KNOWLEDGE SHARING IN VIRTUAL TEAMS: THE IMPACT ON TRUST, COLLABORATION, AND TEAM EFFECTIVENESS

by

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The practice of virtual teams has provided organizations with a convenient solution for gathering experts to collaborate online in order to accomplish organizational tasks. However, the dynamics and characteristics of virtual teams create challenges to effective collaboration. Collaboration is an important element in teamwork, team members need to collaborate to achieve the goal for which the team is established. Literature on virtual teams has been growing for over a decade with research investigated different aspects of virtual work. Trust among virtual team members has been investigated by information systems researchers as a crucial challenge for virtual teams. Knowledge sharing and management in virtual teams have been the focus of many research recently as they represent a challenge for virtual work environment; because the knowledge is scattered among geographically distributed team members with limited face to face interaction. Yet, trust and knowledge sharing are not the final outcome of teamwork, there is a gap in the literature on how trust and knowledge sharing affect collaboration and ultimately team effectiveness in virtual settings. This study extends the literature on virtual teams through investigating the relationship between knowledge sharing, trust, and collaboration among team members in virtual team settings; and how these constructs ultimately affect virtual team effectiveness. We argue that the characteristics and structure of virtual teams requires a distinctive understanding on how
to make their members collaborate in a comparable and effective way to collocated teams. We argue that knowledge as a valuable asset and a personal advantage of a virtual team member could be a key for successful virtual team collaboration.

This research introduces a conceptual model which describes the hypothesized relationship between knowledge sharing, trust, collaboration, and team effectiveness in virtual team settings. The model is developed based on an intensive review of the literature on virtual teams, knowledge sharing and management, trust, collaboration, and team effectiveness in traditional and virtual settings. The theoretical foundation for the model is found in the Knowledge Based Theory of The Firm, Social Capital Theory, and the Social Exchange Theory. The survey research method will be used to test the proposed model.

The form and content of this abstract are approved. I recommend its publication.

Approved: Dawn Gregg
DEDICATION

I dedicate this work to my parents, for all the sacrifices they made to raise me and provide me with the means to be a successful person.

I also dedicate this work to the love of my life, my wife Enas for her love, support, and patience throughout this journey.

Finally, I dedicate this work to my sons Eyad and Hazem. For all the time I could not spend with you because I was working on this research.
ACKNOWLEDGMENTS

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# Table of Contents

1. Introduction ................................................................................................................................. 1  
1.2. Importance of Topic ................................................................................................................ 1 
1.3. Research Problem and Scope ............................................................................................... 2  
1.4. Research Questions .................................................................................................................. 3 
1.5. Research Contribution .......................................................................................................... 4  
1.6. Outline of Dissertation ......................................................................................................... 4  
2. Intention to Collaborate: Investigating Online Collaboration in Virtual Teams ............ 5 
2.1. Abstract ................................................................................................................................... 5  
2.2. Keywords .............................................................................................................................. 5  
2.3. Introduction ............................................................................................................................ 6  
2.4. Theoretical Foundation ......................................................................................................... 7  
2.4.1. Virtual Teams .................................................................................................................... 7  
2.4.2. Online Collaboration .......................................................................................................... 9  
2.5. Measurement Scale Development Process ........................................................................... 11 
2.5.1. Stage 1: Literature Investigation and Construct Identification ....................................... 11  
2.5.2. Stage 2: Item Creation ....................................................................................................... 19  
2.5.3. Stage 3: Scale Development ............................................................................................ 20 
2.5.4. Stage 4: Instrument Testing - Field Study ....................................................................... 25
LIST OF TABLES

Table

1: Online Collaboration Dimensions .................................................................................. 13
2: Mapping Online Collaboration Dimensions .................................................................. 14
3: Intention to Collaborate Online Scale Items .................................................................. 21
4: Measurement Items after Pilot Study ........................................................................... 24
5: Number of items after Pilot Study ................................................................................. 25
6: Reliability Statistics – Perceived Incentives ................................................................. 26
7: Correlation Matrix - Perceived Incentives .................................................................... 26
8: Reliability Statistics Repeat – Perceived Incentives ...................................................... 26
9: Correlation Matrix Repeat - Perceived Incentives ......................................................... 27
10: Reliability Statistics – Perceived Voluntariness ............................................................ 27
11: Correlation Matrix - Perceived Voluntariness .............................................................. 27
12: Reliability Statistics Repeat– Perceived Voluntariness .................................................. 27
13: Correlation Matrix Repeat - Perceived Voluntariness ................................................... 28
14: Reliability Statistics– Perceived Common Ground ........................................................ 28
15: Correlation Matrix - Perceived Common Ground ......................................................... 28
16: Reliability Statistics Repeat – Perceived Common Ground .......................................... 28
17: Correlation Matrix Repeat - Perceived Common Ground ............................................. 29
18: Reliability Statistics– Perceived Members’ Expertise .................................................... 29
19 : Correlation Matrix– Perceived Members’ Expertise ..................................................... 29
20: Reliability Statistics– Perceived Members’ Expertise .................................................... 29
21: Correlation Matrix Repeat – Perceived Members’ Expertise ......................................... 30
22: Items Correlation ........................................................................................................... 31
23: Rotated Component Matrix ................................................................. 32
24: Rotated Component Matrix - Repeat .................................................. 33
25: Total Variance Explained .................................................................. 33
26: Virtual Team Research Categories ...................................................... 46
27: Levels of Knowledge Management Systems ...................................... 49
28: Types of Trust in Previous Research ................................................... 54
29: Definitions of the Study Constructs ..................................................... 71
30: Cronbach’s alpha ................................................................................. 73
31: Demographics and Descriptive Statistics ............................................. 74
32: Convergent And Discriminant Validities .............................................. 75
33: Cross Loading ...................................................................................... 76
34: Summary of Hypotheses Tests ............................................................. 78
35: Sobel Test for the Significance of Mediation ....................................... 78
36: Control Variable Effect ....................................................................... 79
37: Multi-group moderating effect (Trust) ................................................ 81
38: Multi-group moderating effect (Collaboration) .................................... 82
LIST OF FIGURES

Figure

1: Intention to Collaborate Online ........................................................................................................ 14

2: Spiral of knowledge – Adapted from Nonaka and Takeuchi (1995)........................................... 48

3: CSCW Matrix – Adapted From Johansen (1988) ........................................................................ 59

4: Theoretical Research Model ........................................................................................................... 62

5: Measurement Model ....................................................................................................................... 71

6: PLS SEM Results ............................................................................................................................ 77

7: Control Variable Analysis ............................................................................................................... 79
1. Introduction

The research presented in this dissertation addresses virtual team effectiveness. This research sheds light on the importance of knowledge sharing in virtual team settings and how the behavior of knowledge sharing has the potential to compensate for the absence of observed physical behaviors. This study extends the previous literature on virtual teams through investigating the role of knowledge sharing and trust in enabling collaboration in virtual team settings; and eventually makes the team outcome more effective. Individuals consider knowledge to be a personal advantage and sharing it leads to loss of ownership of this knowledge and consequently loss of power and potential replacement which makes them hoard the knowledge and be reluctant to share it (Kankanhalli et. al. 2005). Nonetheless, sharing knowledge and exchanging ideas is crucial for team collaboration. We argue that an efficient virtual team, is one which its team members put the success of the team ahead of their personal tendency to hoard knowledge for themselves.

1.2. Importance of Topic

As globalization and open markets continue to manifest, organizations are realizing more the prominence of virtual teams as a convenient way to enable teamwork in situations where people of expertise cannot be brought together into the same location. Virtual teams have a set of characteristics and dynamics that are different from traditional face –to- face teams since are composed of individuals of complex traits and diverse backgrounds. Yet, these individuals are expected to be effective and collaborate to achieve an organizational goal.
Because virtual teams normally do not have face-to-face interaction, their effectiveness is more challenging compared to traditional teams. Although the literature shows that virtual teams can reach a level of effectiveness which could be compared to traditional teams' effectiveness, this process in virtual environment takes more time and effort.

Knowledge is a critical factor in improving team effectiveness and sharing knowledge is essential for team members’ collaboration. In virtual teams, however, knowledge is fragmented among already distributed individuals whose only mean of interaction is mediated by technology. Therefore, sharing knowledge in virtual teams is more critical and challenging than in traditional teams.

Trust is considered to be a crucial but challenging factor of successful teams. This characteristic is difficult to establish and foster among team members especially when those members are geographically distributed, have different perceptions of trust due to their diverse backgrounds, and they are challenged with limited observed behaviors of fellow team members.

In this research, we investigate how sharing knowledge influences trust and collaboration among virtual team members. We also investigate the impact of these relationships on virtual team effectiveness.

1.3. Research Problem and Scope

A main distinction we make in this research is between virtual teams and open online communities of practice. A key characteristic of online communities of practice is that their members are personally motivated to join these communities based on shared
interest. Virtual teams, however, members join them to collaborate on an organizational task mainly because of the organization need for their expertise.

Online communities of practice are formed and managed beyond the organizational boundaries and their members are not governed or concerned with organizational structure or reward system. Virtual teams are established of members who work in an organization or across an inter-organizational system. They are employees who are expected to work together and collaborate to achieve an organizational goal within specific time and limited resources.

Early virtual teams were described as temporary teams whose members are brought together by technology to work on a complex problem. Although this type of virtual teams still exists, nowadays virtual teams are more embedded into the organization and their members are working on traditional everyday tasks for relatively long periods of time.

Similar to traditional teams, virtual teams are expected to collaborate to accomplish a common goal. However, the structure and characteristics of virtual teams impose challenges on how effective these teams can be.

1.4. Research Questions

This research aims to answer the following research questions:

1. What factors influence a virtual team member’s intention to collaborate online?

2. How do different factors combine to influence a virtual team member’s intention to collaborate online?

3. How can we measure online collaboration in virtual team settings?
4. Does knowledge sharing significantly influence trust and collaboration in virtual team setting?

1.5. Research Contribution

The research included in this dissertation has two main contributions. The first is a literary contribution. From conducting an intensive literature review on virtual teams, an observation was made. The literature investigates how different factors influence trust and knowledge sharing in virtual teams. Yet, trust and knowledge sharing are not the final outcomes of team work. As such, the final contribution of this dissertation is an empirical one.

1.6. Outline of Dissertation

The focus of this dissertation virtual teams effectiveness, the role of knowledge sharing, trust, and collaboration. It consists of four chapters: (1) Introduction, (2) Intention to Collaborate: Investigating Online Collaboration in Virtual Teams. (3) Virtual Teams Effectiveness: The Role Of Knowledge Sharing, Trust, And Collaboration. (4) Comprehensive Conclusion.

2.1. Abstract

The emergence of online tools supporting collaboration has allowed more people to work together online, some in open online communities, others in professional groups within organizations, and others in professional groups across inter-organizational systems. The advancement of information and communication technology provided the opportunity for organizations to establish virtual teams with needed expertise regardless of geographical boundaries. Virtual team members are expected to collaborate in order to solve predefined problems and organizational tasks. In this paper, we introduce a conceptual model and a measurement scale which are derived from investigating the literature on online collaboration and virtual teams. The proposed scale makes important contributions to both research and practice. For research, it will provide a validated scale to measure perceived intention to collaborate in virtual team settings, which will support further research in this important field. For practice, it will help identify what contributes to a virtual team member's intention to collaborate and can assist in the establishment of virtual teams in organizations.

2.2. Keywords

Online Collaboration, Virtual Teams, Conceptual Model, Measurement Scale.
2.3. Introduction

Globalization along with continuous improvement in information and communication technologies has led more professionals to work together online. The web is providing a platform for collaboration and it is continuously shifting towards a more user centric experience (Lai and Turban, 2008). On an organizational level, information technology offers organizations the opportunity to form partnerships, communicate with each other, and coordinate activities. These inter-organizational systems are important in a market where products and services require multi-organizational collaboration; which is considered to be a shift from organizational competition to inter-organizational collaboration (Kumar and Dissel, 1996; Zwass, 2003). This change in the organizational structure and in the way organizations conduct their business, makes the practice of virtual teams an organizational necessity. Web 2.0 and the variety of tools it provides (e.g. blogs, wikis, and social bookmarking) have led to the emergent of new kinds of services such as social networks, aggregation services, and cloud based office-style software. These tools provide a means for organizations to establish teams based on required expertise regardless of physical location. They allow professionals to establish and join open online communities that relate to their field of expertise and to serve as a virtual work place for knowledge exchange, collaboration, and problem solving. Moreover, this technology advancement has resulted in a new innovative form of online collaboration between producers and consumers; which is outsourcing product development to digital consumer networks (Arakji and Lang, 2007).

This study investigates the factors which influence a virtual team member’s intention to collaborate in organizational settings. Prior research on online collaboration
has focused on finding new constructs that contribute to online collaboration; whereas, this study improves our understanding of how different factors combine to influence an individual’s intention to collaborate. The foundation of this approach is based in the Socio-Technical Theory and the Theory of Reasoned Action.

This research proposes a conceptual model of virtual teams collaboration along with a measurement scale derived from the literature. The research is designed to answer the following research questions:

1. What factors influence a virtual team member’s intention to collaborate online?
2. How do different factors combine to influence a virtual team member’s intention to collaborate online?
3. How can we measure the intention to collaborate in virtual team settings?

Answering these questions will allow researchers to better understand virtual teams and the factors that contribute to collaboration among virtual team members.

The next section outlines the theoretical foundation of this research. It is followed by the development of a theoretical model for online collaboration and a measurement scale to test the model. The scale is then refined through a pretest and tested in a field study. The paper concludes with the implications for future research.

2.4. Theoretical Foundation

2.4.1. Virtual Teams

A virtual team is defined by Powel et al as “a group of geographically, organizationally and/or time dispersed workers brought together by information and
communication technologies to accomplish one or more organizational tasks” (Powel et al. 2004). Organizations incorporated virtual teams into their structure to address their business needs, Townsend et al. (1998) attributes the need for virtual teams in the organization to five factors. These factors are the change of organizational structure from vertical to horizontal, the need for inter-organizational collaboration, employees’ preference and expectations, Organizations are moving towards providing services rather than manufacturing products, and due to globalization (Townsend et al. 1998).

Traditionally, virtual teams were established based on an organization need to gather necessary expertise to solve complex problems, they used to be temporary teams, and they suffered low commitment among team members. (Jarvenpaa et al. 1998; Squire and Johnson, 2000; Kanawattanachai and Yoo, 2002). Recently, however, more organizations are establishing virtual teams to work on everyday tasks; and many organizations are allowing their employees to work remotely from places of their choice. Griffith et al. (2003) describe this as the degree of “virtualness”, that is, some teams are completely virtual, while other teams are a combination of co-located and distributed members.

Moving to virtual teams has an impact on organizational structure. It is reported in the literature that virtual teams create forms that are more reconfigurable, flexible, and require mass collaboration (DeSanctis and Monge, 1999; Zammuto et al. 2007). The challenges to virtual teams include time difficulties, feedback delays, misinterpretation, cultural barriers, scheduling, and lack of communication and response (Fussell et al. 1998; Jarvenpaa and Leidner, 1998; Powell et al, 2004). These challenges if not addressed and managed by the organization can threaten virtual teams’ success and
effectiveness (Piccoli et al. 2004). We argue that virtual teams can only thrive if individual team members can overcome the challenges to virtual collaboration and manage to work in a coordinated effort to solve problems together. This suggests the need for an improved understanding of how to create virtual teams that work effectively.

2.4.2. Online Collaboration

Collaboration can be successfully accomplished in traditional face-to-face-teams. However, the change from a physical to a virtual work space brings challenges to how members collaborate within the same team, with solely relying on information technology for communication and coordination. Information and communication technologies have significantly improved over the last two decades, and virtual teams are equipped with variety of tools and technologies to support their work. Therefore, researchers have called for investigating the social factors of virtual teams which could impact their effectiveness (Holton, 2001; Kirkman et al. 2004; Powell et al, 2004; Henttonen and Blomqvist, 2005). Durate and Snyder (2006) discuss seven types of virtual teams (i.e. networked teams, parallel teams, product development teams, production teams, service teams, management teams, and action teams), they argue that all of these teams have in common that team members must communicate and collaborate to achieve effective outcomes. Evidence in the literature suggests that when given sufficient time and managed properly, virtual teams could collaborate effectively compared to traditional teams (Holton, 2001; Webster and Wong, 2008).

From an organizational perspective, Kumar and Dissel (1996) argue that three arguments are needed to explain collaboration in an inter-organizational system, economic, technical, and socio-political. The social system in workplace is a platform for
continuous interplay between the technical process and the social process to meet the demands of an emerging and continuously changing work environment (Taylor, 1975). The importance of both technology usage and social relationships to a virtual team success is consistent with the Socio-Technical theory which states that organizations consist of two interacting systems; the social and the technical (Bostrom and Heinen, 1977). While the technical system includes the process, task, and technology dimensions, the social system explains how the relationships and interaction among individuals affect the system outcome (Bostrom and Heinen, 1977). An organizational system design which doesn’t successfully integrate both the technical and social systems is unlikely to produce effective outcome (Appelbaum, 1997).

Collaboration is different than coordination. While sometimes used interchangeably, a main difference between the two is the degree to which the work is coordinated among individuals. It is noted that collaboration requires higher level of coordination among individuals than cooperation (Dillenbourg, 1999). Previous studies have investigated why virtual team members share their knowledge especially outside the organization boundaries (Bechky, 2003, Wasko and Faraj, 2005). However, collaboration goes beyond sharing information or knowledge through a form of an information system, it’s about working together in a coordinated effort through continuous discussion and communication in order to jointly and collectively solve a problem. In face-to-face setting, Hoegl and Gemuenden (2001) define a team as “a social system of three or more people, which is embedded in an organization, whose members perceive themselves as such and are perceived as members by others, and whose members collaborate on a
common task.” Kudaravalli and Faraj (2008) argue that online collaboration has received limited attention in the literature.

2.5. Measurement Scale Development Process

The development of the measurement scale was carried out in four stages. The first stage involved investigating relevant literature to find out the constructs which influence a virtual team member intention to collaborate online. The second stage was item creation stage; the purpose of this stage is to create a pool of items for the constructs which were identified in the previous stage. The third stage was the scale development stage which included a panel of judges who were asked to categorize and sort the items created in the second stage. The final stage was the instrument testing stage which included a pilot test with a small sample of respondents to get an indication of the scale content validity and reliability. This stage also included a full scale study to test the final instrument. The following sections will describe these stages in detail.

2.5.1. Stage 1: Literature Investigation and Construct Identification

The first step in developing a measurement model of online collaboration is a thorough investigation of the literature on virtual teams, collaboration, and surrounding research areas. While there is a considerable volume of research which investigates online collaboration, much of it has focused on finding new constructs that contribute to online collaboration as opposed to understanding how different factors combine to influence an individual’s intention to collaborate.

Investigation of the literature on virtual teams’ collaboration and surrounding research areas revealed eleven dimensions. These dimensions, the studies in which they
were reported, and the context of each study are summarized in Table 1. It is noteworthy to point out that the list of studies in Table 1 is not inclusive; however, we found them to be most suitable to answer our research questions. Dimensions illustrated in Table 1 are mapped into three categories based on the context of the original studies and the theoretical support in the literature. These categories are intention to collaborate online dimensions, online collaboration dimensions, and moderating dimensions. The mapping of these factors is illustrated in Table 2.

Building on the preceding discussion, a research model depicting the constructs and relationships examined in this study is depicted in Figure 1. In the model, five antecedent dimensions identified in prior literature influence a virtual team member’s intention to collaborate online. Intention is relevant for this model because without intent, actual collaboration will not occur. This is consistent with the theory of reasoned action (TRA) which states that a person’s action is a function of his intention (Fishbein and Ajzen’s, 1975). As such "intention" is seen as the primary driver of actual collaboration online. The relationship between intention to collaborate online and online collaboration is moderated by the ability to meet in person and the availability of IT support. The remainder of this paper will focus on further understanding the relationship between these five dimensions and the intention to collaborate online. The study of actual online collaboration is beyond the scope of this study.

2.5.1.1. Perceived Incentives

Organizations offer incentives to motivate individuals to contribute activity, and the reward system is reported to affect organizational behavior (Clark and Wilson, 1961).
<table>
<thead>
<tr>
<th>Study</th>
<th>Context</th>
<th>dimension(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agarwal and Prasad (1997)</td>
<td>Technology Acceptance</td>
<td>Voluntariness</td>
</tr>
<tr>
<td>Bardram(1998)</td>
<td>CSCW</td>
<td>IT Support, communication, coordination</td>
</tr>
<tr>
<td>Fussell et al. (1998)</td>
<td>Virtual Teams</td>
<td>Communication, Coordination</td>
</tr>
<tr>
<td>Jarvenpaa et al. (1998)</td>
<td>Virtual Teams, Trust</td>
<td>Voluntariness, Coordination</td>
</tr>
<tr>
<td>Cramton (2001)</td>
<td>Virtual Teams, Knowledge sharing</td>
<td>Communication</td>
</tr>
<tr>
<td>Holton(2001)</td>
<td>Virtual Teams, Trust, and Collaboration</td>
<td>Communication, Meet in person</td>
</tr>
<tr>
<td>Montoya-Weiss et al. (2001)</td>
<td>Virtual Teams, Management</td>
<td>Coordination</td>
</tr>
<tr>
<td>Desanctis et.al.(2003)</td>
<td>Online Communities</td>
<td>Communication, IT Support, Openness</td>
</tr>
<tr>
<td>Hall and Graham (2004)</td>
<td>Online Communities</td>
<td>Incentives, Meet in person, Common Ground</td>
</tr>
<tr>
<td>Leinonen et.al. (2005)</td>
<td>Virtual Teams, Collaboration</td>
<td>Communication, Coordination</td>
</tr>
<tr>
<td>Wasko and Faraj (2005)</td>
<td>Online Communities, Collaboration</td>
<td>Background similarities, level of expertise, Incentives</td>
</tr>
<tr>
<td>Durate and Snyder (2006)</td>
<td>Virtual Teams, Management</td>
<td>Voluntariness</td>
</tr>
<tr>
<td>Metiu (2006)</td>
<td>Virtual Teams</td>
<td>Background similarities, Tension</td>
</tr>
<tr>
<td>Kanawattanachai and Yoo (2007)</td>
<td>Virtual Teams, Knowledge Coordination</td>
<td>Communication</td>
</tr>
<tr>
<td>Kudaravalli and Faraj (2008)</td>
<td>Online Communities, Collaboration</td>
<td>Background similarities, Communication, Different level of expertise, Voluntariness</td>
</tr>
<tr>
<td>Bjørn and Ngwenyama (2009)</td>
<td>Virtual Teams, Collaboration</td>
<td>Communication, common ground, Coordination</td>
</tr>
<tr>
<td>Hemetsberger and Reinhardt (2009)</td>
<td>Online Communities, Collaboration</td>
<td>IT Support, Openness, Tension</td>
</tr>
</tbody>
</table>
Table 2. Mapping Online Collaboration Dimensions

<table>
<thead>
<tr>
<th>Intention to Collaborate Online Dimensions</th>
<th>Moderators</th>
<th>Online Collaboration Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Background similarities</td>
<td>IT Support</td>
<td>Communication</td>
</tr>
<tr>
<td>Perceived Common Ground</td>
<td>Meet in person</td>
<td>Coordination</td>
</tr>
<tr>
<td>Perceived Different level of expertise</td>
<td></td>
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</tr>
<tr>
<td>Perceived Incentives</td>
<td></td>
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<tr>
<td>Perceived Voluntariness</td>
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</tbody>
</table>

Figure 1: Intention to Collaborate Online

Normally, there are incentives for a virtual team member to collaborate, some of which could be tangible (e.g. reward, bonus, promotion …etc.) while others could be intangible (reputation, recognition, personal satisfaction … etc.). Organizations implement reward systems to induce employees to contribute and teams to succeed (Hertel et al, 2004).

The literature on knowledge sharing reported that organizations had implemented reward systems and offer variety of incentives to promote knowledge sharing (Bock et al.
Hall and Graham (2004) reported that code breakers joined an online group to share knowledge and collaborate to break a code in the hope of winning an award. Hall and Graham (2004) also reported that some members were also interested achieving personal satisfaction and enhanced reputation which is consistent with the findings of Wasko and Faraj (2005) who argue that members contribute their knowledge when they perceive that it enhances their professional reputations.

The Social Exchange Theory explains social interaction in terms of reward expectations (Blau, 1964). Individuals have a tendency to maximize their rewards and reduce their cost (Emerson, 1976). Therefore if a reward system is implemented, virtual team members will be expected to work towards maximizing their benefits and will be more motivated to collaborate online with each other.

2.5.1.2. Perceived Voluntariness

Professionals join online communities voluntarily based on shared interest without any obligation to collaborate or any commitment to the community and its objectives. However, when organizations form teams, team members are mandated –or at least expected- to collaborate in order to solve problems and achieve a common goal. Since virtual team members can cooperate but not collaborate, we could look at collaboration as a form of voluntary cooperation in which team members not only work on a task, but they communicate with each other and coordinate their activities (Kudaravalli and Faraj, 2008). Thus, voluntariness could affect collaboration practices in virtual teams, mainly because individuals are more effective when they are guided by their own behavior and not forced to act in a certain way (Eisenberger and Cameron, 1996).
Virtual teams can be formed without a choice of their members, which could influence members’ intention to collaborate online because voluntariness is considered to be a form of social influence and voluntary membership is a principal element of collaboration (Roberts and Bradley, 1991; Durate and Snyder, 2006; Karahanna et al., 1999). Perceived voluntariness could have a bigger influence on behavior than actual voluntariness (Moore and Benbasat, 1991) and it has the potential to significantly affect individual behavior and intentions (Agarwal and Prasad, 1997).

The Unified Theory of Acceptance and Use of Technology (UTAUT) model – which is an extended version of the Technology Acceptance Model (TAM) - posits that voluntariness has an effect on behavioral intention and use behavior (Venkatesh et al., 2003). Hemetsberger and Reinhardt (2009) suggest that team leaders can at least coordinate tasks while giving virtual team members the freedom to choose what task each one of them would like to work on. Based on the preceding discussion, we posit that perceived voluntariness of online collaboration contribute to a virtual team member’s intention to collaborate online.

2.5.1.3. Perceived Common Ground

Crossing geographical boundaries affects the way in which virtual teams communicate and collaborate which makes reaching a common ground crucial for effective collaboration (Durate and Snyder, 2006; Alavi and Tiwana, 2002). The unique characteristics of virtual teams create challenges to develop common ground among team members (Alavi and Tiwana, 2002). Virtual team members are sometimes distributed across vast geographical areas and live in different time zones which constrain their ability to communicate and achieve a common ground.
In the absence of face-to-face interaction, developing common ground and shared understanding in technology mediated communication can be challenging. Empirical research has highlighted that virtual settings negatively affects the perceptions of their members (Burke et al. 1999). Studies have also demonstrated negative associations between the degree of virtualeness and communication which could affect virtual team member’s ability to establish a common ground in a timely manner (Cohen and Gibson, 2003; Webster and Wong, 2008). In order to overcome the challenges of virtual environments, virtual team members need to establish immediate, frequent, and effective communication channels among each other to reach a common ground in a timely manner (Kanawattanachai and Yoo, 2007).

Establishing common ground is a process of creating a shared meaning context among team members (Bjørn and Ngwenyama, 2009). This shared meaning need to be established in an early stage of virtual work or else the virtual team will be exposed to challenges which could lead to failure in achieving effective collaboration (Cramton, 2001). The establishment of common ground and shared context in virtual teams is complicated and challenging. Virtual team members –especially in global virtual team context- have different backgrounds, different work experience, different expectations, and sometimes language and cultural barriers. These challenges if not addressed properly could lead to failure in communication and interpretation which ultimately leads to failure in collaboration (Cramton, 2001). Based on the preceding discussion we argue that the perception of establishing mutual understanding and common ground among virtual team members impacts their intention to collaborate online because common ground facilitates communication and collaboration.
2.5.1.4. Perceived Background Similarities

Transforming from traditional team work into virtual team work changes the way work is carried out, which has an effect on the social aspects of team work. As members from different backgrounds join a virtual team, online collaboration becomes more difficult and can add problems and complications to virtual team work (Bechky 2003; Durate and Snyder, 2006). The existence of different backgrounds among team members could affect the structure and effectiveness of a virtual team, mainly because members of different backgrounds tend to have different ways of working together and collaborate with each other (Durate and Snyder, 2006).

The social categorization and the identity argument states that the more similar the group members are to one another, the more they identify with the group which in turn could influence members collaboration because individuals with similar backgrounds tend to develop relationships and collaborate together faster (Abrams et al. 2005; Webster and Wong, 2008).

According to social identity theory, people seek out certainty by identifying themselves within groups of members of similar attributes and characteristics (Ashforth and Mael, 1989). Considering that the uncertainty is relatively high in virtual teams, it is reasonable for team members to tend to identify themselves within groups of similar backgrounds (Tajfel and Turner, 1986). Based on the preceding discussion, we argue that background similarities among virtual team members impact their intention to collaborate online.
2.5.1.5. Perceived Members Expertise

Organizations establish teams in order to gather members of different skills and experience to collaborate on a common organizational task (Johnson, 2001). The prevalence of organizations establishing virtual teams and accept their challenges and overhead could be attributed to the need to recruit expert members to work across or outside the physical boundaries of organizations. Virtual teams enable members to bring different skills and expertise to help solve problems regardless of their physical location (Johnson, 2001; Wasko and Faraj, 2005).

The integration of expert users into virtual teams increases opportunities by enlarging the workforce and specialized knowledge within the team. Collaboration depends on the extent to which team members are able to locate the necessary knowledge within the team and retrieve it (Kanawattanachai and Yoo, 2007).

Diversity of expertise has a positive impact on online collaboration (Kudaravalli and Faraj, 2008). Having expert members in a virtual team leads to members benefit from each other, gain access to new information and ideas not available locally, and problem solving process is improved (Wasko and Faraj, 2005). Based on the preceding discussion we argue that having varying levels of expertise within a virtual team will have a positive influence on a virtual team member’s intention to collaborate.

2.5.2. Stage 2: Item Creation

The methodology used to develop the scale in this research is based on procedures described in Moore and Benbasat (1991) and in MacKenzie et al. (2011). The first stage was to create a number of items for the scale, the initial scale items were adopted from the literature on collaboration, virtual teams, online communities, computer supported
collaborative work, and knowledge sharing. Additional items were created through interviews and group discussions. An initial set of 75 items were developed in this stage. These initial items were reduced to 65 to eliminate narrow scope and ambiguous questions; we also made sure that each construct has at least 10 questions. Items were written as a statement to which the respondent can relate and indicate a degree of agreement or disagreement with using a seven point Likert scale ranging from strongly disagree to strongly agree.

2.5.3. Stage 3: Scale Development

The next stage was a pretest to refine the initial set of items in order to assess their content validity. In this stage a panel of seven expert judges was asked to sort the items into categories based on the similarities and differences among them. The judges were all PhD students with four of them have experience in virtual team work. They were given the set of items randomly distributed and the five constructs on which the items should be categorized along with an additional category for ambiguous or unclear items. The judges were also asked to rank order the items within each factor based on the closeness in meaning with the factor itself.

The card sort analysis revealed a confusion caused by the items of Perceived Members Expertise items and Perceived background similarities. All the judges misplaced items from both of these construct, the judges reported that these two constructs could easily be confused with one another. As this overlap between constructs represents a threat to the internal validity of the model we had to make a choice of either dropping one of the constructs, or dropping the items which threatened the internal validity and modifying the rest. We chose the second option.
<table>
<thead>
<tr>
<th>Factor</th>
<th>Item</th>
<th>Developed based on</th>
</tr>
</thead>
</table>
| Background Similarities  | • The background of my online team members does not influence my intention to collaborate with them  
                           | • I’m more likely to collaborate online with members with whom I share a similar culture  
                           | • I’m more likely to collaborate online with individuals with whom I share similar background  
                           | • My intention to collaborate online is positively affected by the diversity of my team members’ background and expertise  
                           | • Having team members of different backgrounds makes me less likely to collaborate online  
                           | • I tend to collaborate online with team members that have different backgrounds than mine  | (Webster and Wong, 2008)  
                           |                                                                         | (Jarvenpaa et al. 1998)  
                           |                                                                         | (Webster and Wong, 2008)  
                           |                                                                         | (Webster and Wong, 2008)  
                           |                                                                         | (Webster and Wong, 2008)  
                           |                                                                         | (Webster and Wong, 2008)  |
| Common Ground            | • I’m more likely to collaborate online when the team reaches common ground from the beginning  
                           | • Reaching a common ground has nothing to do with my intention to collaborate online  
                           | • Collaborating online requires me to engage in continuous communication with other team members to reach common ground  
                           | • I collaborate online even when my team members and I do not fully share the same vision of the problem we are trying to solve.  
                           | • Mutual understanding is essential for me to collaborate online  
                           | • It is not essential to have a mutual understanding with other team members for me to collaborate online  
                           | • For me to collaborate online, the team should share a common understanding of problems to be addressed.  | (Kudaravalli and Faraj, 2008)  
                           |                                                                         | (Kudaravalli and Faraj, 2008)  
                           |                                                                         | (Leinonen et al. 2005)  
                           |                                                                         | (Leinonen et al. 2005)  
                           |                                                                         | (Leinonen et al. 2005), (Kudaravalli and Faraj, 2008)  
                           |                                                                         | (Leinonen et al. 2005)  |
| Members Expertise        | • Having expert members on my team makes me more willing to collaborate online  
                           | • Diversity of members’ expertise in a virtual team encourages me to collaborate online  
                           | • I collaborate online with members who have expertise I can benefit from  
                           | • I collaborate online with team members who can benefit from my expertise  
                           | • Virtual team members’ expertise does not influence my intention to collaborate with them online.  | (Wasko and Faraj, 2005)  
                           |                                                                         | (Wasko and Faraj, 2005)  
                           |                                                                         | (Wasko and Faraj, 2005)  
                           |                                                                         | (Wasko and Faraj, 2005)  
                           |                                                                         | (Wasko and Faraj, 2005)  |
| Incentives               | • I collaborate with my online team members regardless of any incentives  
                           | • I expect to be rewarded by my organization or team supervisor when I collaborate online.  
                           | • I expect something in return when I collaborate with team members online  
                           | • I collaborate with others online to improve my image within the team  | (Kankanhalli et al. 2007)  
                           |                                                                         | (Kankanhalli et al. 2007)  
                           |                                                                         | (Kankanhalli et al. 2007)  
<pre><code>                       |                                                                         | (Kankanhalli et al. 2007)  |
</code></pre>
<table>
<thead>
<tr>
<th>Incentives (Cont.)</th>
<th>Items</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I only collaborate online when there are incentives for my collaboration</td>
<td>(Kankanhalli et al., 2007)</td>
</tr>
<tr>
<td></td>
<td>I’m less likely to collaborate online without getting something in return</td>
<td>(Agarwal and Prasad, 1997)</td>
</tr>
<tr>
<td></td>
<td>Collaborating online enhances my professional reputation</td>
<td>(Agarwal and Prasad, 1997)</td>
</tr>
<tr>
<td></td>
<td>I only collaborate online when there are incentives for my collaboration</td>
<td>(Kankanhalli et al., 2007)</td>
</tr>
<tr>
<td></td>
<td>I’m more likely to collaborate online when I voluntarily join the team</td>
<td>(Agarwal and Prasad, 1997)</td>
</tr>
<tr>
<td></td>
<td>I collaborate with other team members online even when not mandated by my organization</td>
<td>(Agarwal and Prasad, 1997)</td>
</tr>
<tr>
<td></td>
<td>I’m less Likely to collaborate with other team members online when I’m forced to do so</td>
<td>(Agarwal and Prasad, 1997)</td>
</tr>
<tr>
<td></td>
<td>Mandating online collaboration makes me less willing to collaborate with team members</td>
<td>(Agarwal and Prasad, 1997)</td>
</tr>
<tr>
<td></td>
<td>Mandating online collaboration makes me more willing to collaborate with team members</td>
<td>(Agarwal and Prasad, 1997)</td>
</tr>
<tr>
<td></td>
<td>I’m more likely to collaborate online when I choose to join a team</td>
<td>(Agarwal and Prasad, 1997)</td>
</tr>
</tbody>
</table>

Post card sorting interviews were conducted with the judges to further refine and improve the items. These interviews resulted in rewording some items to improve their clarity and dropping the items that the judges felt did not adequately represent the underlying construct they were measuring. This process resulted in a refined scale containing 33 items as listed in Table3.

2.5.3.1. Pilot Study

Before administering the scale on a large population, a pilot study was conducted to insure that the scale under development used clear and appropriate language and had no obvious errors (Johanson and Brooks, 2010). The objective of this pilot study was to provide additional insights regarding the content validity, clarity, and appropriateness of the survey questions and to further refine the survey items before using them in a larger study. The respondents first were asked to complete the questionnaire, and then comment
on the questions length, wording, redundancy, and total number of questions. The scale items were transformed into seven point Likert scale survey which was implemented on the web. A filtering question related to virtual team experience was added to the survey to insure that respondents have the background necessary to complete the survey.

The target population for the pilot study was MBA students at the University of Colorado Denver Business School. MBA students were a good fit for the pilot study because most of them are professionals working for companies in the Denver area. Control questions were also added to control for years of experience, membership and leadership, current virtual team membership, and global virtual team experience. A convenient sample of 15 MBA students was invited to participate in the survey via an invitation from the University of Colorado Denver MBA student club president. The pilot test with the MBA students was used to identify any additional problem with the survey.

The respondents provided feedback regarding the background similarities construct arguing that it was vague and difficult to answer its questions. The respondents reported that the definition of the word background was unclear and that they could interpret it in different contexts such as experience background, cultural background, and educational background. Furthermore, the respondents reported that some questions were vague and redundant. Eventually, based on the feedback of this pilot study the construct “background similarities” and 5 items from the remaining constructs were dropped from the study to improve the scale reliability and validity. The revised scale has 4 constructs with 21 questions, table 4 shows the final list of questions used in the survey.
Table 4: Measurement Items after Pilot Study

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Ground</td>
<td>• I’m more likely to collaborate online when the team reaches common</td>
</tr>
<tr>
<td></td>
<td>ground from the beginning</td>
</tr>
<tr>
<td></td>
<td>• Reaching a common ground has nothing to do with my intention to</td>
</tr>
<tr>
<td></td>
<td>collaborate online</td>
</tr>
<tr>
<td></td>
<td>• Collaborating online requires me to engage in continuous</td>
</tr>
<tr>
<td></td>
<td>communication with other team members to reach common ground</td>
</tr>
<tr>
<td></td>
<td>• I collaborate online even when my team members and I do not fully</td>
</tr>
<tr>
<td></td>
<td>share the same vision of the problem we are trying to solve.</td>
</tr>
<tr>
<td></td>
<td>• For me to collaborate online, the team should share a common</td>
</tr>
<tr>
<td></td>
<td>understanding of problems to be addressed.</td>
</tr>
<tr>
<td>Incentives</td>
<td>• I collaborate with my online team members regardless of any</td>
</tr>
<tr>
<td></td>
<td>incentives</td>
</tr>
<tr>
<td></td>
<td>• I expect to be rewarded by my organization or team supervisor when</td>
</tr>
<tr>
<td></td>
<td>I collaborate online.</td>
</tr>
<tr>
<td></td>
<td>• I expect something in return when I collaborate with team members</td>
</tr>
<tr>
<td></td>
<td>online</td>
</tr>
<tr>
<td></td>
<td>• I collaborate with others online to improve my image within the</td>
</tr>
<tr>
<td></td>
<td>team</td>
</tr>
<tr>
<td></td>
<td>• I’m less likely to collaborate online without getting something in</td>
</tr>
<tr>
<td></td>
<td>return</td>
</tr>
<tr>
<td></td>
<td>• Collaborating online enhances my professional reputation</td>
</tr>
<tr>
<td>Members</td>
<td>• Having expert members on my team makes me more willing to</td>
</tr>
<tr>
<td>Expertise</td>
<td>collaborate online</td>
</tr>
<tr>
<td></td>
<td>• Diversity of members’ expertise in a virtual team encourages me to</td>
</tr>
<tr>
<td></td>
<td>collaborate online</td>
</tr>
<tr>
<td></td>
<td>• I collaborate online with members who have expertise I can benefit</td>
</tr>
<tr>
<td></td>
<td>from</td>
</tr>
<tr>
<td></td>
<td>• I collaborate online with team members who can benefit from my</td>
</tr>
<tr>
<td></td>
<td>expertise</td>
</tr>
<tr>
<td></td>
<td>• Virtual team members’ expertise does not influence my intention to</td>
</tr>
<tr>
<td></td>
<td>collaborate with them online.</td>
</tr>
<tr>
<td>Voluntariness</td>
<td>• I only collaborate with online team members when I’m asked to</td>
</tr>
<tr>
<td></td>
<td>• I’m more likely to collaborate online when I voluntarily join the</td>
</tr>
<tr>
<td></td>
<td>team</td>
</tr>
<tr>
<td></td>
<td>• I collaborate with other team members online even when not</td>
</tr>
<tr>
<td></td>
<td>mandated by my organization</td>
</tr>
<tr>
<td></td>
<td>• I’m less Likely to collaborate with other team members online when</td>
</tr>
<tr>
<td></td>
<td>I’m forced to do so</td>
</tr>
<tr>
<td></td>
<td>• Mandating online collaboration makes me less willing to collaborate</td>
</tr>
<tr>
<td></td>
<td>with team members</td>
</tr>
</tbody>
</table>

24
### Table 5: Number of items after Pilot Study

<table>
<thead>
<tr>
<th>Construct</th>
<th>Number of deleted items</th>
<th>Number of final items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Incentives</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Perceived Common Ground</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Perceived Member Expertise</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Perceived Voluntariness</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

#### 2.5.4. Stage 4: Instrument Testing - Field Study

Once the measurement model has been formally specified, data need to be obtained from a sample of respondents in order to examine the scale and to evaluate its convergent, discriminant, and nomological validity (MacKenzie et al. 2011). The measurement scale was implemented as an online survey and respondents were recruited from professional groups in linkedin.com. The groups we used as a sample frame are listed in Appendix I. The total number of members in these groups was 1372, 118 responses are obtained with a response rate of 8.6%. The number of usable responses after eliminating incomplete surveys is 103.

The statistical analysis implemented in this study is adapted from Moore and Benbasat (1991). The constructs are first tested for reliability and validity. Reliability is tested using Cronbach’s alpha with a value of at least 0.70 indicates adequate reliability. In order to improve the reliabilities of the corresponding constructs, one or more questions could be dropped from the study.

The scale is tested for validity using factor analysis with principal components analysis. Convergent validity is assessed by checking loadings to see if items within the same construct correlate highly amongst themselves. Furthermore, discriminant validity is assessed by examining the factor loadings to see if questions loaded more highly on
their intended constructs than on other constructs (Kankanhalli et al. 2005). Loadings of 0.63 to 0.70 are considered very good, and above 0.71 are considered excellent (Hair et al. 2009). Questions which could load onto other constructs are dropped.

2.5.4.1. Perceived Incentives

Reliability test for perceived incentives resulted in a very poor alpha value. According to the correlation table (Table 6), two of the six perceived incentives items have very poor correlation with rest of the items. So we decided to drop these items and run the reliability test again without them. The reliability results for perceived incentives after dropping items 4 and 6 are shown in table 8 which illustrates that alpha value now is 0.962, which indicates excellent reliability.

Table 6: Reliability Statistics – Perceived Incentives

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.411</td>
<td>.757</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 7: Correlation Matrix - Perceived Incentives

<table>
<thead>
<tr>
<th></th>
<th>INC1</th>
<th>INC2</th>
<th>INC3</th>
<th>INC4</th>
<th>INC5</th>
<th>INC6</th>
</tr>
</thead>
<tbody>
<tr>
<td>INC1</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INC2</td>
<td>.901</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INC3</td>
<td>.814</td>
<td>.862</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INC4</td>
<td>.045</td>
<td>.000</td>
<td>.021</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INC5</td>
<td>.809</td>
<td>.858</td>
<td>.948</td>
<td>.018</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>INC6</td>
<td>.046</td>
<td>.093</td>
<td>.106</td>
<td>.442</td>
<td>.121</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 8: Reliability Statistics Repeat – Perceived Incentives

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.962</td>
<td>.963</td>
<td>4</td>
</tr>
</tbody>
</table>
2.5.4.2. Perceived Voluntariness

Reliability test for perceived voluntariness resulted in an adequate alpha value of (0.78). However, according to the correlation matrix (Table 11), item “VOL5” has a very poor correlation with most of the items. So we decided to drop this item in order to improve the scale’s reliability. After removing VOL5 we ran the reliability test again. The reliability results for perceived voluntariness is shown in table 12 which illustrates that alpha value now is 0.959, which indicates excellent reliability.

Table 9: Correlation Matrix Repeat - Perceived Incentives

<table>
<thead>
<tr>
<th></th>
<th>INC1</th>
<th>INC2</th>
<th>INC3</th>
<th>INC5</th>
</tr>
</thead>
<tbody>
<tr>
<td>INC1</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INC2</td>
<td>.901</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INC3</td>
<td>.814</td>
<td>.862</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>INC5</td>
<td>.809</td>
<td>.858</td>
<td>.948</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 10: Reliability Statistics – Perceived Voluntariness

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Cronbach's Alpha Based</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.780</td>
<td>.850</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 11: Correlation Matrix - Perceived Voluntariness

<table>
<thead>
<tr>
<th></th>
<th>VOL1T</th>
<th>VOL2</th>
<th>VOL3</th>
<th>VOL4</th>
<th>VOL5</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOL1T</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOL2</td>
<td>.958</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOL3</td>
<td>.836</td>
<td>.840</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOL4</td>
<td>.790</td>
<td>.793</td>
<td>.926</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>VOL5</td>
<td>.004</td>
<td>.041</td>
<td>.090</td>
<td>.040</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 12: Reliability Statistics Repeat – Perceived Voluntariness

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.959</td>
<td>0.960</td>
<td>4</td>
</tr>
</tbody>
</table>
2.5.4.3. Perceived Common Ground

Reliability test for perceived common ground resulted in an adequate alpha value of (0.762). However, according to the correlation matrix (Table 15), item “CGD3” has a very poor correlation with most of the items in the scale. So this item was dropped in order to improve the scale’s reliability. After removing CGD3 we ran the reliability test again. The reliability results for perceived voluntariness is shown in table 16 which illustrates that alpha value now is 0.938, which indicates excellent reliability.

Table 13: Correlation Matrix Repeat - Perceived Voluntariness

<table>
<thead>
<tr>
<th></th>
<th>VOL1T</th>
<th>VOL2</th>
<th>VOL3</th>
<th>VOL4</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOL1T</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOL2</td>
<td>.958</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOL3</td>
<td>.836</td>
<td>.840</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>VOL4</td>
<td>.790</td>
<td>.793</td>
<td>.926</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 14: Reliability Statistics – Perceived Common Ground

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.762</td>
<td>.827</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 15: Correlation Matrix - Perceived Common Ground

<table>
<thead>
<tr>
<th></th>
<th>CGD1</th>
<th>CGD2</th>
<th>CGD3</th>
<th>CGD4</th>
<th>CGD5T</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGD1</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGD2</td>
<td>.851</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGD3</td>
<td>.030</td>
<td>.056</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGD4</td>
<td>.762</td>
<td>.803</td>
<td>-.011</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>CGD5T</td>
<td>.762</td>
<td>.783</td>
<td>-.017</td>
<td>.863</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 16: Reliability Statistics Repeat – Perceived Common Ground

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.938</td>
<td>.943</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 17: Correlation Matrix Repeat - Perceived Common Ground

<table>
<thead>
<tr>
<th></th>
<th>CGD1</th>
<th>CGD2</th>
<th>CGD4</th>
<th>CGD5T</th>
</tr>
</thead>
<tbody>
<tr>
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2.5.4.4. Perceived Members’ Expertise

Reliability test for perceived members’ expertise resulted in an adequate alpha value of (0.812). However, according to the correlation matrix (Table 19), item “EXP5” has a very poor correlation with most of the items. So this item was dropped in order to improve the scale’s reliability. After removing EXP5 we ran the reliability test again. The reliability results for perceived voluntariness is shown in table 20 which illustrates that alpha value now is 0.959, which indicates excellent reliability.

Table 18: Reliability Statistics – Perceived Members’ Expertise

<table>
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<th>Cronbach's Alpha</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
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Table 19 : Correlation Matrix – Perceived Members’ Expertise

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Table 20: Reliability Statistics – Perceived Members’ Expertise

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Factor analysis was used as another assessment of construct validity. Principal Components analysis was conducted with VARIMAX rotation. The initial analysis included all the items including those which demonstrated poor correlation with items in the same variable. The results in table 22 indicate that the items resulted in 8 factors, while our proposed model includes only 4 factors.

The rotated factor matrix was examined for items which either did not load strongly on any factor (<0.40), or were too complex -which loaded highly or relatively equally on more than one factor. The rotated factor matrix in table 23 shows that the items which affected the reliability analysis are the same items which either have poor loading, load on a different construct than the one it should load onto, or load on a separate construct. Thus, these items were dropped from the scale, and a second factor analysis was conducted. This analysis again used Principal Components with VARIMAX rotation. While the first analysis was exploratory, this analysis was conducted to confirm that the items dropped in the previous validation steps resulted in factors that loaded onto the correct construct (e.g. Moore and Benbasat, 1991). As demonstrated in the factor matrix in table 22, a fairly simple factor structure emerged. No item loaded highly on more than one factor. Furthermore, all items remaining in the various scales loaded together on the target factor in the excellent range. These results indicate that the various scales achieved a high degree of unidimensionality.

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Table 23: Rotated Component Matrix
### Table 24: Rotated Component Matrix - Repeat

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### Table 25: Total Variance Explained

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2.6. Limitations and Future Work

A limitation of this research is that it examines self-reported intention to collaborate as opposed to actual collaboration. This study relies on the theoretical foundation in the Theory of Reasoned Action (TRA) which argues that a person’s action is a function of his intention. However, intention to collaborate is only a proxy for the actual outcome organizations wish to achieve, actual collaboration. One benefit of developing this model and measurement scale for intention to collaborate online is that, future studies can use this scale to address actual collaboration in a real world setting. This will allow researchers to better understand whether factors influence intention to collaborate have the same effect on actual observable collaboration.

A second limitation of this research is that it utilized subjects recruited from a social network website instead of a traditional organizational setting. This environment is appropriate to recruit members because a number of online groups do coordinate as virtual teams (e.g. for group members working for the same organization). However, recruiting in such an environment may have implications with respect to the types of antecedents to virtual team participation that are present in the sample. Specifically, the sample may include more members that are participating in virtual teams voluntarily than would be seen in a more traditional organizational setting. Future research should examine a sample from an organizational setting so the scale can be tested with a population which may have exposure to a different set of antecedent factors influencing virtual team participation and collaboration.

Lastly, because items could be added, dropped, or reworded in the scale test process, future work could retest the measurement model using a new sample of data.
2.7. Implications to Research and Practice

This study provides important implications for both research and practice. The study proposes a conceptual research model and a validated measurement scale for virtual team members’ intention to collaborate. The theoretical background which supports the study is found in the Socio-Technical Theory and the Theory of Reasoned Action.

For research, this study calls for a better understanding of the social aspects surrounding virtual team members’ collaboration. Building upon the Socio-Technical Theory this research suggests that technology advancement alone does not facilitate online collaboration in virtual teams, social aspects of virtual teams plays an important role in their collaboration as well. Prior research has reported several factors which contribute to virtual team collaboration. This study, however, investigated how these factors combine to influence a virtual team member’s intention to collaborate. The contribution of this study will enable researchers to rely on a validated measurement scale and conceptual model to further investigate online collaboration construct and its interaction with other constructs in virtual team settings. Future work could retest the model presented in this paper or use this model in a study where online collaboration is one of the constructs.

For practice, this study provides noteworthy implications regarding the importance of social characteristics and social relationships among virtual team members in fostering an environment of collaboration within the team in the organization. Today there is increased adoption of virtual teams in organizations and there is a need for improved inter-organizational cooperation. Given that collaboration is essential for teamwork, this study provides key implications to practice on how to establish and manage
virtual teams which collaborate effectively. It also provides insights into how to integrate technology and social characteristics in a way that serves virtual team objectives.

2.8. Conclusion

The advancement in information and communication technologies along with globalization and inter-organizational cooperation allowed organizations to establish teams regardless of members’ physical locations. Virtual team members are expected to collaborate online to solve problems. This study investigated the factors which influence a virtual team member’s intention to collaborate online.

Prior research on virtual teams’ collaboration focused primarily on technical factors with little attention to the social issues surrounding their work. Research which investigated social aspects of virtual teams’ collaboration has focused on finding new constructs that contribute to online collaboration without examining how different factors combined influence a virtual team member intention to collaborate.

This study investigated the factors which influence online collaboration in virtual team settings that were reported in the literature. The contributions of this study include a conceptual model for online collaboration and a measurement scale to test this model. The measurement scale was pretested and refined through a card sort exercise and validated through a pilot and a field study. Additional research is necessary to further validate the measurement scale and evaluate its generalizability across different virtual team environments.

3.1. Abstract

Virtual teams are utilized by organizations to gather experts to collaborate online in order to accomplish organizational tasks. However, the characteristics of these teams create challenges to effective collaboration and effective team outcome. Collaboration is an essential component of teamwork, the notion of forming teams in organizations is the need for members with complementary skills and expertise to collaborate in order to achieve the goal for which the team is established. Literature on virtual teams has been growing for over a decade with researchers investigating different aspects of virtual work. Trust among virtual team members has been investigated by information systems researchers as a crucial challenge for virtual teams success. Knowledge sharing and management in virtual teams has been the focus of recent research studies as it represents a challenge in virtual work environments; specifically because the knowledge is scattered among geographically distributed team members with the absence of face to face interaction. This study extends the literature on virtual teams by investigating the relationship between knowledge sharing, trust, and collaboration among team members in virtual team settings; and examining how these constructs ultimately affect virtual team effectiveness. We argue that knowledge as a valuable asset of virtual team members’ is a key factor influencing virtual team effectiveness.

This research introduces a conceptual model which describes the hypothesized relationship between knowledge sharing, trust, collaboration, and team effectiveness in virtual team settings. The model is developed based on an intensive review of the
literature on the constructs of interest in both traditional and virtual team settings. The theoretical foundation for the model is found in the Knowledge Based Theory of The Firm, Social Capital Theory, and the Social Exchange Theory. The study extends the Knowledge Based Theory of the Firm by improving our understanding of how knowledge sharing impacts trust, collaboration, and virtual team effectiveness.

3.2. **Keywords**: Virtual team, Knowledge sharing, Trust, Collaboration, Team effectiveness.

3.3. **Introduction**

The web and surrounding technologies are continuously and rapidly improving. The web is providing a platform for individuals to communicate and collaborate, and it is continuously shifting towards a more user centric experience (Lai and Turban, 2008). On an organizational level, the Web offers organizations a means to address their business needs and collaborate with each other (Zwass, 2003). Web 2.0 and the variety of tools it provides (e.g. blogs, wikis, and social bookmarking) have led to the emergence of new kinds of services such as social networks, aggregation services, and cloud based software applications. These tools provide a means for organizations to establish teams based on required expertise regardless of the physical location of individual team members.

Literature on inter-organizational systems highlights the role of information technology in enabling organizations to form alliances and collaborate with each other to deliver a new product or service. Nowadays, inter-organizational collaboration became crucial for a rapid response in a market where new products require numerous organizations working together to produce (Kumar and Dissel, 1996; Zwass, 2003). The
significance of establishing virtual teams is that physical boundaries and barriers vanish, which enables a more efficient inter-organizational collaboration.

In the knowledge-based view of the firm (Nonaka 1994), organizations treat knowledge as an asset and a key factor for improving both the organization and its individuals. Organizations nowadays are considered knowledge-focused systems as they are continuously realizing the significance of knowledge as a valuable asset which has the potential to prosper them in their markets, maximize their economic value, and improve their effectiveness (Gold et. al. 2001; Alavi and Leidner, 2001). There exists a considerable body of research in Information Systems literature which has investigated knowledge management systems (KMS). The objective of deploying KMSs in organizations is to support and improve the different components of knowledge management process which are knowledge creation, storage, transfer, and application within and among different entities of the organization (Alavi and Leidner, 2001).

Organizations form teams to work on sophisticated organizational tasks. The advantage of team structure is that it integrates the knowledge that is distributed among team members, which facilitate achieving more effective problem solving (Lam, 2000). Teams are organizational instrument which often considered being the solution for large, complex, and non-routine tasks which if managed properly can lead to an increase in organizational value (Alavi and Tiwana, 2002). Virtual teams are groups of individuals who are distributed across different physical locations and required to communicate and collaborate using information technology (Jarvenpaa, 1998; Powel et al. 2004). Virtual teams provide a convenient solution for integrating knowledge that is distributed across the organization or across different organizations. The steady increase of organizational
reliance on the practice of virtual teams is attributed to five main reasons according to Townsend et al. (1998) which are the modern structure of organizations which tends to be horizontal rather than vertical, the need for inter-organizational collaboration to produce quality products and services, continuous globalization were organizations are spanning across vast geographical locations, the interest of organizations in providing services not manufacture products, and to employee preferences in which organizations address their need for team members who hold specialized knowledge regardless of their physical location, while employees can belong to an organization without the need to move to its physical location. Nevertheless, virtual teams also offer unique challenges as they encompass members with complex traits and characteristics including absence of prior shared work history, different cultures and backgrounds, and the chance of working with members outside the organization boundaries. These challenges, if not addressed and managed properly by the organization, could jeopardize virtual teams’ effectiveness and success.

The theme for establishing teams in organizations is to bring together members with the necessary expertise and skills to collaborate on an organizational task (Hoegl and Gemuenden, 2001). When the team is a virtual one, collaboration becomes more complex since team members are separated through time and/or space which indicates that online collaboration among virtual team members requires more effort and different means for communication and coordination to be effective (Riegelsberger et. al. 2003; Piccoli et al. 2004).

This study extends the literature on virtual teams through investigating the role of knowledge sharing and trust in enabling collaboration in virtual team settings; and how
this will ultimately affect the team outcome by measuring its effectiveness. Individuals consider knowledge to be a personal advantage and sharing it leads to loss of ownership of this knowledge and consequently loss of power and potential replacement, which makes them hoard their knowledge for themselves and be reluctant to share it (Kankanhalli et. al. 2005). Nonetheless, sharing knowledge and exchanging ideas is crucial for team collaboration. An effective virtual team, is one which its team members put the success of the team ahead of their personal tendency to hoard knowledge for themselves.

Several studies have reported the importance of trust as a factor to virtual teams’ success and effectiveness (Jarvenpaa and Leidner, 1998; Zolin et al. 2004; Glen, 2002; Steinfeld, 2002; Henttonen and Blomqvist. 2005, Ulriksson and Ayani 2005). However, in virtual team settings, building trust among team members is a complex task mainly because of the absence of observed behaviors which members of traditional face-to-face teams rely upon to establish and maintain trust. Therefore, virtual team members need to rely on different behaviors to assess trustworthiness among each other in order for them to compensate for the lack of physically observed behaviors. As a personal advantage and a valuable personal asset, we argue that knowledge sharing could be considered a significant behavior which virtual team members can observe and use to build trust.

The practice of virtual teams has provides organizations the ability to work across physical and geographical boundaries. Yet, this structure brings with it some unique challenges (Boudreau et. al. 1998). Knowledge exists in the individual and in the group (Nonaka 1994); individuals create knowledge in the first place, organizations and teams do not create knowledge by themselves. The purpose of a team is to create a social
knowledge through the interaction and collaboration of team members (Alavi and Leidner 2001). Nevertheless, transforming individual knowledge into a social knowledge is not an easy task. Even if the proper technology is in place, individuals tend to hoard knowledge for different reasons; primarily they hoard their knowledge and selectively release part of it in order to appear valuable to their organization (Gilmour, 2003; Bock et.al. 2005). Therefore, knowledge sharing across the organization depends on employees' willingness to share and contribute their knowledge through a form of a knowledge management system (Bock et al. 2005). The reluctance of employees to share knowledge has serious consequences which have the potential to hinder team collaboration and could lead to a team that is unsuccessful in achieving its goals (Van den Bosch et al. 1999).

The purpose of this research is to investigate the hypothesized relationship between knowledge sharing, trust, collaboration, and team effectiveness among virtual team members. We argue that knowledge as a valuable asset and higher trust among virtual team members, will lead to better collaboration and a more effective virtual team. This research is designed to answer the following research questions:

1. Does sharing knowledge influence trust in virtual teams?
2. Does sharing knowledge influence collaboration in virtual teams?
3. Does collaboration influence virtual team effectiveness?
4. Does trust influence the relationship between collaboration and team effectiveness in virtual teams?

Answering these questions will allow researchers to better understand virtual teams and the factors which contribute to their effectiveness. This study will also provide
guidance to organizations about how to design and manage virtual teams in a way which encourages collaboration and enhances team effectiveness.

The reminder of this paper is structured as follows: Section 2 presents a literature review which focuses on virtual teams, trust, knowledge sharing and management, collaboration, and team effectiveness. Section 3 presents the theoretical model of the research and hypotheses development. Section 4 presents the methodology we used to conduct this research. Section 5 presents a discussion of the results. Section 6 discusses the research limitation. Finally, the paper concludes with a summary and implications for future research.

3.4. Literature Review

Virtual teams have been widely investigated by researchers over the past two decades with trust and collaboration being identified as crucial factors for virtual team success. The literature on knowledge sharing and management in the organization has been growing tremendously in the past few years. Organizations are increasingly realizing the importance of knowledge as an asset for competitive and sustainable advantage. In this section, we present streams of research in the literature which investigated knowledge sharing, trust, and collaboration in virtual team settings.

3.4.1. Virtual Teams

Following Hoegl and Gemuenden we define a team as “a social system of three or more people, which is embedded in an organization, whose members perceive themselves as such and are perceived as members by others, and whose members collaborate on a common task.” (Hoegl and Gemuenden, 2001).
Teams are one form of a social system that is embedded within an organization. As a social system, there is a set of human relationships in which the act of one individual affects all other individuals in the same social system. Organizations establish teams to work collaboratively on a common task, in their definition of a team Katzenbach and Smith (1993) argue that the characteristics of team members should include complementary skills, they must be committed to achieve a common goal that is set by the organization, and they need to hold themselves mutually accountable for the success or failure of the team mission.

Organizations rely on teams to work on complex and non-routine tasks, and to achieve an effective outcome, the underlying assumption is that team members are expected to collaborate to achieve quality collective performance which exceeds an individual team member’s performance (Gardner, 2012; Griffith et al. 2003). The structure of teams has changed dramatically over the past two decades. Teams are increasingly becoming virtual, in that they are often geographically dispersed and mainly rely on using information technology to communicate and collaborate (Jarvenpaa and Leidner 1999). Different terms and synonyms are cited in the literature to describe virtual teams such as distributed teams (Gorton and Motwani, 1996; Mortensen and Hinds, 2001; Hinds and Bailey, 2003) and Technology Mediated Teams (Henttonen and Blomqvist, 2005; Fuller et.al, 2006) with the majority using the term Virtual Teams. Following Powel et al. we define virtual teams as “A group of geographically, organizationally and/or time dispersed workers brought together by information and communication technologies to accomplish one or more organizational tasks” Powel et al. (2004).
Traditionally, virtual teams used to be established to work on temporary projects with a short life cycle; these teams were mainly established based on a need to quickly gather necessary expertise to solve complex or non-routine problems. Squire and Johnson (2000) argued that virtual teams are formed as need for them arises in the organization, which means that as soon as virtual team members finish the required work task the team is disassembled. These characteristics of early virtual teams made them more of task oriented with limited opportunities to form social relationships (Jarvenpaa et al. 1998).

Recently, however, organizations are increasingly establishing virtual teams to work on everyday routine and non-routine tasks. Furthermore, several organizations are allowing their employees to work virtually from the physical location of their preference. Griffith et al. (2003) describe this as the degree of team virtualness (i.e. some teams are completely distributed while others are a combination of co-located and distributed members).

Powel et al. (2004) identifies four major categories of virtual team research. They include inputs (i.e. design, culture, technical, and training), socio-emotional process (i.e. relationship building, cohesion, and trust), task process (i.e. communication, coordination, and task-technology-structure fit), and outputs (i.e. performance and satisfaction). Table 26 illustrates research in the literature which investigated one or more of those research categories.

Moving from traditional to virtual teams practice has an impact on organizational structure. While virtual teams offer unique benefits for organizations, they are not without their challenges. Virtual team challenges mainly stem from the fact that members are distributed among different physical locations; and their communication and
collaboration is mediated by technology. Reported challenges include time difficulties, feedback delays, misinterpretation, cultural barriers, scheduling conflicts, lack of communication, and delayed responses (Fussell et al. 1998; Jarvenpaa and Leidner, 1998; Alavi and Tiwana 2002; Powell et al, 2004). These challenges, if not addressed properly and managed, can threaten the success and effectiveness of virtual teams (Piccoli et al. 2004).

Table 26: Virtual Team Research Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Research</th>
<th>Research Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Kristof et. al. 1995</td>
<td>Design</td>
</tr>
<tr>
<td></td>
<td>Snow et. al. 1996</td>
<td>Design</td>
</tr>
<tr>
<td></td>
<td>Gorton and Motwani, 1996</td>
<td>Design</td>
</tr>
<tr>
<td></td>
<td>Townsend et. al. 1998</td>
<td>Design, culture</td>
</tr>
<tr>
<td></td>
<td>Boudreau et. al. 1998</td>
<td>Design, technical</td>
</tr>
<tr>
<td></td>
<td>Squire and Johnson, 2000</td>
<td>Technical</td>
</tr>
<tr>
<td>Socio-Emotional</td>
<td>Handy, 1995</td>
<td>Trust</td>
</tr>
<tr>
<td>Processes</td>
<td>Meyerson et. al. 1996</td>
<td>Trust</td>
</tr>
<tr>
<td></td>
<td>Jarvenpaa et. al. 1998</td>
<td>Trust</td>
</tr>
<tr>
<td></td>
<td>Mortensen and Hinds, 2001</td>
<td>Cohesion</td>
</tr>
<tr>
<td></td>
<td>Bhattacherjee, 2002.</td>
<td>Trust</td>
</tr>
<tr>
<td></td>
<td>Hinds and Bailey, 2003</td>
<td>Relationship building, Cohesion</td>
</tr>
<tr>
<td></td>
<td>Henttonen and Blomqvist, 2005</td>
<td>Trust</td>
</tr>
<tr>
<td></td>
<td>Chandra et. al. 2011</td>
<td>Trust</td>
</tr>
<tr>
<td></td>
<td>Koehne et. al. 2012</td>
<td>Relationship building, Cohesion</td>
</tr>
<tr>
<td>Task Processes</td>
<td>DeSanctis, 1999</td>
<td>Communication processes</td>
</tr>
<tr>
<td></td>
<td>Alavi and Tiwana, 2002</td>
<td>Knowledge sharing</td>
</tr>
<tr>
<td></td>
<td>Steinfeld et. al. 2002</td>
<td>Communication</td>
</tr>
<tr>
<td></td>
<td>Griffith et. al. 2003</td>
<td>Task-Technology- Structure fit</td>
</tr>
<tr>
<td></td>
<td>Chiu et. al. 2006</td>
<td>knowledge sharing</td>
</tr>
<tr>
<td></td>
<td>Kanawattanachai and Yoo, 2007</td>
<td>Coordination</td>
</tr>
<tr>
<td>Outputs</td>
<td>Piccoli et. al. 2004</td>
<td>Effectiveness</td>
</tr>
<tr>
<td></td>
<td>Fuller, 2006</td>
<td>Efficacy</td>
</tr>
<tr>
<td></td>
<td>Kanawattanachai and Yoo, 2007</td>
<td>Performance</td>
</tr>
<tr>
<td></td>
<td>Heath et. al. 2011</td>
<td>Performance</td>
</tr>
</tbody>
</table>
Team effectiveness has to do with group-produced outputs and the reward system the organization implements for team members (Piccoli et al. 2004). An effective virtual team needs to achieve its objectives, perform as a cohesive group in which everyone is accountable for the outcome, produce high quality output, and team members need to have a sufficient level of satisfaction with the work outcome and with one another. Accordingly, team effectiveness in virtual settings has two dimensions, performance and satisfaction (Lurey and Raisinghani, 2001; Piccoli et al. 2004).

The principle for investigating virtual teams in Information Systems is to expand our understanding of how technology mediated interaction affect virtual team performance and effectiveness especially when compared to traditional face-to-face team settings (Potter and Balthazard, 2002). Nonetheless, virtual team performance should not be attributed solely to the technology which team members use for communication and collaboration; a major influence on virtual team performance should be attributed to the social interaction and social capital among team members (Potter and Balthazard, 2002). According to social presence theory, “communication is effective if the communication medium has the appropriate social presence required for the level of interpersonal involvement required for a task” (Sallnas et al. 2000). In this research, we extend the literature by investigating how the factors of knowledge sharing and trust affect team effectiveness through enabling collaboration among virtual team members.

### 3.4.2. Knowledge Sharing and Management

Knowledge is an organizational asset and a significant organizational resource which has the potential to improve an organization competitive advantage (Nonaka, 1994; Alavi and Leidner, 2001). Nonaka and Takeuchi (1995) define knowledge as “a
dynamic process of justifying personal belief towards the truth” and Liebeskind (1996) defines it as “information whose validity has been established through tests of proof”. Nonaka (1994) conceptualized two dimensions of knowledge in organizations: tacit and explicit. The tacit dimension of knowledge is considered to be personal, complex, difficult to explain or share, and comprised of both cognitive and technical elements (Nonaka 1994). The cognitive element is considered to be an individual's mental models which were developed through experience, test, and proof in the mind of an individual. The technical element refers to knowledge which can be codified, shared, and communicated from one individual to another (Nonaka, 1994; Alavi and Leidner, 2001). The interaction between these two knowledge dimensions results in four modes of knowledge conversion according to Nonaka and Takeuchi (1995) who introduced the spiral of knowledge (Figure 2) to describe these dimensions. These modes are socialization, externalization, combination, and internalization. These four modes are considered essential for knowledge creation and sharing in the organization.

![Figure 2: Spiral of knowledge – Adapted from Nonaka and Takeuchi (1995)](image)
Since knowledge is considered a valuable organizational asset, managing it, enforcing adequate policies, and implementing Knowledge Management Systems (KMS) become an organizational necessity. The process of knowledge management in the organization aims to identifying knowledge throughout the organization, make it available and accessible, and use it to improve the organization competitive advantage (Davenport and Prusak, 1998; von Krogh, 1998; Alavi and Tiwana, 2002).

KMS is a category of information systems which organizations implement to support the processes of knowledge creation, storage, transfer, and application throughout the organization (Alavi and Leidner, 2001; Gallupe, 2001) describes three levels of knowledge management technologies illustrated in Table 27 which are: KMS tools, KMS generators, and Specific KMS. There exist a rich literature on user technology acceptance (e.g. Davis, 1985) when it comes to using technology, and in the case of knowledge sharing and management an important issue arises which is users willingness to share their knowledge and seek other’s knowledge using a KMS (Bock et.al. 2005; Kankanhalli et. al. 2005). While technological capabilities are important, implementing a KMS does not guarantee a successful knowledge management process. For a KMS to be used and utilized effectively, the organization needs to address both the social and technical dimensions of KMSs usage (Kankanhalli et. al. 2005).

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>KMS Tools</td>
<td>Programming languages, Database Management Systems</td>
</tr>
<tr>
<td>Level 2</td>
<td>KMS Generators</td>
<td>Lotus Notes, emails</td>
</tr>
<tr>
<td>Level 3</td>
<td>Specific KMS</td>
<td>OracleKM, SalesForce</td>
</tr>
</tbody>
</table>
3.4.2.1. Organizational Knowledge Management Processes

Following Alavi and Leidner (2001), an organizational knowledge management process includes a set of four processes: knowledge creation, knowledge storage/retrieval, knowledge transfer, and knowledge application. Organizational knowledge creation includes developing new knowledge or replacing an existing one (Pentland 1995). Knowledge is normally created by an individual within the organization, but the interchange and the spiral of knowledge as described by Nonaka (1994) (See Figure 2 section 3.4.2) integrates and transforms the knowledge to make it available throughout the organization (Nonaka 1994; Alavi and Leidner, 2001).

Organizational memory refers to the information and coded knowledge which are stored in a form of repository within the organization and accessible by its individual (Walsh and Ungson, 1991). Knowledge could be stored in various forms within the organization including written documentation, digital repositories, and as tacit knowledge in the mind of the individuals (Alavi and Leidner 2001; Tan and Hung, 2006). However, the main challenge in the organizational knowledge management process is making the stored knowledge accessible by individuals throughout the organization. From a technical perspective, KMSs are implemented to support this process. Nevertheless, technology support does not guarantee a successful integration and transfer of knowledge within the organization; unless the organization implement a comprehensive knowledge management strategy which takes into consideration both the technical and the social dimensions of knowledge, the effectiveness of the KMS will be difficult to estimate (Alavi and Leidner, 1999; Kankanhalli et. al. 2005).
Transactive memory refers to the process of sharing and exchanging knowledge within a group. In traditional team settings, transactive memory is developed through interaction among team members and is considered to have an influence on team performance and effectiveness (Alavi and Tiwana, 2002; Choi et al. 2010). However, in virtual team setting transactive memory is more complex and takes longer time to develop, mainly because team members are geographically distributed and interact through a communication medium which has the potential to negatively impact team effectiveness. In traditional team settings, research has found that knowledge sharing is critical for team effectiveness (Powell et al. 2004). Considering the distributed nature of organizational cognition, an important process of knowledge management in organizational settings is the transfer of knowledge to locations where it is needed and can be used. The distributed and fragmented nature of virtual teams leads to the fragmentation of knowledge among different team members who reside in different locations which make knowledge sharing and integration difficult to be accomplished when compared to traditional team settings.

In summary, knowledge is a personal advantage for individuals and a valuable asset for teams and organizations. Organizations have employed various techniques to integrate and transfer knowledge; and a new model of knowledge management is emerging in the organization which aims to motivate individuals to share their knowledge (Al-Alawi et al. 2007). Handy (1995) describes virtual teams as a concept without a place and a new organizational view to their employees to be human assets and not human costs. The asset which Handy (1995) refers to here is the knowledge which virtual team members possess and bring to the team. In this study, we argue that sharing knowledge in
virtual team setting has an effect on trust among team members as it compensate for some of the observed behaviors which are missing in the virtual environment. Also, we argue that sharing knowledge affects collaboration among virtual team members which ultimately influences the team effectiveness.

3.4.3. Trust

Trust is a key factor in forming and maintaining social relationships and it is a key for cooperative relationships and effective teamwork (Jarvenpaa et. al 1998; Jarvenpaa et al. 2004; Zaheer et.al, 1998; Powell et al. 2004). In co-located organizational settings, research has reported that trust has many benefits such as better productivity, facilitates resolution of conflicts disagreements, and improves effectiveness (Earley, 1986; Hagen and Choe, 1998; Zaheer et.al, 1998). High-trust teams tend to exchange ideas more openly, have clearer goals, more motivated and satisfied, and less willing to leave the team (Zand, 1972; Jarvenpaa et. al 1998).

There is no one agreed upon a definition of trust, but generally, trust includes elements of risk, vulnerability, and uncertainty. Mayer et.al, (1995) defines trust as “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor.”, Baba (1999) defines trust to be “the subjective expression of one actor’s expectations regarding the behavior of another actor in a way that is safe and secure.”, and McAllister (1995) defines trust among team members to be “the extent to which a person is confident in, and willing to act on the basis of, the words, actions, and decisions of another”.
Mayer et al. (1995) argue that the attributes of trust are ability (i.e. skills of trustee which makes him capable of performing his task), benevolence (i.e. willingness to do good), and integrity (i.e. dependability and reliability). Numerous researchers have built on Mayer’s (1995) conceptualization in investigating trust in virtual teams (e.g. Jarvenpaa et al. 1998; Jarvenpaa and Leidner, 1999; Dirks and Ferrin 2001; McKnight et. al. 2002; Gefen et. al. 2003). In this study, we also adopt the trust construct as conceptualized in Mayer et al. (1995).

The literature on trust reported different types of trust in different contexts. Lewis and Wiegert (1985) distinguished between cognitive and affective based trust, Lewicki and Bunker (1995) argue that trust can be calculus based, knowledge based, or identification based, and Meyerson et al. (1996) brought the concept of swift trust in temporary teams. These types of trust are illustrated in Table 28.

Lewis and Wiegert (1985) argue two distinctive types of trust: the cognitive and the affective. Individuals build cognitive trust based on evidence of observed behavior rather than emotion and genuine caring which are considered to be the foundations for affective based trust. In organizational settings, McAllister (1995) argues that cognitive trust is built among individuals based on their performance, cultural or ethnical similarities, and higher professional credentials, while affective trust is built based on citizenship and interaction frequency. Lewicki and Bunker (1995) argue that trust is dynamic and changing phenomenon which takes different shapes in different stages of a relationship. Therefore, as individuals interact and observe each other’s behaviors overtime, trust will become more evident (Panteli and Sockalingam, 2005).
Lewicki and Bunker (1995) suggest three types of trust, each corresponding to a different stage of the relationship: Calculus-Based Trust (CBT), Knowledge-Based Trust (KBT) and Identification-Based Trust (IBT). CBT is based on the concepts of reward and punishment for maintaining or violating trust. KBT is similar to cognitive based trust in which individuals build a trust decision based on observing behaviors throughout interactions over time. IBT is considered a higher level of trust which takes longer time to be developed. IBT requires a high degree of mutual understanding among individuals and a more established trust to the point which one can act on behalf of the other (Rousseau, 1998; Lewicki and Wiethoff, 2000).

Table 28: Types of Trust in Previous Research

<table>
<thead>
<tr>
<th>Research</th>
<th>Type of Trust</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lewis and Wiegert 1985</td>
<td>Cognition-based trust</td>
<td>Individuals consciously choose those in whom they trust based on perceptions of evidence for their trustworthiness.</td>
</tr>
<tr>
<td></td>
<td>Affect-based trust</td>
<td>Individuals demonstrate their genuine caring and concern for one another over time</td>
</tr>
<tr>
<td>Lewicki and Bunker (1995)</td>
<td>Calculus-Based Trust</td>
<td>Assessments of costs and rewards for violating or sustaining trust.</td>
</tr>
<tr>
<td></td>
<td>Knowledge-Based Trust</td>
<td>Individuals have enough information and understanding about each other to predict behavior.</td>
</tr>
<tr>
<td></td>
<td>Identification-Based Trust</td>
<td>Parties take time to develop their common interests, values, perceptions, motives and goals</td>
</tr>
<tr>
<td>Meyerson et. al. (1996)</td>
<td>Conventional Trust</td>
<td>Traditional trust which results from observing individuals behavior.</td>
</tr>
<tr>
<td></td>
<td>Swift Trust</td>
<td>Trust developed in temporary – short lived groups which presume clear roles and responsibilities.</td>
</tr>
</tbody>
</table>
The literature on virtual teams recognizes trust as a critical requirement for team success and effectiveness (Jarvenpaa et al. 1998; Sarker et al. 2001; Kirkman et al. 2002; Powell et al. 2004). Having trust in an organization and among members of a virtual team is considered to be a key element of success and a necessity to overcome the obstacles which team members face due to the absence of face-to-face interaction (Kristof et al. 1995; Furst et al. 1999; Kirkman et al. 2002).

As organizations are becoming more distributed, concerns about how to build trust among team members are increasing. Kirkman et al. (2002) argue that building trust is the biggest challenge for virtual team success. For instance, as organizations are becoming more distributed, more team members find themselves to be working with others whom they have never met and whose cultures and societies they know little about, but with whom they must collaborate through technology to achieve a predefined organizational goal (Jarvenpaa et al. 1998; Kirkman et al. 2002). This creates a significant challenge for organizations on how to establish trust and collaborative relationship among members of virtual teams.

Considering the characteristics of virtual teams, developing trust is not an easy task or even similar to the development of trust in traditional teams. In practice, most people judge an individual trustworthiness in terms of a person’s observed behaviors. But observed behaviors in virtual teams are different from those of traditional teams. Within the traditional organizational literature, an important factor of trust is the degree of familiarity with other people (i.e. the more we get to know others, the more likely it is that we trust them) (Lewicki and Bunker, 1996). However, virtual team members do not possess this characteristic, they are separated in space and/or time, and their interaction is
mediated by technology. Therefore, the observed behaviors and the signals which exist in traditional team setting do not apply to virtual team settings, which means that virtual team members lose key information which help build a trust decision. This loss of information normally leads to increase uncertainty, and lower trust among virtual team members (Riegelsberger et. al. 2003). Furthermore, it is reported in the literature that information technology increases the potential for faulty first impressions (Ferreira et al. 2012). Therefore, we need to consider other factors, behaviors, and standards especially designed for virtual teams in order for members to trust each other.

Meyerson et al. (1996) present the concept of swift trust in which they argue that trust can be developed in temporary team settings in spite of the short life cycle and the absence of trust determining behaviors found in regular teams. Instead, the swift trust argument is built on establishing clear roles and responsibilities and assuming that a sufficient level of trust already exists among team members (Jarvenpaa et al. 1998; Panteli and Sockalingam, 2005). Nonetheless, swift trust was originally introduced to describe trust in temporary traditional co-located teams. The early literature on virtual teams reported that virtual team members exhibit trust characteristics which are most similar to swift trust because virtual teams were mainly temporary teams as well (Jarvenpaa et al. 1998). Therefore, swift trust applies to temporary virtual teams with a short life cycle which makes it difficult to establish strong trust among members. Nowadays, however, virtual teams are embedded into the organization structure and they are not necessarily created work on temporary tasks but rather to work on everyday tasks. This form of virtual teams in today’s organizations should have the time, technology, and
means to build a stronger trust beyond swift trust in order to sustain a long relationship and produce effective outcome.

Kanawattanachai and Yoo, (2002) found that virtual team members rely more on cognition-based trust than on affect-based trust in which they base their trust decision on perceptions of evidence for their trustworthiness not on genuine caring and emotion. In this research we investigate the relationship between trust and knowledge sharing and its effect on collaboration and team effectiveness. We argue that sharing knowledge in virtual team setting will influence trust mainly because virtual team members who share and contribute their knowledge provide evidence for their trustworthiness which would compensate for the lack of trust signals exist in traditional team settings.

3.4.4. Collaboration

An organization is a social system of individuals who are required to work collectively and collaboratively on accomplishing a common goal (Alavi and Tiwana, 2002). Collaboration in work settings is defined by Aram and Morgan as “the presence of mutual influence between persons, open and direct communication and conflict resolution, and support for innovation and experimentation” (Aram and Morgan, 1976).

Collaboration is an essential part of team work and an effective collaboration leads to an effective team outcome (Aram and Morgan, 1976). To collaborate effectively, the knowledge that is distributed among team members must be properly and adequately integrated (Gray, 2000). In virtual team setting, integrating knowledge to achieve an effective collaboration is challenging as knowledge is distributed among physically separated team members.
Virtual team members are chosen and assigned based on the need for their unique knowledge and expertise. However, recruiting expert members does not guarantee effectiveness collaboration (Kudaravalli and Faraj, 2008). In order for virtual teams to collaborate effectively, they need establish an open communication and efficiently coordinate activities among each other (Hemetsberger and Reinhardt, 2009). Coordinating activities in group work is already difficult for co-located teams and is even more challenging for virtual teams (Fussell et al. 1998). When collaborating in traditional face-to-face settings, conversations which take place in the shared physical space facilitate coordinating activities (Kudaravalli and Faraj, 2008). However, in virtual team settings where members are geographically distributed and communication is mediated by technology, coordination becomes more complex. If virtual team members are not properly coordinating their activities and are unaware of the work progress across the team, the team is likely to face serious obstacles which impact collaboration.

Durate and Snyder (2006) discuss seven types of virtual teams, they argue that all of them have in common that team members must collaborate to accomplish their work. Virtual team members need to overcome the challenges they face by keeping open communication channels, coordinate activities, and collaborate effectively. Otherwise, they will not achieve effective outcomes. We argue that virtual teams can only thrive if individual team members can overcome the challenges to virtual collaboration and manage to work in a coordinated effort to solve problems together. This suggests the need for an improved understanding of how to create virtual teams that work, share knowledge, and collaborate effectively.
The literature on Computer Supported Collaborative Work (CSCW) addresses how collaborative activities can be supported by means of computer information systems (Schmidt, 2011). CSCW investigates collaborative work in groups in both face-to-face and virtual team settings and aims to provide a better understanding of the technology and the social aspects of group work. Johansen (1988) introduced the CSCW Matrix which conceptualizes CSCW systems in terms of the context of system use. The matrix considers work contexts along two dimensions, time and space. The matrix distinguishes between the needs of different work groups whether they are co-located or geographically distributed, and whether they collaborate synchronously or asynchronously. The CSCW matrix is illustrated in Figure 3.

According to the CSCW Matrix, when team members are collaborating from different distributed places and in different times they need CSCW systems that facilitate communication and coordination activities. In traditional team settings, communication and coordination are also reported as indicators for team collaboration (Aram and Morgan, 1976; Rousseau et al. 2006).

![CSCW Matrix]

**Figure 3: CSCW Matrix – Adapted From Johansen (1988)**
Collaboration depends upon trust to enable channels of open communication (Scott, 2000). Trust is reported to reduce task uncertainty, improves task coordination process among team members, and lead to an effective collaboration (Kollock, 1994; Holton, 2001). Weick and Roberts (1993) argue that to coordinate knowledge among team members, they need to trust each other’s capabilities. In this research, we investigate the how knowledge sharing and trust and influence effective collaboration in virtual teams setting.

3.4.5. Team Effectiveness

Teams are fundamental component of the organizational structure, they enable organizations reach better solutions and more effective outcomes (Gardner et al. 2012). Organizations increasingly rely on virtual teams to meet the demands of a changing marketplace (Luery and Raisinghani, 2001). Because of their unique characteristics, virtual teams can be difficult to manage and could take longer time to reach an effective outcome. In traditional team settings, Cohen and Bailey (1997) categorize team effectiveness into three major dimensions: performance, member attitudes, and behavioral outcomes. In virtual team settings, however, Lurey and Raisinghani (2001) argue that the dimensions of virtual team effectiveness are team performance and team members’ satisfaction which is consistent with the work of Mathieu et al (2008). Team performance is measured by evaluating the team outcome and comparing it to the requirements of the assigned task, while satisfaction represents team member’s approval of work process, commitment to the team objectives, and chances of personal growth (Lurey and Raisinghani, 2001). Virtual teams will not be effective if the team members themselves are not satisfied with the way the team functions. Team members need to
have a sense of belonging to the team; this can only exist if they are satisfied with the work experience.

In this study, we investigate how knowledge sharing, trust, and collaboration influence virtual team’s outcome by measuring perceived virtual team effectiveness. We argue that a virtual team where knowledge is freely shared and trust is well established will be a more effective team. We argue that knowledge sharing affect team effectiveness through improving team collaboration while trust moderates the relationship between collaboration and team effectiveness.

3.5. Research Model and Hypotheses Development

Even though information and communication technologies impact knowledge sharing, trust, and collaboration, social factors also have the potential improve or jeopardize virtual team work (Zakaria et al. 2004). Organizations are distributed knowledge systems and the ability of the organization to identify knowledge resources, leverage them, and make them available for its employees can lead to a distinctive competitive advantage (Tsoukas, 1996; Davenport and Prusak, 1998; Alavi and Tiwana, 2002). In this section we present the research model, along with the research hypotheses, which explain the relationships between knowledge sharing, trust, collaboration, and their impact on virtual team effectiveness.

The theoretical research model is demonstrated in Figure 4. The model represents a correlational research in which knowledge sharing is proposed to positively influence trust, collaboration and team effectiveness. Furthermore, we argue that trust moderates the relationship between collaboration and team effectiveness in which the higher levels of trust; the higher is collaboration influence on team effectiveness.
The Knowledge Based Theory of The Firm states that a firm is a knowledge creating entity (Nonaka 1994; Nonaka et. al. 2000). Nonaka and Konno introduced the “concept of ba” which they define as “a shared space which serves as a foundation for knowledge creation” (Nonaka and Konno, 1998). An organization is considered to be a “ba” according to Nonaka and Konno (1998), which means that an organization is a shared space for individuals to create knowledge and improve together. Grant (1996) emphasizes the role of the individual within the organization in creating knowledge and argues that the role of the organization is to integrate, store, and apply the knowledge created by its individuals. If effectively utilized and integrated, created knowledge could be transformed into an organizational asset which has the potential to improve the organization competitive advantage (Nonaka and Konno 1998; Nonaka et. al. 2000).
Virtual teams are assembled of knowledgeable and skilled individuals who are expected to perform an organizational task to the best of their abilities. Ability is one of Mayer’s (1995) three attributes of trust (i.e. Ability, Benevolence, and Integrity); virtual team members are then left with other two attributes they need to establish among each other which are benevolence and integrity. The characteristics of virtual teams, especially the technology mediated communication and lack of face-to-face interaction, cause virtual team members to lose important observed behavior they need to evaluate each other’s trust (Kanawattanachai and Yoo, 2002). With the lack of physical interaction which takes place in collocated team settings, virtual team members need to demonstrate different and unique behaviors to their team mates in order to prove their benevolence and integrity. By sharing the knowledge they possess, we argue that virtual team members demonstrate their willingness to do well and that they are dependable and reliable.

Sharing knowledge in virtual team settings is indeed a controversial and a complex issue. On one hand, knowledge is viewed by virtual team members as a valuable personal asset and sharing it leads to the loss of their unique relative advantage to the organization while it enables others to free-ride on their effort (Wasko and Faraj, 2005). On the other hand, organizations continue to form and rely on virtual teams and team members seem to share knowledge for variety of reasons, it is also reported that virtual team members share their knowledge to appear valuable to their organization (Gilmour, 2003).

Trust among virtual team members is expected to affect team performance and effectiveness as it enables an environment of open information exchange and assist team
members overcome the physical barrier (Scott, 2000; Kanawattanachai and Yoo, 2002). Since trust is a dynamic phenomenon which changes throughout time, and since virtual teams are becoming part of the organizational structure and not necessarily temporary anymore (Lewicki and Bunker, 1995; Kanawattanachai and Yoo, 2002; Griffith et al. 2003; Panteli and Sockalingam, 2005), virtual team members nowadays have sufficient time to build social capital and make a sound trust decision. The challenge in virtual environments is identifying unique and distinctive behaviors to assist team members in making the trust decision.

The type of trust which develops in virtual setting is reported to be a cognitive based trust (Kanawattanachai and Yoo, 2002), this is primarily for two reasons: 1) information technologies are not successful in transferring feelings and emotions which affect based trust depends upon; 2) trust decisions are often built based on team members ability, integrity, and benevolence which in the absence of face-to-face interaction virtual team members need to provide evidence for (Sproull and Kiesler 1986; Kanawattanachai and Yoo, 2002; Mayer et al. 1995). Overall, virtual team members need to provide solid evidence of their trustworthiness for other team members to trust them.

In the early phase of virtual team work, team members could quickly develop affect based trust by assuming the good in each other. This is consistent with Mayerson et al. concept of swift trust which Jarvenpaa and Leidner (1998) describe as “fragile and temporal”. However, since trust is cognitively assessed in virtual teams and since trust takes different shapes along time, we argue that in virtual team settings, the behavior of sharing knowledge provides evidence of virtual team members’ trustworthiness which leads to higher levels of trust among the team members.
**H1: In virtual team settings, knowledge sharing has a positive influence on trust among team members.**

Teams perform better when they comprise members with the expertise relevant to the task they are supposed to accomplish (Gardner, 2012). When virtual teams are able to locate and access organizational knowledge, they perform better and they produce a more effective outcome (Civi, 2000; Gardner et al. 2012).

Social Exchange Theory explains human behavior in social exchange (Blau 1964). The basic principle behind The Social Exchange Theory is that individuals within a social system exchange favors with a general expectation of some future but unclear return. Therefore, Social Exchange Theory assumes a long-term relationship where individuals have enough time to exchange favors (Blau 1964; Molm et al. 2000). Fulk et al. argues that knowledge sharing can be seen as a form of generalized social exchange, where individuals share their knowledge without a clear expectation what the return would be but on a promise of a long mutual relationship.

Resources (tangible and intangible) are considered to be the currency of social exchange. Social Exchange Theory posits that people behave in ways that maximize their benefits and minimize their costs (Molm et. al. 2000). The main cost of sharing knowledge, especially in virtual team setting, is the loss of a personal relative advantage while the main benefit is effective collaboration and integration of diverse resources to reach new insights. Furthermore, organizations are continuously implementing reward systems to encourage team members to contribute and share knowledge and punish them if they refuse to share the knowledge they possess (Bartol and Srivastava, 2002).
To collaborate effectively, virtual teams require the knowledge that is distributed among their team members to be adequately located and integrated. Otherwise, virtual teams will suffer high costs associated with searching for the necessary knowledge to perform their job (Gray, 2001). Based on the preceding discussion, we argue that sharing knowledge in virtual team settings has a positive effect on collaboration among team members.

**H2: In virtual team settings, knowledge sharing has a positive influence on collaboration.**

Virtual teams characteristics influence the way in which team members work together and have the potential to hinder team success and effectiveness. The ability of virtual teams to achieve effective outcomes without face-to-face interaction is a controversial matter in the literature since virtual teams tend to take longer time to reach common ground and collaborate effectively (Holton, 2001; Potter and Balthazard, 2002; Kirkman et al. 2004). On the other hand, it is reported that virtual team members tend to express their opinions more freely and openly regardless of any social or managerial constrains. Consequently, virtual team members are able to assess each other more accurately based on performance and contribution; they also show less bias compared to traditional teams when evaluating each other’s performance and contribution (Weisband and Atwater, 1999).

Virtual team effectiveness has two dimensions: team performance and individual satisfaction (Lurey and Raisinghani, 2001; Piccoli et al. 2004). An effective virtual team is the one which delivers high task performance and sufficient members’ satisfaction in terms of work experience, task load, and working with one another (Peters and Manz,
To achieve these two effectiveness dimensions, with the absence of face-to-face interaction, and solely relying on information technology medium for communication and collaboration, virtual team members need to contribute more effort into collaboration by exchanging more ideas, share more knowledge, and sufficiently coordinate tasks among each other. Based on the proceeding discussion, we argue that an effective and successful collaboration will ultimately influence the output of the virtual team in terms of team effectiveness.

**H3: In virtual teams, collaboration among team members has a positive influence on team effectiveness.**

A virtual team is a social system of individuals who are expected to collaborate on a common organizational task; and the act of one team member affects all other team members (Hoegl and Gemuenden, 2001). Social Capital Theory explains how changes in relations among individuals in a social system facilitate action, coordination, collaboration, and resource exchange (Colman, 1988, Adler and Kwon, 2002; Chiu et al, 2006).

Colman describes the social capital process in this paragraph “If A does something for B and trusts B to reciprocate in the future, this establishes an expectation in A and obligation on the part of B. This obligation can be conceived as a credit slip held by A for performance by B...Unless the placement of trust has been unwise and these are bad debts that will not be repaid” (Colman, 1988).

Based on Colman (1988) argument, we conclude that in order to build a social capital in social systems, two components are necessary: action and trust among the individuals in the system. For the action to take place a trust decision must be made; and
based on the act of the other parties trust is either confirmed or turn to be misplaced. Trust is reported in the literature to be the foundation for effective collaboration (Mayer et al. 1995; Rousseau et al. 1998; Paul and McDaniel 2004). In social systems such as teams, trust is considered a key factor in reducing complexity and uncertainty and enabling a positive atmosphere of collaboration among individuals within the system (Kollock, 1994; Paul and McDaniel, 2004).

Theoretically, when a virtual team is newly established trust levels among virtual team members is expected to be significantly low (Jarvenpaa et al. 1998). The reason is that virtual team members normally lack a past history working together, communicate via technology with little to no chance to meet in person, and unable to observe each other’s behaviors therefore they would be unable to make a trust decision (Robert et. al. 2009). Consistent with Colman’s (1988) description, we argue that when team members trust each other they have expectation of certain behaviors and certain performance based on this trust. Trust facilitates transactions by reducing the uncertainty and risk of collaboration and team members with higher trust are more likely to work together cooperatively (Baba, 1999; Jarvenpaa et al. 1998).

Team collaboration is the backbone that supports and drives team success and effectiveness. In spite of the availability of advanced information and telecommunication technologies, trust continues to influence collaboration among virtual team members since the ability to collaborate depends heavily upon trust to facilitate sharing of information and knowledge across the team (Koehne et al. 2012; Scott, 2000). Based on the preceding argument, we argue that trust moderates the relationship between collaboration and team effectiveness in virtual team setting.
**H4:** (a) In high trust context, there will be a positive association between collaboration and team effectiveness. (b) In low trust contexts, this association between collaboration and team effectiveness will be significantly less strong.

3.6. Methodology

The research presented in this project can be described as quantitative, positivist research. The survey method for data collection is used to test the proposed research model. The unit of analysis is at the individual level and behavior level as virtual team members’ perceptions of trust, collaboration, and team effectiveness in an open knowledge sharing environment.

3.6.1. Sample

The theoretical population comprises of any and all virtual team members who work in an organizational setting. In order to avoid sampling bias, we chose to focus on a specific industry. Therefore, the study population includes virtual team members who work in the information technology industry (e.g. software engineers, and developers). To acquire a representative sample, the sample frame in this study was mainly acquired from social media websites (e.g. Linkedin and Facebook) where we were able to identify members who work in virtual teams in the IT industry. Also, a sample frame was developed of individual known to be virtual team members. This sample frame was developed by an effort of the investigator and the list included members who fit the description of the study population.

Purposive sampling was used to target individuals who work in virtual settings. The data was collected in two phases. In the first phase, we identified individuals, pages,
and groups which include members who best represent the population. In the second phase, emails were sent to group admins, directly to group members, and directly to virtual team members in the sample frame developed by the investigator seeking their response to the survey. In the second phase, a brief description of the research was given along with a link to access the survey online. A total of 193 subjects were recruited for participation in this study. Given the method the sample was gathered, response rate could not be estimated.

3.6.2. Measures

The survey measures are derived from previously published studies in the literature. The variables of interest are knowledge sharing, trust, collaboration, and team effectiveness. The measure for knowledge sharing is adopted from the work by Phang et al. (2009). Additional survey items are adopted from a survey used in practice by MITRE Corporation (www.mitre.org) to obtain a baseline of knowledge sharing behaviors and enablers. These items are evaluated for content validity by the researcher’s advisor, expert judges, professional virtual team members, and researchers in the field.

The measure for trust is derived from Mayer et al. (1995) which is considered the most widely cited researches on trust in the organization with over 7000 citations, and the measure they developed is widely used and accepted in the literature (e.g. Jarvenpaa and Leidner 1998, Jarvenpaa et al. 1999, Dirks and Ferrin 2001, and Bhattacherjee 2002).

The measure for collaboration is derived from Aram and Morgan (1976). Although this measure was developed to measure collaboration in traditional team settings, it has been adopted in studies which investigate online collaboration (e.g. Zhu et al. 2010; Chandra et al. 2011; and Heath et al. 2011).
The measure for team effectiveness is derived from Lurey and Raisinghani (2001) which measures virtual team effectiveness in terms of team performance and team member’s satisfaction. The formal construct definitions and sources are given in Table 29 below and the actual items used in the survey are given in APPENDIX II.

![Figure 5: Measurement Model](image)

### Table 29: Definitions of the Study Constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Sharing</td>
<td>The degree to which knowledge is shared (contribute/seek) among virtual team members</td>
</tr>
<tr>
<td>Trust</td>
<td>The belief in the good intent and the ability of other virtual team members.</td>
</tr>
<tr>
<td>Collaboration</td>
<td>The degree to which team members work together to accomplish an organizational task</td>
</tr>
<tr>
<td>Team Effectiveness</td>
<td>Group-produced outputs and the consequences a group has for its members</td>
</tr>
</tbody>
</table>
3.7. Data Analysis

Data analysis includes demographics and descriptive analysis. The model is then tested for reliability using Cronbach’s alpha. The validity of the model is assessed by evaluating content validity, convergent validity, and discriminant validity. The partial least squares (PLS) method is used to examine the hypotheses, as it is recommended for complex models focusing on prediction, and allows for minimal demands on measurement scales, sample size, and residual distribution (Chin et al., 2003). Finally the Sobel test of mediation is used along with control variable analysis and multi-group analysis.

3.7.1. Demographics and Descriptive Statistics

Respondents were asked to indicate their gender and age. Respondents were also asked to indicate how long they worked in virtual teams, how long they have been members of the same team, if they participated in pure virtual environment or in both virtual and face-to-face environments, if they have been members of global virtual teams, if they ever been virtual team leader, and if they work for the same organization (Table 31).

3.7.2. Reliability

Reliability of the measurement model is assessed by examining internal consistency and indicator reliability. Internal consistency measures the reliability of a set of indicators, represented by Cronbach’s alpha. Indicator reliability is defined as the proportion of the indicator variance explained by the corresponding latent variable, and is represented by indicator loading, described as follows: fair (.45 - .54), good (.55 - .62),
very good (.63 - .70), and excellent (.71 and higher) (Comrey, 1973). Cronbach’s alpha values for the constructs in the model are illustrated in Table 30 and all constructs show high and adequate alpha values.

3.7.3. Validity

Validity of the measurement model is assessed by examining content validity, internal consistency and discriminant validity. Content validity is an assessment of the degree of correspondence between the items selected to constitute a summated scale and its conceptual definition (Hair et. al. 2005). Content validity is ensured by utilizing measurement items validated in existing research (Section 4.2).

The psychometric properties of the research model were evaluated by examining item loadings, internal consistency, and discriminant validity. Researchers suggest that item loadings and internal consistencies greater than .70 are considered acceptable (Hair et. al. 2005). As can be seen by the shaded cells in Table 33, all item loadings surpass this threshold. Internal consistency is evaluated by a construct’s composite reliability score. The composite reliability scores are located in the leftmost column of Table 32 which shows adequate reliability scores for all constructs.

### Table 30: Cronbach’s alpha

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Sharing</td>
<td>0.93</td>
</tr>
<tr>
<td>Trust</td>
<td>0.83</td>
</tr>
<tr>
<td>Collaboration</td>
<td>0.91</td>
</tr>
<tr>
<td>Team Effectiveness</td>
<td>0.92</td>
</tr>
<tr>
<td>Communication</td>
<td>0.90</td>
</tr>
<tr>
<td>Coordination</td>
<td>0.91</td>
</tr>
<tr>
<td>Performance</td>
<td>0.93</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>0.92</td>
</tr>
</tbody>
</table>
### Table 31: Demographics and Descriptive Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Participants</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Sample Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>77%</td>
<td>1.23</td>
<td>0.42</td>
<td>0.18</td>
</tr>
<tr>
<td>Female</td>
<td>23%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. 18 - 20</td>
<td>0</td>
<td>2.81</td>
<td>0.88</td>
<td>0.88</td>
</tr>
<tr>
<td>2. 21 - 29</td>
<td>43%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. 30 - 39</td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. 41 - 50</td>
<td>12%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. 51 - 60</td>
<td>5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Experience</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. less than a year</td>
<td>12%</td>
<td>2.27</td>
<td>0.74</td>
<td>0.77</td>
</tr>
<tr>
<td>2. 1 - 5</td>
<td>54%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. 6 - 10</td>
<td>27%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. 10 - 15</td>
<td>6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. more than 15</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Member of Current Team</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. less than a year</td>
<td>28%</td>
<td>2.27</td>
<td>0.74</td>
<td>0.55</td>
</tr>
<tr>
<td>2. 1 - 5</td>
<td>54%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. 6 - 10</td>
<td>27%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. 10 - 15</td>
<td>6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. more than 15</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Virtual Team Type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Online only</td>
<td>6%</td>
<td>1.85</td>
<td>0.65</td>
<td>0.42</td>
</tr>
<tr>
<td>2. Combined online and face-to-face members</td>
<td>34%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Both Types</td>
<td>59%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Face-to-face only</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leader VS. Member</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Leader</td>
<td>42%</td>
<td>0.42</td>
<td>0.49</td>
<td>0.24</td>
</tr>
<tr>
<td>2. Member</td>
<td>58%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Global Virtual Team Member</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Yes</td>
<td>60%</td>
<td>0.42</td>
<td>0.49</td>
<td>0.24</td>
</tr>
<tr>
<td>2. No</td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Members work for the same organization</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Yes</td>
<td>82%</td>
<td>0.60</td>
<td>0.49</td>
<td>0.24</td>
</tr>
<tr>
<td>2. No</td>
<td>18%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mandatory Vs. Voluntarily</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Yes</td>
<td>76%</td>
<td>0.82</td>
<td>0.39</td>
<td>0.15</td>
</tr>
<tr>
<td>2. No</td>
<td>24%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Evaluating discriminant validity has two parts; firstly, each item should load higher on its respective construct than on the other constructs in the model, and secondly, the Average Variance Extracted (AVE) for each construct should be higher than the inter-construct correlations (Agarwal and Karahanna, 2000). In Table 33, we can see that all items load higher on their respective construct than the other constructs in the research model. Likewise, in Table 32, we can see that the square root of the AVE in the diagonal for each construct is higher than the inter-construct correlations on the same row and the same column. These two comparisons suggest that the model has good discriminant validity.

3.7.4. PLS Analysis

Partial Least Squares (PLS) method is used to examine the hypotheses; a two-stage analysis has been performed using confirmatory factor analysis to assess the measurement model followed by examination of the structural relationships. PLS is an extension of the multiple linear regression model; it is a linear model specifies the relationship between a dependent variable (Y) and a set of predictor variables (X’s).

Table 32: Convergent And Discriminant Validities

<table>
<thead>
<tr>
<th>Construct</th>
<th>CR</th>
<th>AVE</th>
<th>Knowledge Sharing</th>
<th>Trust</th>
<th>Collaboration</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Sharing</td>
<td>0.95</td>
<td>0.84</td>
<td>0.92</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust</td>
<td>0.85</td>
<td>0.88</td>
<td>0.65</td>
<td>0.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration</td>
<td>0.95</td>
<td>0.71</td>
<td>0.70</td>
<td>0.61</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td>0.96</td>
<td>0.75</td>
<td>0.64</td>
<td>0.43</td>
<td>0.71</td>
<td>0.87</td>
</tr>
</tbody>
</table>
### Table 33: Cross Loading

<table>
<thead>
<tr>
<th></th>
<th>Collaboration</th>
<th>Effectiveness</th>
<th>Knowledge Sharing</th>
<th>Trust</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM1</td>
<td>0.91</td>
<td>0.56</td>
<td>0.61</td>
<td>0.55</td>
</tr>
<tr>
<td>COM2</td>
<td>0.80</td>
<td>0.49</td>
<td>0.59</td>
<td>0.52</td>
</tr>
<tr>
<td>COM3</td>
<td>0.79</td>
<td>0.57</td>
<td>0.63</td>
<td>0.48</td>
</tr>
<tr>
<td>COM4</td>
<td>0.78</td>
<td>0.54</td>
<td>0.67</td>
<td>0.48</td>
</tr>
<tr>
<td>COM5</td>
<td>0.73</td>
<td>0.46</td>
<td>0.57</td>
<td>0.48</td>
</tr>
<tr>
<td>COR1</td>
<td>0.88</td>
<td>0.68</td>
<td>0.57</td>
<td>0.42</td>
</tr>
<tr>
<td>COR2</td>
<td>0.85</td>
<td>0.64</td>
<td>0.57</td>
<td>0.35</td>
</tr>
<tr>
<td>COR3</td>
<td>0.86</td>
<td>0.63</td>
<td>0.56</td>
<td>0.35</td>
</tr>
<tr>
<td>COR4</td>
<td>0.72</td>
<td>0.55</td>
<td>0.49</td>
<td>0.43</td>
</tr>
<tr>
<td>COR5</td>
<td>0.70</td>
<td>0.56</td>
<td>0.45</td>
<td>0.43</td>
</tr>
<tr>
<td>PER1</td>
<td>0.64</td>
<td>0.90</td>
<td>0.59</td>
<td>0.29</td>
</tr>
<tr>
<td>PER2</td>
<td>0.62</td>
<td>0.87</td>
<td>0.59</td>
<td>0.27</td>
</tr>
<tr>
<td>PER3</td>
<td>0.61</td>
<td>0.88</td>
<td>0.53</td>
<td>0.30</td>
</tr>
<tr>
<td>PER4</td>
<td>0.60</td>
<td>0.82</td>
<td>0.50</td>
<td>0.29</td>
</tr>
<tr>
<td>SAT1</td>
<td>0.65</td>
<td>0.88</td>
<td>0.65</td>
<td>0.36</td>
</tr>
<tr>
<td>SAT2</td>
<td>0.57</td>
<td>0.70</td>
<td>0.49</td>
<td>0.36</td>
</tr>
<tr>
<td>SAT3</td>
<td>0.67</td>
<td>0.83</td>
<td>0.55</td>
<td>0.28</td>
</tr>
<tr>
<td>SAT4</td>
<td>0.64</td>
<td>0.84</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>SAT5</td>
<td>0.65</td>
<td>0.86</td>
<td>0.59</td>
<td>0.34</td>
</tr>
<tr>
<td>KN1</td>
<td>0.60</td>
<td>0.48</td>
<td>0.86</td>
<td>0.49</td>
</tr>
<tr>
<td>KN2</td>
<td>0.61</td>
<td>0.50</td>
<td>0.86</td>
<td>0.54</td>
</tr>
<tr>
<td>KN3</td>
<td>0.65</td>
<td>0.64</td>
<td>0.90</td>
<td>0.52</td>
</tr>
<tr>
<td>KN4</td>
<td>0.64</td>
<td>0.64</td>
<td>0.88</td>
<td>0.48</td>
</tr>
<tr>
<td>KN5</td>
<td>0.67</td>
<td>0.64</td>
<td>0.87</td>
<td>0.43</td>
</tr>
<tr>
<td>KN6</td>
<td>0.62</td>
<td>0.60</td>
<td>0.88</td>
<td>0.41</td>
</tr>
<tr>
<td>TR1</td>
<td>0.46</td>
<td>0.29</td>
<td>0.42</td>
<td>0.80</td>
</tr>
<tr>
<td>TR2</td>
<td>0.43</td>
<td>0.26</td>
<td>0.47</td>
<td>0.82</td>
</tr>
<tr>
<td>TR3</td>
<td>0.59</td>
<td>0.49</td>
<td>0.48</td>
<td>0.83</td>
</tr>
<tr>
<td>TR4</td>
<td>0.32</td>
<td>0.12</td>
<td>0.42</td>
<td>0.82</td>
</tr>
</tbody>
</table>

The PLS method allows for simultaneous analysis of the measurement and structural models, and allows each indicator to vary in how much it contributes to the
composite score of the latent variable (Chin et al., 2003). PLS also allows for latent variable modeling of interaction effects, necessary for the proposed model as it includes a moderating variable.

The results of the PLS SEM analysis are presented in Figure 6. Knowledge Sharing has an R-Squared value of 0 because it is not being predicted by any other construct. Trust has an R-Squared value of 0.31, collaboration has an R-Squared value of 0.489, and team effectiveness has an R-Squared value of 0.50. This means that 31% of the variance in Trust and 49% of the variance in Collaboration is explained by Knowledge Sharing, and 50% of the variance in Team Effectiveness is explained by Collaboration (Agarwal and Karahanna, 2000). The path coefficients between knowledge sharing, trust, collaboration, and team effectiveness were significant at .001. However, the path coefficient for trust moderating the relationship between collaboration and team effectiveness is insignificant. In summary, three out of the four hypotheses were supported as illustrated in table 34.

![Figure 6: PLS SEM Results](image)
Table 34: Summary of Hypotheses Tests

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: Knowledge Sharing $\rightarrow$ Trust</td>
<td>Yes</td>
</tr>
<tr>
<td>H2: Knowledge Sharing $\rightarrow$ Collaboration</td>
<td>Yes</td>
</tr>
<tr>
<td>H3: Collaboration $\rightarrow$ Team Effectiveness</td>
<td>Yes</td>
</tr>
<tr>
<td>H4: Trust x Collaboration $\rightarrow$ Team Effectiveness</td>
<td>No</td>
</tr>
</tbody>
</table>

3.7.5. Mediation Analysis

Sobel Test for the Significance of Mediation is used to test for the significance of collaboration mediating the relationship between knowledge sharing and team effectiveness. The Sobel test is a specialized t test that provides a method to determine whether the reduction in the effect of the independent variable, after including the mediator in the model, is a significant reduction and therefore whether the mediation effect is statistically significant. Table 35 represents the results of the Sobel test. As shown in the table the Sobel test for mediation is significant at the 0.01 level, which indicates that collaboration mediates the relationship between knowledge sharing and team effectiveness.

Table 35: Sobel Test for the Significance of Mediation

<table>
<thead>
<tr>
<th>Path Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Sharing $\rightarrow$ Collaboration</td>
<td>0.722</td>
</tr>
<tr>
<td>Collaboration $\rightarrow$ Team Effectiveness</td>
<td>0.685</td>
</tr>
<tr>
<td>Sobel Test Statistics</td>
<td>2.99358902</td>
</tr>
<tr>
<td>One-tailed probability</td>
<td>0.00137859</td>
</tr>
<tr>
<td>Two-tailed probability</td>
<td>0.00275717</td>
</tr>
</tbody>
</table>
3.7.6. Control Variable Analysis

In this study we controlled for the effect of the design process on the dependent variables (i.e. trust and team effectiveness). Conducting PLS analysis on the model after adding the control variable resulted in minor changes in the R-Squared values for trust and team effectiveness as shown in table 36. Also as shown in figure 7, the path coefficient between the control variable and both trust and team effectiveness are not strong.

**Figure 8: Control Variable Analysis**

**Table 36: Control Variable Effect**

<table>
<thead>
<tr>
<th>Construct</th>
<th>R-Squared: No Control</th>
<th>R-Squared: With Control</th>
<th>Change</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust</td>
<td>0.31</td>
<td>0.314</td>
<td>&lt; 0.1</td>
<td>-</td>
</tr>
<tr>
<td>Team Effectiveness</td>
<td>0.50</td>
<td>0.593</td>
<td>&lt; 0.1</td>
<td>**</td>
</tr>
</tbody>
</table>

3.7.7. Multi-group analysis

Multigroup analysis is conducted to determine if there is any significant effect for specific individual team characteristics on the knowledge sharing behavior. These characteristics are how long the respondents has been working as a virtual team member,
how long the respondents has been member of his current team, if the respondent has been a virtual team leader, if the respondent ever participated in a global virtual team, if team members met in person, and if sharing knowledge is voluntarily or mandatory.

For each variable, the data set was separated based on the different values of the variable. PLS analysis was calculated for both sets, and the results were tested for significance for both trust and collaboration. The trust results are summarized in Table 37 and the collaboration results are summarized in Table 38. The only variable which shows a significant difference between the two groups is being a member of a global virtual team which has a 0.05 significant level for trust. This result provides an indication that virtual team members’ cultural and background diversity does affect the level of knowledge shared between team members and the levels of trust among them.

3.8. Discussion

The objective of this study is to investigate the relationship between knowledge sharing, trust, and collaboration and how this relationship ultimately affects the effectiveness of virtual teams. Our final results provide support for the theoretical model and qualified support for most of our hypothesized relationships. The results show that knowledge sharing has a significant influence on both trust and collaboration in virtual team settings. This provides support for our hypotheses H1 and H2. The results indicate that knowledge sharing in virtual settings could be a crucial factor in establishing a social capital among virtual team members. Consistent with the Knowledge-Based Theory of the Firm and Nonaka’s concept of ba (1995), a virtual team could be considered a place where members share their knowledge and transform their environment to reach new insights. Furthermore, in this study we extend the literature on virtual teams to claim that
sharing knowledge is crucial for virtual team members to collaborate, trust each other, and be effective.

Table 37: Multi-group moderating effect (Trust)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;= 5 Years</td>
<td>&gt; 5 Years</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>124</td>
<td>69</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.69</td>
<td>0.554</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0595</td>
<td>0.1054</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>1.220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.224</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Member of the current virtual team</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>&lt;= 5 Years</td>
<td>&gt; 5 Years</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.634</td>
<td>0.726</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0617</td>
<td>0.0534</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>0.594</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.554</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leader Vs. Member</td>
<td>Yes</td>
<td>NO</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Sample Size</td>
<td>82</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.655</td>
<td>0.647</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.084</td>
<td>0.0626</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>0.078</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.938</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global virtual team</td>
<td></td>
<td></td>
<td>Significant at 0.05</td>
</tr>
<tr>
<td>Sample Size</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.753</td>
<td>0.546</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0654</td>
<td>0.0588</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>2.238</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.027</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandatory or voluntarily</td>
<td></td>
<td></td>
<td>Not Significant</td>
</tr>
<tr>
<td>Sample Size</td>
<td>Mandatory</td>
<td>Voluntarily</td>
<td></td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.747</td>
<td>0.591</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0472</td>
<td>0.0747</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>1.162</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.247</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meet in Person</td>
<td></td>
<td></td>
<td>Not Significant</td>
</tr>
<tr>
<td>Sample Size</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.724</td>
<td>0.627</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0621</td>
<td>0.0556</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>0.848</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.398</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 38: Multi-group moderating effect (Collaboration)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;= 5 Years</td>
<td>&gt; 5 Years</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>124</td>
<td>69</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.698</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0556</td>
<td>0.825</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>0.071</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.944</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Member of the same virtual team</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>159</td>
<td>34</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.69</td>
<td>0.792</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0649</td>
<td>0.0437</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>0.628</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.531</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leader Vs. Member</td>
<td>Yes</td>
<td>NO</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Sample Size</td>
<td>82</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.719</td>
<td>0.703</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0695</td>
<td>0.0662</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>0.164</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.870</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global virtual team</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>113</td>
<td>80</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.655</td>
<td>0.776</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0902</td>
<td>0.0383</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>2.238</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.027</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandatory or voluntarily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>52</td>
<td>141</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.747</td>
<td>0.591</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0472</td>
<td>0.0747</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>1.162</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.247</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meet in Person</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>45</td>
<td>148</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Regression Weight</td>
<td>0.848</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>Standard Error (S.E.)</td>
<td>0.0308</td>
<td>0.075</td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>1.191</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value (2-tailed)</td>
<td>0.235</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results show that the relationship between collaboration and team effectiveness is significant which confirms hypothesis H3. The Sobel test of mediation also indicates that collaboration mediates the relationship between knowledge sharing and team effectiveness. This provides additional support for the importance of knowledge sharing in virtual team settings.

Hypothesis 4 was not supported; in this hypothesis we argue a moderating effect for trust on the relationship between collaboration and team effectiveness. However, there was no significant support that such an impact exists. Aubert and Kelsey (2003) investigated the influence of trust on virtual team performance and found that the level of trust among virtual team members does not have a significant impact on team performance. This is consistent with the results of our study and suggests that the impact of trust may have a limited influence on virtual team effectiveness. Jarvenpaa et al. (2004) argue that trust effects are sensitive to the context of the virtual team, which might suggest that our results could be limited to the population of the study. Nevertheless, further research is needed to further investigate the impact of trust on virtual teams collaboration and effectiveness.

The multi-group moderation effect results were negative for all items except for global virtual team members’ perception of trust. This result may indicate that trust is higher among virtual team members who have similar characteristics (i.e. culture, language).

The results of this research have interesting implications for both research and practice. For research, this research provides implications for the importance of knowledge sharing in virtual team setting. Furthermore, this research suggests that more
research is necessary to better understand the influence of trust on virtual team outcome. For practice, this research highlights the role which knowledge sharing plays in virtual teams. This suggests that organizations should support their virtual team members knowledge sharing by providing them with the tools to do so.

3.9. Limitations

A limitation of this study is that the research investigates knowledge sharing independent from the technology. KMSs vary from a simple blog or discussion board to a more sophisticated software application especially designed for organization knowledge needs. It is reported in the literature that technology could influence the quality and quantity of knowledge shared. This research is concerned with the social aspect of sharing knowledge in virtual teams’ independent from the knowledge management system (KMS) technology. Therefore, the model should be applied with care to contexts which use different KMS technology than the one in this study sample context.

A second limitation is that we relied on purposive sampling. The study targeted a specific sample of virtual team members in a specific industry. Future studies need to examine other dimensions of the theoretical population of the study.

A third limitation is that we investigate team members in organizational settings. There exist a literature that investigates knowledge sharing, trust, and collaboration in online communities of practice outside the organization. Future studies could test the proposed model in online communities of practice environment beyond the organizational setting.
3.10. Conclusion

This research proposes a conceptual model which represents the hypothesized relationship between knowledge sharing, trust, collaboration, and team effectiveness in virtual team settings. The model is developed based on an intensive review of the literature on knowledge management and sharing, virtual teams, trust, and collaboration. The theoretical foundation for the model is found in the Knowledge Based Theory of The Firm, Social Capital Theory, and the Social Exchange Theory.

The model is tested using a survey research design developed based on measures from previous research. The results of this research support three hypotheses which explain the relationship between knowledge sharing, trust, and collaboration. For research, the results of our research imply the need of further research to investigate how different factors affect virtual teams’ effectiveness. For practice, the results of this research calls for better understanding for the role of knowledge sharing in virtual teams.
4. Conclusion

The work presented in this dissertation consists of two parts. The first investigates online collaboration in virtual teams and the second investigates the impact of knowledge sharing on trust, collaboration, and team effectiveness in virtual team settings. The theoretical foundation which supports the first study is found in the Socio-Technical Theory and the Theory of Reasoned Action. The theoretical foundation which supports the second study is found in the Social Capital Theory, Social Exchange Theory, and The Knowledge Based Theory of The Firm.

The result of the first part is a theoretical model and a measurement scale for intention to collaborate online. The model and measurement scale were tested and validated through a pilot study and in a field study. However, additional research is necessary to further validate the measurement scale and evaluate its generalizability across different virtual team environments.

The first study provides important implications for both research and practice. For research, this study calls for a better understanding of the social aspects surrounding virtual team members’ collaboration. For practice, this study provides noteworthy implications regarding the importance of social characteristics and social relationships among virtual team members in fostering an environment of collaboration within the team in the organization.

The results of the second part is a conceptual model which describes the hypothesized relationship between knowledge sharing, trust, collaboration, and team effectiveness in virtual team setting. The model is tested using a survey research design developed based on measures from previous research.
The results of this research support three hypotheses which explain the relationship between knowledge sharing, trust, and collaboration. For research, the results of this research imply the need of further research to investigate how different factors affect virtual teams’ effectiveness especially trust among virtual team members. For practice, the results of this research calls for better understanding for the role of knowledge sharing in virtual team effectiveness.
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APPENDIX 1: Linkedin Groups

1. Online Collaboration Group
2. Online collaboration software user group
3. Oracle ERP User Network
5. The Project Manager Network - #1 Group for Project Managers
6. Best Practice Transfer
APPENDIX 2: Survey

Study 1 Survey

Section 1: Demographics

Please provide the following demographic information for analysis purposes. --No personal information will be collected—

1. Please indicate whether you are
   Male
   Female

2. What is your age group?
   18 - 24
   25 - 29
   30 – 39
   40 – 49
   50 – 59
   60 or above

3. How long have you worked as a virtual team member?
   less than 1 year
   2–5 years
   6–10 years
   11–15 years
   More than 15 years

4. Have you participated in a purely online virtual team or in a team that combined online and face-to-face work?
   Participated in online team(s) only
   Participated in combined online and face-to-face teams
   Participated in both types of virtual teams
   I have not participated in a virtual team

5. Are you currently a virtual team member?
   Yes
   No

6. Have you ever been a virtual team leader?
   Yes
   No

7. Have you ever been part of a global virtual team (members from different countries and/or cultures)?
   Yes
   No
Section 2: Incentives
The following section will be likert scale questions, these questions will measure the extent of your agreement to a statement.

8. I expect to be rewarded by my organization or team supervisor when I collaborate online.
   - Strongly Disagree
   - Disagree
   - Somewhat Disagree
   - Undecided
   - Somewhat Agree
   - Agree
   - Strongly Agree

9. I expect something in return when I collaborate with team members online.
   - Strongly Disagree
   - Disagree
   - Somewhat Disagree
   - Undecided
   - Somewhat Agree
   - Agree
   - Strongly Agree

10. I collaborate with others online to improve my image within the team.
    - Strongly Disagree
    - Disagree
    - Somewhat Disagree
    - Undecided
    - Somewhat Agree
    - Agree
    - Strongly Agree

11. I’m less likely to collaborate online without getting something in return
    - Strongly Disagree
    - Disagree
    - Somewhat Disagree
    - Undecided
    - Somewhat Agree
    - Agree
    - Strongly Agree

12. Collaborating online enhances my professional reputation
    - Strongly Disagree
    - Disagree
    - Somewhat Disagree
    - Undecided

Somewhat Agree
Agree
Strongly Agree

13. I collaborate with my online team members regardless of any incentives.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

Section 3: Voluntariness

Does making collaboration with virtual team members voluntary influence your intention to collaborate online?

14. I only collaborate with online team members when I’m asked to
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

15. I am more likely to collaborate online when I voluntarily join the team
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

16. I voluntarily collaborate with other team members online even when not mandated by my organization
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree
17. Mandating online collaboration makes me less willing to collaborate with my team members
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

18. I’m less likely to collaborate with other team members online when I’m forced to do so
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

Background Similarities

Do your virtual team members background (culture, education, nationality, ethnicity) influence your intention to collaborate with them online?

19. I am more likely to collaborate online with individuals with whom I share similar background
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

20. I am more likely to collaborate online with members with whom I share a similar culture
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree
21. Having team members of different backgrounds makes me less likely to collaborate online
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

22. I tend to collaborate online with team members who have a different background than mine
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

23. The background of my online team members does not influence my intention to collaborate with them
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

   Common Ground
   Does reaching a common ground with virtual team members' influence your intention to collaborate with them online?
24. Collaborating online requires me to communicate with other team members in order to reach a common ground
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

25. I am more likely to collaborate online when the team reaches common ground from the beginning
   Strongly Disagree
26. I collaborate online even when my team members and I do not fully share the same vision of the problem we are trying to solve
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

27. For me to collaborate online, the team should share a common understanding of problems to be addressed
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

28. Reaching a common ground has nothing to do with my intention to collaborate online
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

Members Expertise
Does having virtual team members' with different levels of expertise influence your intention to collaborate online?

29. Having expert members on my team makes me more willing to collaborate online
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
Strongly Agree

30. Diversity of members’ expertise in a virtual team encourages me to collaborate online
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

31. I collaborate online with members who have expertise I can benefit from
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat Agree
   Agree
   Strongly Agree

32. I collaborate online with team members who can benefit from my expertise
   Strongly Disagree
   Disagree
   Somewhat Disagree
   Undecided
   Somewhat agree
   Agree
   Strongly Agree

33. Virtual team members' expertise does not influence my intention to collaborate with
    them online.
    Strongly Disagree
    Disagree
    Somewhat Disagree
    Undecided
    Somewhat agree
    Agree
    Strongly Agree

34. Please feel free to leave any comments or feedback you see appropriate
    Please feel free to leave any comments or feedback you see appropriate
    You Have Completed the Survey,
    Thank You For Participating,

    Best Regards
    Mohammad Alsharo, CU Denver Business School

   113
Study 2 Survey

Section 1 out of 6
Please provide the following demographic information for analysis purposes. --No personal information will be collected--

1. Please indicate whether you are
   Male
   Female

2. What is your age group?
   18 - 20
   21 - 29
   30 – 39
   40 – 49
   50 – 59
   60 or above

3. How long have you worked as a virtual team member?
   less than 1 year
   1–5 years
   6–10 years
   Over 10 years

4. How long have you been a member of your current virtual team?
   less than one year
   1-5 years
   6-10 years
   over 10 years

5. Have you participated in a purely online virtual team or in a team that combined online and face-to-face work?
   Participated in online team(s) only
   Participated in combined online and face-to-face teams
   Participated in both types of virtual teams
   I have not participated in a virtual team

6. Are you currently a virtual team member?
   Yes
   No

7. Have you ever been a virtual team leader?
   Yes
   No

8. Have you ever been part of a global virtual team (members from different countries and/or cultures)?
9. Do all members of your team work for the same organization (company)?
   Yes
   No

10. In my organization, sharing knowledge is mandatory.
    Yes
    No

Section 2 out of 6
Please answer the following questions.
For the following questions, please indicate to what extent you agree or disagree with each statement.

11. Team members were asked for their suggestions when the team was originally formed
    Strongly Disagree
    Disagree
    Somewhat Disagree
    Undecided
    Somewhat Agree
    Agree
    Strongly Agree

12. Careful consideration was given to the team’s objectives during the design of this team.
    Strongly Disagree
    Disagree
    Somewhat Disagree
    Undecided
    Somewhat Agree
    Agree
    Strongly Agree

13. I received sufficient information to understand the team’s purpose when I was notified that I will be part of this team.
    Strongly Disagree
    Disagree
    Somewhat Disagree
    Undecided
    Somewhat Agree
    Agree
    Strongly Agree
14. My role in the team was clearly explained to me.

Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

15. I have received training focused on becoming more effective in the virtual team setting.

Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree

Strongly Agree

16. My virtual team is equipped with adequate tools and technologies to perform our tasks.

Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

17. The electronic methods we use to communicate with one another are effective.

Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

18. My team members were given the opportunity to meet each other in person.

Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree

Agree
Strongly Agree

19. I’m rewarded individually for my work effort
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

Section 3 out of 6
Please answer the following questions about behaviors and practices in your virtual team.

20. I routinely share my knowledge with my team members
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

21. I routinely seek out knowledge from other team members
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

22. If I had my way, I wouldn't let the other team members have any influence over issues that are important to the project.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

23. I really wish I had a good way to oversee the work of the other team members on the project.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

24. My virtual team members communicate in a positive manner to one another.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

25. If a team member makes a mistake, others generally point out his error and discuss it with him
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

26. My team has been effective in reaching its goals
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

27. My team is meeting its business objectives.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

Section 4 out of 6
Please answer the following
28. Overall, I find the information I need to do my job.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

29. I would be comfortable giving the other team members complete responsibility for the completion of this project.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

30. I can turn to my team mates for help when needed
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

31. I would be comfortable giving the other team members a task or problem which was critical to the project, even if I could not monitor them.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

32. I try to be honest about what I think and feel when working with my team members.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

33. When several team members are discussing an issue, I can ask questions about anything I do not understand.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

34. My input is valued by my team members.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

35. My team members and I respect each other.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

36. In my team, members’ morale is high.
Strongly Disagree
Disagree
Somewhat Disagree
Undecided
Somewhat Agree
Agree
Strongly Agree

49. Please feel free to leave any comments or feedback you see appropriate

You Have Completed the Survey,
Thank You For Participating,

Best Regards
Mohammad Alsharo, CU Denver Business School