was estimated, and no significant differences existed for all the variables suggesting no nonresponse bias.

Last, this study used the correlation method design, which requires caution when interpreting correlations and relationships. Casual inferences must be treated with caution

when using these types of correlation studies. Although the results are consistent with prior research and with our hypothesized model, extending our casual inference should be taken with caution.

Furthermore, this study suggests a number of implications for future research, many of which were previously noted. Additionally, future researchers are encouraged to extend the current study to determine whether similar results and relationships are achieved at various industries that rely on virtual teams such as software companies. Testing this model in different work environments would address its generalizability. Another challenge for future research is to identify factors that facilitate deep-level diversity on team performance. Future research should attempt to disentangle the effects of deep-level diversity on virtual teams. For example, how familiar do virtual team members need to be with one another in order to outweigh the negative effect of deep-level diversity.

Conclusion

This study contributes to the field of virtual team literature by providing empirically-based answers to some management questions and practical implications for global organizations. Virtual teams help global organizations compete in today's complex global environment; preparing team members to work more effectively in virtual contexts is an important challenge for these organizations. Little empirical data exist on how ACAP and CCAP make virtual teams more innovative. This study demonstrated that ACAP and CCAP are positively related to the performance of virtual teams. We poise to suggest that effective ACAP and CCAP will be the hallmark of the success of collaboration for innovation in virtual teams. This finding confirms the important role of

ACAP & CCAP activities in explaining the knowledge-creating process in virtual teams. This is essential for developing innovation in virtual environment. In addition, this study showed that there is a positive correlation between media richness and ACAP. Table 45 summarizes the hypotheses results of this chapter.

Table 45 Summary of hypotheses results

Alternative Hypothesis	Results
Hypothesis 1: The relationship between deep-level diversity and virtual team innovation outcome is mediated by ACAP.	Supported
Hypothesis 2: The relationship between functional-level diversity and virtual team innovation outcome is mediated by ACAP.	Supported
Hypothesis 3: CCAP positively moderates the relationship between deep-level diversity and ACAP, such that ACAP is strongest when CCAP is high and weakest when CCAP is low.	Not Supported
Hypothesis 4: CCAP positively moderates the relationship between functional-level diversity and ACAP, such that ACAP is strongest when CCAP is high and weakest when CCAP is low.	Supported
Hypothesis 5: Media richness is positively associated with ACAP.	Supported

CHAPTER V

SUMMARY AND CONCLUSION

This research examined the collaboration capability and absorptive capacity constructs at the virtual team level with respect to their theoretical definition, the inter-relationships among their dimensions and their influence on team innovation. This research also examined the different facets of diversity present in virtual teams and how diversity influences team collaboration and innovation. Moreover, this study demonstrated that CCAP and ACAP virtual team constructs are parsimonious and reliable research models ready for further testing.

Chapter summaries

The first chapter set the motivation and the scope for this research. It provided a brief introduction and background on the use of virtual teams and how they have become an important method of knowledge creation for the innovation process within or among modern organizations. The premise of the study is based on the assumption that managing these aspects of collaboration to enhance innovation is a way of preserving and expanding a firm's effectiveness. Developing innovative and useful products and services reduces costs and increases sales. Therefore, enhancing innovation is an essential business skill that eventually improves the growth of an organization. The remainder of the chapter described the research goals and set definitional framework for virtual teams.

Chapter 2 concentrated on understanding the collaboration capability aspect of virtual teams. This chapter examined the CCAP construct at the virtual team level: its definition, the inter-relationship among its dimensions, and its influence on the innovation characteristics of the team. CCAP was defined as the teams as the ability to build and manage network relationships based on trust, communication and commitment (Blomqvist and Levy, 2006). The CFA results in this chapter support the hypothesized, three-dimensional model of CCAP. It was found that each of the three dimensions of CCAP was empirically distinct and that the three-dimensional model fit well. The study in Chapter 2 also provided empirical validation of the role of CCAP in moderating the relationship between team diversity and team innovation. The conceptual moderation model was based on the traditional I-P-O framework that draws from existing theory and extends current research.

Chapter 3 concentrated on understanding the absorptive capacity aspect of virtual teams. This chapter examined the ACAP construct at the virtual team level: its definition, the inter-relationship among its dimensions, and its influence on the innovation characteristics of the team. ACAP was defined as the team's ability to recognize the value of new, external information, assimilate it, and apply it to commercial ends (Cohen and Levinthal, 1990). The CFA results in this chapter support the hypothesized, three-dimensional model of ACAP. We found that each of the three dimensions of ACAP was empirically distinct and that the three-dimensional model fit well. The study in Chapter 3 also provided empirical validation of the role of ACAP in mediating the relationship between team diversity and team innovation. For team innovation, we found support in the survey data for a mediation role for ACAP with respect to team diversity and team

innovation. The conceptual mediation model was based on the traditional I-P-O framework that draws from existing theory and extends current research. This chapter provided new insights into the ACAP construct and its strategic role in virtual team environments. Despite the fact that a large body of research has cited Cohen and Levinthal's (1990) work on ACAP, very little work had been done to validate and operationalize ACAP at the virtual team level. In addition, even though Cohen and Levinthal (1990) highlighted the multi-dimensionality of ACAP, many prior researchers have measured ACAP as a unidimensional construct, which often raises questions about the accuracy of the nature and contributions of ACAP. The present study, however, extended the ACAP concept to the virtual team level and further validated it as a multi-dimensional construct consistent with the seminal work of Cohen and Levinthal (1990).

Chapter 4 focused on building an integrated model using CCAP and ACAP constructs as the core elements. Based on the traditional I-P-O model, the integrated framework in Chapter 4 extends the research concepts in Chapter 2 and Chapter 3 to include the effects of CCAP and ACAP as core elements in the team processes. In particular, team diversity and media richness are included as the bases for team inputs. At the process level are the CCAP and ACAP constructs. We investigate the role of CCAP in moderating the relationship between team diversity and ACAP. At the outcome level is team performance, which includes both team innovation and team effectiveness. Chapter 4 concludes by discussing the empirical findings, which clearly showed that team diversity plays a significant role in establishing relationships among virtual team members. Further, the findings confirm that CCAP moderates the relationship between

team diversity and ACAP. Mediation effects of ACAP on the relationship between team diversity and team innovation are significant.

Future directions

This research measured team CCAP and ACAP at a particular point in time. An interesting avenue for future research would be to investigate how CCAP and ACAP build over time with a longitudinal survey. For example, teams that are diverse with respect to deep-level diversity may build CCAP more slowly than homogeneous teams. In addition, teams that are homogenous with respect to functional-level diversity may build ACAP more slowly than more diverse team.

Task interdependence is the degree to which team members must rely on one another to perform their tasks effectively, given the design of their jobs (Georgopoulos, 1986; Kiggundu, 1981). Task interdependence was not included as one of the elements in our study, but further research could include this element to gain an understanding of its role in virtual team collaboration. For example, team members with higher levels of task interdependence may have greater CCAP, while team members with low levels of task interdependence may have lower levels of CCAP.

Conclusion

This dissertation aims at filling the present gap in the literature on CCAP and ACAP by extending and validating these important constructs to the virtual team environment. This research takes an integrative approach to the theories of CCAP and ACAP and builds a comprehensive framework that includes important elements for a collaborative and innovative virtual team model.

Virtual teams will continue to be an important and critical part of global organizations. The results of this quantitative research provide researchers, managers, and leaders with greater insight and perspective into virtual team design and management. The knowledge and empirical results in this dissertation will contribute to developing a better understanding of virtual teams with a greater perceived influence on their productivity and success.

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APPENDIX A

SURVEY INSTRUMENT FOR TEAM RESPONSE

1. WELCOME TO TEAM SURVEY!

INTRODUCTION. This survey is part of an academic research study with the purpose to collect team level data in order to further investigate team dynamics in a global team setting. Its important for researchers to understand team dynamics in a global setting in order to address the issues and areas of concern for the further enhancement in managing global teams.
Your participation involves answering questions regarding your experience and perception of your team. The survey takes between 10-15 minutes to complete. Your participation is important in contributing to the academic research in team science.

ABOUT US: This study is being conducted by Fadi Batarseh, for his doctoral dissertation, under the supervision of Dr. John Usher, Dr. Kari Babski-Reeves , Dr. Stan Bullington and Dr. Joshua J. Daspit, at Mississippi State University. If you have any questions about this study, or would like to get further information, please feel free to contact Fadi Batarseh at fb150@msstate.edu (714-267-3200). This study has been approved and reviewed by the Institutional Review Board (IRB) at Mississippi State University.

DIRECTION: In the context of this survey, please answer all the questions from the perspective of the team you are a member of. If you are involved in multiple teams, please choose the most important one and rate this team throughout this survey. Please answer all questions as honestly and thoughtfully as possible. Your responses are greatly appreciated.

VOLUNTARY PARTICIPATION: Please understand that this is an academic research project and your participation in this study is completely voluntary. There is no risk in taking this survey. Declining to answer or withdrawing from participation will have no impact on you or your job in any way.

CONFIDENTIALITY & ANONYMITY: Your answers to the survey will remain completely confidential and anonymous and it will be combined with other participants. The information you provide will never be conveyed in any way that can identify you.The data will be kept on a password protected database for three years and will be permanently deleted after that.

RAFFLE: As a way of thanking you for participating in this study, there is a raffle to win various gift cards between $10 to $50. Participation in the raffle is completely voluntary. Please follow the link at the end of this survey to enter your contact information (email) in the RAFFLE page.

***1. By clicking Yes, I am providing my consent to to participate in this study!**

- ○ Yes
- ○ No

Thank you for your participation!

2. General Information

2. What is the highest level of school you have completed or the highest degree you have received?

- ○ Some college but no degree
- ○ Associate degree
- ○ Bachelor degree
- ○ Masters Level
- ○ Doctorate Level

3. What is your relationship to the team?

- ○ Team Member
- ○ Team Leader

4. Approximately how big is your organization (number of employees)?

3. Team Configuration

5. How many people in your team (including team Manager)?

6. Approximately how long has been this team formed (in years)?

7. How many different geographic locations (sites) in your team?
Sites are represented as teammates at various locations such as different building or city or region,...

8. Please list how many teammates in each geographic location (site)?

Teammates at Site 1:	
Teammates at Site 2:	
Teammates at Site 3:	
Teammates at Site 4:	
Teammates at Site 5:	
Please list other sites\teammates separated by a comma.	

9. Please select your level of agreement with the following statement using the following scale.

	Strongly Disagree.	Disagree.	Disagree somewhat.	Neither Disagree Nor Agree.	Agree somewhat.	Agree.	Strongly agree.
Different time zones present a great challenge in team communication.	○	○	○	○	○	○	○

4. Media

9. In which ways and how often does your team communicate with each other?

	Never	Less than once a month	Once a month	Once a week	A few times a week	Daily
Face-to-face communication	○	○	○	○	○	○
Video conferencing	○	○	○	○	○	○
Telephone calls	○	○	○	○	○	○
Tele-conference (i.e Webex)	○	○	○	○	○	○
Emails	○	○	○	○	○	○
Instant text messaging	○	○	○	○	○	○

10. Please select your level of agreement with the following statement using the following scale.

	Strongly Disagree.	Disagree.	Disagree somewhat.	Neither Disagree Nor Agree.	Agree somewhat.	Agree.	Strongly agree.
Reliance on virtual tools (i.e. Video-conference, tele-conference, email, Instant message, phone, etc.) presents a great challenge in team communication.	○	○	○	○	○	○	○
Language presents a great challenge in team communication.	○	○	○	○	○	○	○

5.

11. Please select your level of agreement with each statement using the following scale.

	Strongly Disagree.	Disagree.	Disagree somewhat.	Neither Disagree Nor Agree.	Agree somewhat.	Agree.	Strongly agree.
Members of the team are similar in terms of their length of experience.	○	○	○	○	○	○	○
Members of the team are similar in terms of their educational background.	○	○	○	○	○	○	○
Members of the team are similar in terms of their functional expertise.	○	○	○	○	○	○	○

12. Please select your level of agreement with each statement using the following scale.

	Strongly Disagree.	Disagree.	Disagree somewhat.	Neither Disagree Nor Agree.	Agree somewhat.	Agree.	Strongly agree.
Members of the team are similar in terms of their personalities.	○	○	○	○	○	○	○
Members of the team are similar in terms of their personal values.	○	○	○	○	○	○	○
Members of the team are similar in terms of their attitudes towards the project.	○	○	○	○	○	○	○
Members of the team are similar in terms of their attitudes towards the project goals.	○	○	○	○	○	○	○
The well being of fellow team members is important to members of the team.	○	○	○	○	○	○	○
It is important for members to maintain harmony within the team.	○	○	○	○	○	○	○
Members of the team like sharing information with my fellow team members.	○	○	○	○	○	○	○
It is important for members to consult other team members before making a decision.	○	○	○	○	○	○	○
Members help fellow team members in their time of difficulty.	○	○	○	○	○	○	○

6.

13. With respect to new external knowledge originating outside your team:

Sources of external knowledge: Vendors\Suppliers, Customers, Conferences, etc.

	Strongly Disagree.	Disagree.	Disagree somewhat.	Neither Disagree Nor Agree.	Agree somewhat.	Agree.	Strongly Agree.
People in my team are able to decipher the knowledge that will be most valuable to us. *Decipher means: success in understanding, interpreting, identifying knowledge)*	○	○	○	○	○	○	○
It is easy to decide what information and knowledge will be most useful in meeting our internal or external customer's needs.	○	○	○	○	○	○	○
We know enough about the technology we use to determine what new information is credible and trustworthy.	○	○	○	○	○	○	○
The shared knowledge within my team makes it easy to understand new material presented within our technical areas.	○	○	○	○	○	○	○
It is easy to see the connections among the pieces of knowledge held jointly within our team.	○	○	○	○	○	○	○
Many of the new technological developments coming to the team fit well into the current technology.	○	○	○	○	○	○	○
It is easy to adapt our work to make use of the new technical knowledge made available to us.	○	○	○	○	○	○	○
New external technical knowledge can be quickly applied to our work.	○	○	○	○	○	○	○
Our customers (internal or external) can immediately benefit from new technical knowledge learned in the team.	○	○	○	○	○	○	○

7.

14. Please select your level of agreement with each statement using the following scale.

	Strongly Disagree	Disagree	Disagree Somewhat	Neither Disagree Nor Agree	Agree Somewhat	Agree	Strongly Agree
Team members are afraid to express their real views.	○	○	○	○	○	○	○
If we have a decision to make, everyone is involved in making it.	○	○	○	○	○	○	○
We tell each other the way we are feeling.	○	○	○	○	○	○	○
Within the team, everyone's opinion gets listened to.	○	○	○	○	○	○	○
Within the team, people say what they really mean.	○	○	○	○	○	○	○
Team members are encouraged to express our concerns openly.	○	○	○	○	○	○	○

8.

15. Please select your level of agreement with each statement using the following scale.

	Strongly Disagree.	Disagree.	Disagree somewhat.	Neither Disagree Nor Agree.	Agree somewhat.	Agree.	Strongly Agree.
Team members in this team are considerate of other's feelings.	○	○	○	○	○	○	○
Team members are friendly towards each other.	○	○	○	○	○	○	○
Team members can rely on fellow team members.	○	○	○	○	○	○	○
Members of the team are very trustworthy.	○	○	○	○	○	○	○

16. Please select your level of agreement with each statement using the following scale.

	Strongly Disagree.	Disagree.	Disagree somewhat.	Neither Disagree Nor Agree.	Agree somewhat.	Agree.	Strongly Agree.
Team members feel emotionally attached to their team.	○	○	○	○	○	○	○
Team members feel a strong sense of belonging to their team.	○	○	○	○	○	○	○
Team members feel as if the team's problems are their own.	○	○	○	○	○	○	○
Team members feel like part of the family in their team.	○	○	○	○	○	○	○

9. Team Performance

17. Please select your level of agreement with each statement using the following scale.

	Strongly Disagree	Disagree Somewhat	Disagree	Neither Disagree Nor Agree	Agree	Agree Somewhat	Strongly Agree
In the past, the team has been effective in reaching its goals.	○	○	○	○	○	○	○
The team, at present, is meeting its business objectives.	○	○	○	○	○	○	○
Completion of work is generally on time.	○	○	○	○	○	○	○
Completion of work is generally within the established standards.	○	○	○	○	○	○	○
In the past, the team has been efficient in performing the tasks.	○	○	○	○	○	○	○
The team, at present, is producing work of the highest quality.	○	○	○	○	○	○	○
Each member's input is valued by the team.	○	○	○	○	○	○	○
The team members' morale is high in this team.	○	○	○	○	○	○	○
Members enjoy being a part of this team.	○	○	○	○	○	○	○

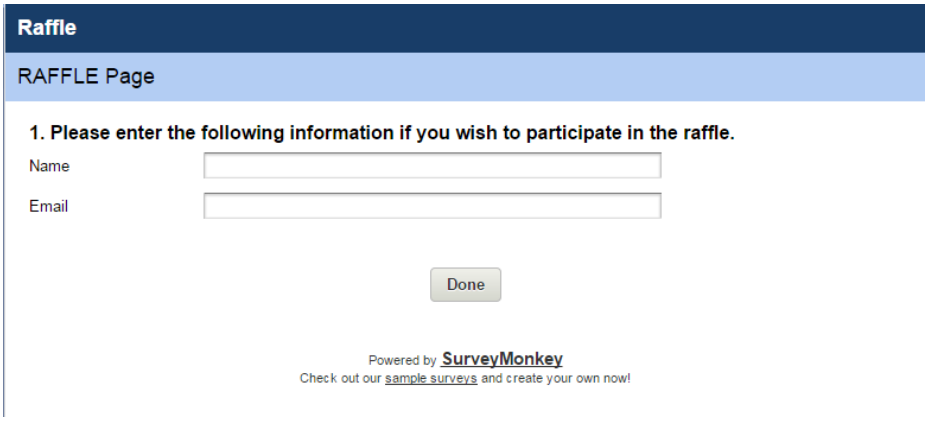
18. Please select your level of agreement with each statement using the following scale.

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
The team frequently introduces new innovative solutions.	○	○	○	○	○
The team is fast in introducing new innovative solutions.	○	○	○	○	○
The team is highly innovative.	○	○	○	○	○

10.

RAFFLE PARTICIPATION

Please follow this link to enter your information to participate in the raffle:
https://www.surveymonkey.com/r/TeamRaffle


Raffle
RAFFLE Page
1. Please enter the following information if you wish to participate in the raffle.
Name
Email
Done
Powered by SurveyMonkey
Check out our sample surveys and create your own now!

APPENDIX B

MISSISSIPPI STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD APPROVAL

1. WELCOME TO TEAM SURVEY!

INTRODUCTION. This survey is part of an academic research study with the purpose to collect team level data in order to further investigate team dynamics in a global team setting. Its important for researchers to understand team dynamics in a global setting in order to address the issues and areas of concern for the further enhancement in managing global teams.
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***1. By clicking Yes, I am providing my consent to to participate in this study!**

- ○ Yes
- ○ No

Thank you for your participation!

MSU HRPP	Approved:	Expires:
	2/24/15	12/31/15
	IRB # 15-062	

APPENDIX C

ADDITIONAL GRAPHS RELATED TO REGRESSION ASSUMPTION TESTING

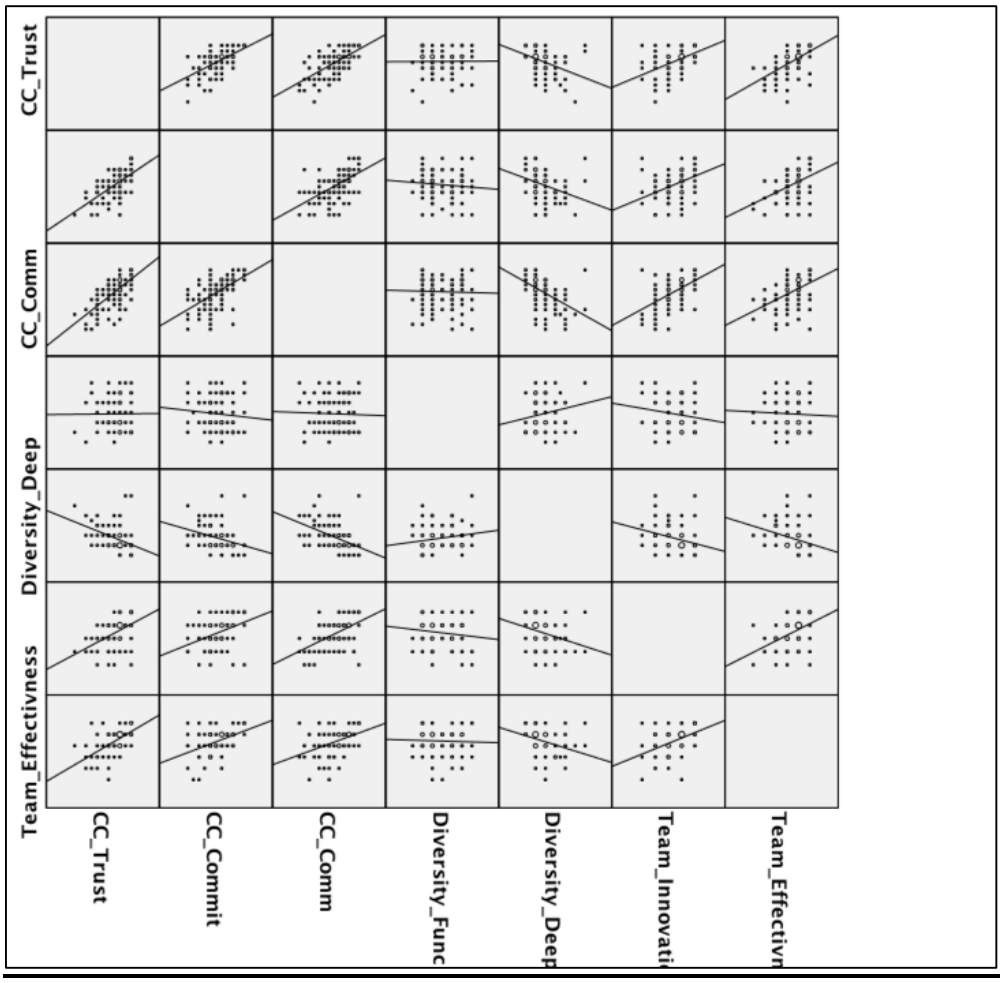

Figure 19 CCAP variables linearity matrix

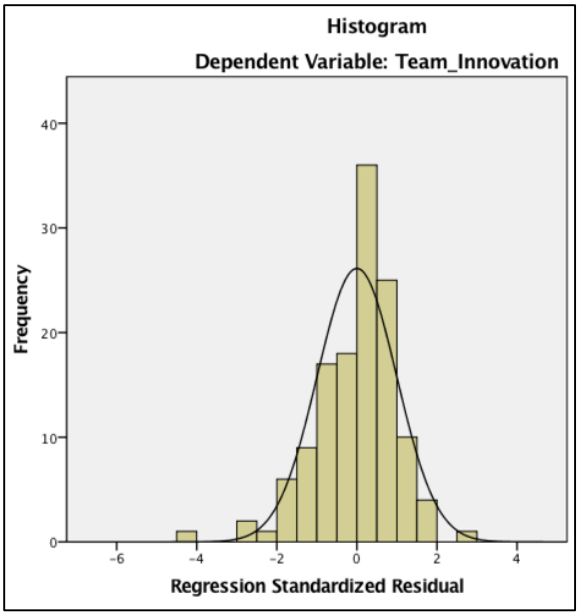

Figure 20 CCAP\Functional regression standardized residual

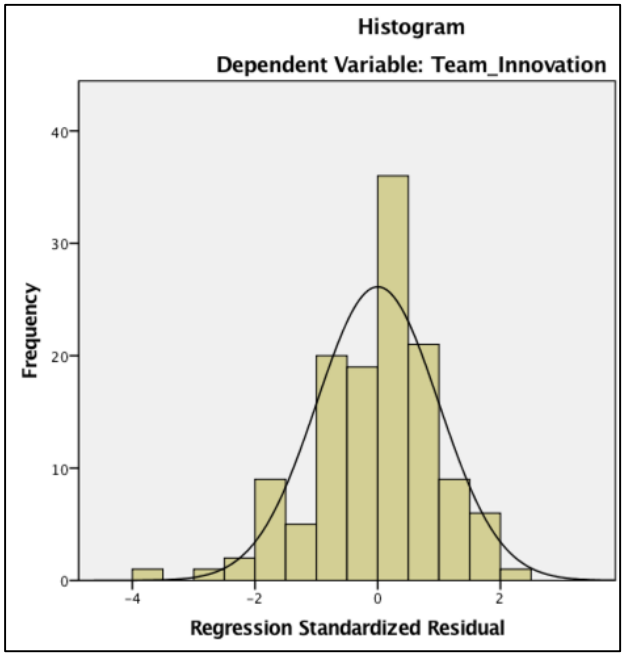

Figure 21 CCAP\Deep-level regression standardized residual

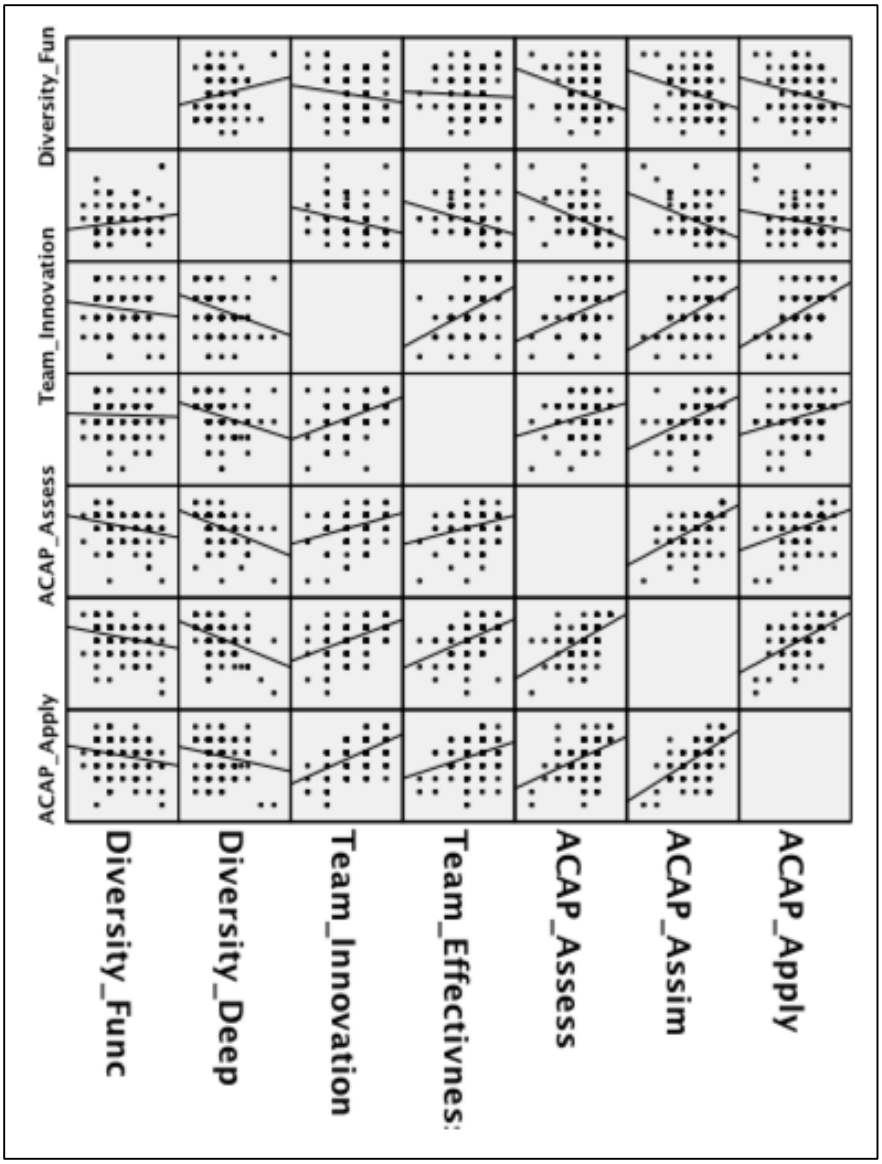

Figure 22 ACAP variables linearity matrix

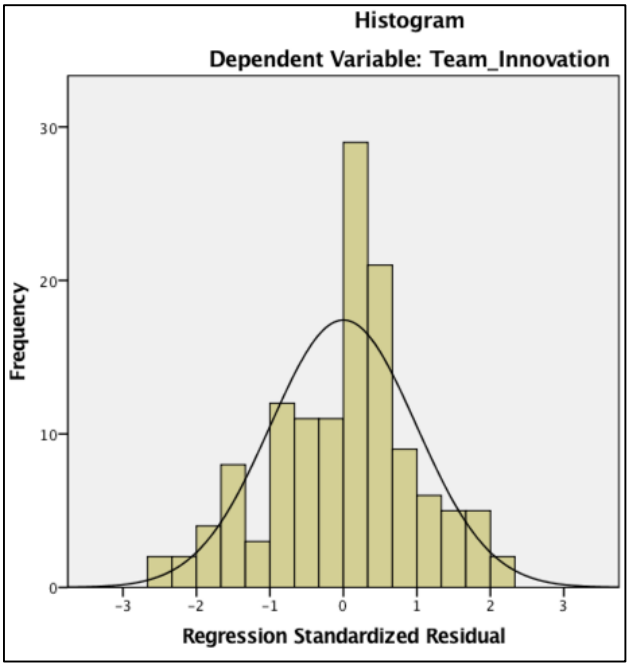

Figure 23 ACAP\Functional regression standardized residual

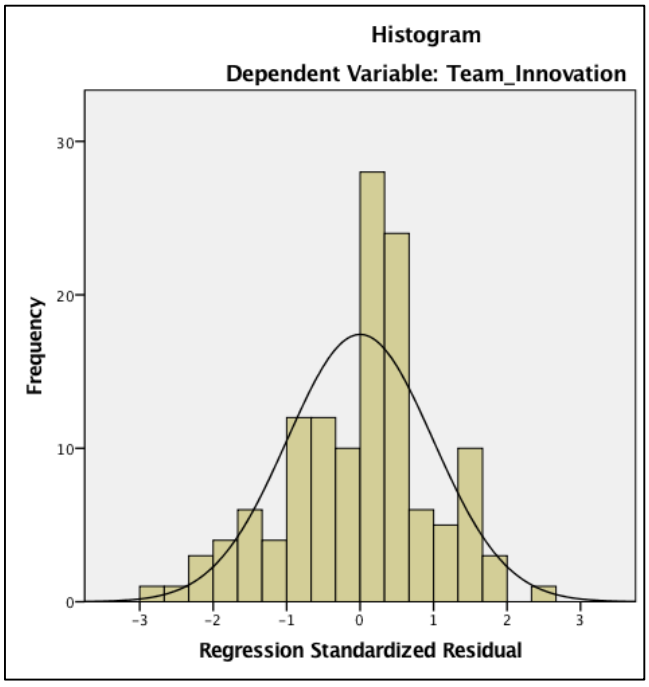

Figure 24 ACAP\Deep-level regression standardized residual